



International Code of Phylogenetic Nomenclature  
Version 4c

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Most recent revision: January 12, 2010

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## Preface to Version 4

The material in the Preface was summarized from a variety of sources; see the History section for literature citations.

The development of the *International Code of Phylogenetic Nomenclature* (referred to here as the *PhyloCode*) grew out of the recognition that the current rank-based systems of nomenclature, as embodied in the current botanical, zoological, and bacteriological codes, are not well suited to govern the naming of clades. Clades (along with species) are the entities that make up the tree of life, and for this reason they are among the most theoretically significant biological entities above the organism level. Consequently, clear communication and efficient storage and retrieval of biological information require names that explicitly and unambiguously refer to clades and do not change over time. The current rank-based codes fail to provide such names for clades. Supraspecific names are not always associated with clades under the rank-based codes, and even when they are, they often fail to retain their associations with particular clades because the names are operationally defined in terms of ranks and types. A clade whose hypothesized composition and diagnostic characters have not changed may be given a different name under the rank-based codes based purely on considerations of rank. Such instability is particularly objectionable given the wide recognition that rank assignment is subjective and of dubious biological significance.

In contrast to the rank-based codes, the *PhyloCode* will provide rules for the purpose of naming clades through explicit reference to phylogeny. In doing so, the *PhyloCode* extends "tree-thinking" to biological nomenclature. This development parallels the extension of tree-thinking into taxonomy, as manifested in the concepts of species as lineage segments and supraspecific taxa as clades. These nomenclatural and taxonomic developments are complementary but independent. Clades can be named using the traditional rank-based systems of nomenclature (though with the problems noted above), and a nomenclatural system based on phylogenetic principles does not require equating supraspecific taxa with clades. The *PhyloCode*, however, is designed for the specific purpose of naming clades.

The purpose of the *PhyloCode* is not to replace existing names but to provide an alternative system for governing the application of both existing and newly proposed names. In developing the *PhyloCode*, much thought has been given to minimizing the disruption of the existing nomenclature. Thus, rules and recommendations have been included to ensure that most names will be applied in ways that approximate their current and/or historical use. However, names that apply to clades will be redefined in terms of phylogenetic relationships rather than taxonomic rank and therefore will not be subject to the subsequent changes that occur under the rank-based systems due to changes in rank. Because the taxon membership associated with particular names will sometimes differ between rank-based and phylogenetic systems, suggestions are provided for indicating which code governs a name when there is a possibility of confusion. Mechanisms are also provided to reduce certain types of nomenclatural divergence relative to the rank-based systems. For example, if a clade name is based on a genus name, the type of the genus under the appropriate rank-based code must be used as an internal specifier under the *PhyloCode* (Art. 11.7, Examples 1 and 2).

The starting date of the *PhyloCode* will be scheduled to coincide with the publication of a volume that will provide phylogenetic definitions for many widely used clade names and the names of many large clades (see below). Names that were provided with published phylogenetic definitions before that date will not be considered to be established under the *PhyloCode*.

**Properties of Phylogenetic Nomenclature.** The phylogenetic system of nomenclature embodied in the *PhyloCode* exhibits both similarities to and differences from the rank-based systems embodied in the traditional codes. Some of the most important similarities are as follows: 1) Both systems have the same fundamental goals of providing unambiguous methods for applying names to taxa, selecting a single accepted name for a taxon from among competing synonyms or homonyms, and promoting nomenclatural stability and continuity to the extent that doing so does not contradict new results and conclusions. 2) Neither system infringes upon the judgment of taxonomists with respect to inferring the composition of taxa or to assigning taxonomic ranks. 3) Both systems use precedence, a clear order of preference, to determine the correct name of a taxon when synonyms or homonyms exist. 4) Both systems use the date of publication (chronological priority) as the primary criterion for establishing precedence. 5) And both phylogenetic and rank-based systems have conservation mechanisms that allow a later-established name to be given precedence over an earlier name for the same taxon if using the earlier name would be contrary to the fundamental goal of promoting nomenclatural stability and continuity.

Some of the most important differences between the phylogenetic system of the *PhyloCode* and the rank-based systems of the traditional codes are as follows: 1) The phylogenetic system is independent of taxonomic rank. Although taxa are hierarchically related, the assignment of taxonomic rank is not part of the naming process and has no bearing on the spelling or application of taxon names. As a consequence, the phylogenetic system does not require ranked taxonomies. 2) In the phylogenetic system, the categories "species" and "clade" are not ranks but different kinds of biological entities. A species is a segment of a population lineage, while a clade is a monophyletic group of species (or organisms). Both are products of evolution that have an objective existence regardless of whether they are named. As a consequence, once a taxon is named, the composition and diagnostic characters of that taxon become questions to be decided by empirical evidence rather than by personal decisions. 3) In addition to applying names to nested and mutually exclusive taxa, as in traditional nomenclature, the phylogenetic system allows names to be applied to partially overlapping taxa (clades). This provision is necessary to accommodate situations involving taxa (both species and clades) of hybrid origin. 4) In contrast to the rank-based codes, which use (implicit) definitions based on ranks and types to determine the application of names, phylogenetic nomenclature uses explicit phylogenetic definitions. Species, specimens, and apomorphies cited within these definitions are called *specifiers* because they are used to specify the clade to which the name applies. These specifiers function analogously to the types of rank-based nomenclature in providing reference points that determine the application of a name; however, they differ from types in that they may either be included in or excluded from the taxon being named, and multiple specifiers may be used. 5) The fundamental difference between the phylogenetic and rank-based systems in how names are defined leads to operational differences in the determination of synonymy and homonymy. For example, under the *PhyloCode*, synonyms are names whose phylogenetic definitions specify the same clade, regardless of prior associations with particular ranks; in contrast, under the rank-

based codes, synonyms are names of the same rank whose types are included within a single taxon at that rank, regardless of prior associations with particular clades. 6) Another novel aspect of the *PhyloCode* is that it permits taxonomists to restrict the application of names with respect to clade composition. If a taxonomist wishes to ensure that a name refers to a clade that either includes or excludes particular taxa, this result may be achieved through the use of additional internal or external specifiers (beyond the minimal number needed to specify a clade), or the definition may contain a qualifying clause specifying conditions under which the name cannot be used. 7) The *PhyloCode* includes recommended naming conventions that promote an integrated system of names for crown and total clades. The resulting pairs of names (e.g., *Testudines* and *Pan-Testudines* for the turtle crown and total clade, respectively) enhance the cognitive efficiency of the system and provide hierarchical information within the name. 8) Establishment of a name under the *PhyloCode* requires both publication and registration. The purpose of registration is to create a comprehensive database of established names (discussed below), which will reduce the frequency of accidental homonyms and facilitate the retrieval of nomenclatural information.

**Advantages of Phylogenetic Nomenclature.** Phylogenetic nomenclature has several advantages over the traditional systems. It eliminates a major source of instability under the rank-based codes—changes in clade names due solely to shifts in rank. It also facilitates the naming of new clades as they are discovered. Under the rank-based codes, it is often difficult to name clades one at a time, similar to the way that new species are named, because the name of a taxon is affected by the taxon's rank, which in turn depends on the ranks of more and less inclusive taxa. In a group in which the standard ranks are already in use, naming a newly discovered clade requires either the use of an unconventional intermediate rank (e.g., supersubfamily) or the shifting of less or more inclusive clades to lower or higher ranks, thus causing a cascade of name changes. This situation discourages systematists from naming clades until an entire classification is developed. In the meanwhile, well-supported clades are left unnamed, and taxonomy falls progressively farther behind knowledge of phylogeny. This is a particularly serious drawback at the present time, when recent advances in molecular and computational biology have led to a burst of new information about phylogeny, much of which is not being incorporated into taxonomy. The availability of the *PhyloCode* will permit researchers to name newly discovered clades much more easily than they can under the rank-based codes. For many researchers, naming clades is just as important as naming species. In this respect, the *PhyloCode* reflects a philosophical shift from naming species and subsequently classifying them (i.e., into higher taxa) to naming both species and clades. This does not mean, however, that all clades must be named. The decision to name a clade (or to link an existing name to it by publishing a phylogenetic definition) may be based on diverse criteria, including (but not restricted to), level of support, phenotypic distinctiveness, economic importance, and whether the clade has historically been named.

Another benefit of phylogenetic nomenclature is that it permits (though it does not require) the abandonment of categorical ranks, which would eliminate the most subjective aspect of traditional taxonomy. The arbitrary nature of ranking, though acknowledged by most taxonomists, is not widely appreciated by non-taxonomists. The existence of ranks encourages researchers to use taxonomies inappropriately, treating taxa at the same rank as though they were comparable in some biologically meaningful way—for example, when they count genera or

families to study past and present patterns of biological diversity. A rankless system of taxonomy, which is permitted but not required by the *PhyloCode*, encourages the development of more appropriate uses of taxonomies in such studies, such as counting clades or species that possess properties relevant to the question of interest, or investigating the evolution of those properties on a phylogenetic tree.

An advantage of the *PhyloCode* over the rank-based codes is that it applies at all levels of the taxonomic hierarchy. In contrast, the *ICZN* does not extend its rank-based method of definition above the level of superfamily, and the *ICBN* extends that method of definition only to some names above the rank of family (automatically typified names) and the principle of priority is not mandatory for those names. Consequently, at higher levels in the hierarchy, the rank-based codes permit multiple names for the same taxon as well as alternative applications of the same name. Thus, as phylogenetic studies continue to reveal many deep clades, there is an increasing potential for nomenclatural chaos due to synonymy and homonymy. By imposing rules of precedence on clade names at all levels of the hierarchy, the *PhyloCode* will improve nomenclatural clarity at higher hierarchical levels.

**History.** The theoretical foundation of the *PhyloCode* was developed in a series of papers by de Queiroz and Gauthier (1990, 1992, 1994), which were foreshadowed by earlier suggestions that a taxon name could be defined by reference to a part of a phylogenetic tree (e.g., Ghiselin, 1984). The theory was in development for several years before the first of these theoretical papers was published, and related theoretical discussions (e.g., Rowe, 1987; de Queiroz, 1988; Gauthier et al., 1988; Estes et al., 1988) as well as explicit phylogenetic definitions (Gauthier, 1984, 1986; Gauthier and Padian, 1985; de Queiroz, 1985, 1987; Gauthier et al., 1988; Estes et al., 1988; Rowe, 1988) were published in some earlier papers. Several other papers contributed to the development of phylogenetic nomenclature prior to the Internet posting of the first version of the *PhyloCode* in 2000 (Rowe and Gauthier, 1992; Bryant 1994, 1996, 1997; de Queiroz, 1992, 1994, 1997a, b; Sundberg and Pleijel, 1994; Christoffersen, 1995; Schander and Thollessen, 1995; Lee, 1996a, b, 1998a, b, 1999a, b; Wyss and Meng, 1996; Brochu, 1997; Cantino et al., 1997, 1999a, b; Kron, 1997; Baum et al., 1998; Cantino, 1998; Eriksson et al., 1998; Härlin, 1998, 1999; Hibbett and Donoghue, 1998; Moore, 1998; Schander, 1998a, b; Mishler, 1999; Pleijel, 1999; Sereno, 1999). Other papers during this period applied phylogenetic nomenclature to particular clades (e.g., Judd et al., 1993, 1994; Holtz, 1996; Roth, 1996; Alverson et al., 1999; Swann et al., 1999; Brochu, 1999; Bremer, 2000; a more complete list can be found at <http://www.phylonames.org>).

Three early symposia increased awareness of phylogenetic nomenclature. The first one, organized by Richard G. Olmstead and entitled "Translating Phylogenetic Analyses into Classifications," took place at the 1995 annual meeting of the American Institute of Biological Sciences in San Diego, California, U.S.A. The 1996 Southwestern Botanical Systematics Symposium at the Rancho Santa Ana Botanic Garden in Claremont, California, U.S.A., organized by J. Mark Porter and entitled "The Linnean Hierarchy: Past Present and Future," focused in part on phylogenetic nomenclature. Philip Cantino and Torsten Eriksson organized a symposium at the XVI International Botanical Congress in St. Louis, Missouri, U.S.A. (1999), entitled "Overview and Practical Implications of Phylogenetic Nomenclature." A few critiques of phylogenetic nomenclature (Lidén and Oxelman, 1996; Dominguez and Wheeler, 1997; Lidén

et al., 1997) and responses (Lee, 1996a; de Queiroz, 1997b; Schander, 1998a) were also published during this period, but the debate became much more active after the posting of the first version of the *PhyloCode* (see below).

The preparation of the *PhyloCode* began in the autumn of 1997, following a decision by Michael Donoghue, Philip Cantino, and Kevin de Queiroz to organize a workshop for this purpose. The workshop took place August 7–9, 1998 at the Harvard University Herbaria, Cambridge, Massachusetts, U.S.A., and was attended by 27 people from five countries: William S. Alverson, Harold N. Bryant, David C. Cannatella, Philip D. Cantino, Julia Clarke, Peter R. Crane, Noel Cross, Kevin de Queiroz, Michael J. Donoghue, Torsten Eriksson, Jacques Gauthier, Kancheepuram Gandhi, Kenneth Halanych, David S. Hibbett, David M. Hillis, Kathleen A. Kron, Michael S. Y. Lee, Alessandro Minelli, Richard G. Olmstead, Fredrik Pleijel, J. Mark Porter, Heidi E. Robeck, Timothy Rowe, Christoffer Schander, Per Sundberg, Mikael Thollesson, and André R. Wyss. An initial draft of the code prepared by Cantino and de Queiroz was provided to the workshop participants in advance and was considerably revised by Cantino and de Queiroz as a result of decisions made at the meeting. The initial draft of Art. 22 was written by F. Pleijel, A. Minelli, and K. Kron and subsequently modified by M. Donoghue and P. Cantino. The initial draft of Rec. 11.7B was contributed by T. Rowe. An earlier draft of Art. 10.9 was written by Gerry Moore, who also provided Example 1. Art. 8 and Appendix A were written largely by T. Eriksson. William M. Owens provided the Latin terms in Art. 9.2. Whenever possible, the writers of the *PhyloCode* used the draft *BioCode* (Greuter et al., 1998), which attempted to unify the rank-based approach into a single code, as a model. Thus, the organization of the *PhyloCode*, some of its terminology, and the wording of certain rules are derived from the *BioCode*. Other rules are derived from one or more of the rank-based codes, particularly the Botanical and Zoological Codes (Greuter et al., 1994, 2000; McNeill et al., 2006; International Commission on Zoological Nomenclature, 1985, 1999). However, many rules in the *PhyloCode* have no counterpart in the any code based on taxonomic ranks because of fundamental differences in the definitional foundations of the alternative systems.

The first public draft of the *PhyloCode* was posted on the Internet in April, 2000. Its existence was broadly publicized in the systematic biology community, and readers were encouraged to submit comments and suggestions. All comments received were forwarded to the advisory group via a listserver, and many of them elicited discussion. Numerous commentaries about phylogenetic nomenclature have been published since the first public posting of the *PhyloCode*, some of them critical (Benton, 2000; Nixon and Carpenter, 2000; Stuessy, 2000, 2001; Forey, 2001, 2002; Lobl, 2001; Berry, 2002; Blackwell, 2002; Jørgensen, 2002, 2004; Carpenter, 2003; Janovec et al., 2003; Keller et al., 2003; Kojima, 2003; Moore, 2003; Nixon et al., 2003; Schuh, 2003; Barkley et al., 2004; Wenzel et al., 2004; Pickett, 2005; Polaszek and Wilson, 2005; Tang and Lu, 2005; Monsch, 2006; Rieppel, 2006; Stevens, 2006), some supportive (Bremer, 2000; Cantino, 2000, 2004; de Queiroz, 2000, 2006; Brochu and Sumrall, 2001; de Queiroz and Cantino, 2001a, b; Ereshefsky, 2001; Laurin, 2001, 2005; Lee, 2001; Bryant and Cantino, 2002; Bertrand and Pleijel, 2003; Pleijel and Rouse, 2003; Donoghue and Gauthier, 2004; Laurin et al., 2005, 2006), and some pointing out both advantages and disadvantages (Langer, 2001; Stevens, 2002). Other publications since 2000 have discussed properties of different kinds of phylogenetic definitions (Gauthier and de Queiroz, 2001), the application of widely used names to a particular category of clades (Anderson, 2002; Laurin, 2002; Joyce et al., 2004; Laurin and

Anderson, 2004; Donoghue, 2005; Sereno, 2005), the conversion of rank-based names to phylogenetically defined names (Joyce et al., 2004), the choice of specifiers (Lee, 2005; Sereno, 2005; Wilkinson, 2006), the number of specifiers (Bertrand and Härlin, 2006), the application of phylogenetic nomenclature to species or least inclusive clades (Pleijel and Rouse, 2000; Artois, 2001; Hillis et al., 2001; Lee, 2002; Pleijel and Rouse, 2003; Spangler, 2003; Dayrat et al., 2004; Dayrat, 2005; Dayrat and Gosliner, 2005; Fisher, 2006), the relevance of phylogenetic nomenclature to phyloinformatics (Donoghue, 2004; Hibbett et al., 2005), the logic and symbolic representation of phylogenetic definitions (Sereno, 2005), the philosophy of different approaches to phylogenetic nomenclature (Härlin, 2003a, b; Pleijel and Härlin, 2004), the use of phylogenetic nomenclature without a code (Sereno, 2005), guidelines for interpreting and establishing pre-*PhyloCode* phylogenetic definitions after the *PhyloCode* is implemented (Taylor, 2007), the possibility of combining elements of phylogenetic and rank-based nomenclature (Kuntner and Agnarsson, 2006), and the development of an integrated approach to naming crown and total clades (de Queiroz, 2007). There have also been many applications of phylogenetic nomenclature to particular clades (e.g., Donoghue et al., 2001; Gauthier and de Queiroz, 2001; Maryanska et al., 2002; Modesto and Anderson, 2004; Smedmark and Eriksson, 2002; Wolfe et al., 2002; Stefanovic et al., 2003; Clarke, 2004; Joyce et al., 2004; Sangster, 2005; Taylor and Naish, 2005; Cantino et al., 2007; a more complete list can be found at <http://www.phylonames.org>).

A second workshop on phylogenetic nomenclature was held at Yale University, July 28–30, 2002, organized by Michael Donoghue, Jacques Gauthier, Philip Cantino, and Kevin de Queiroz. There were 20 attendees from 5 countries, four of whom were observers. The active (voting) participants were Christopher Brochu, Harold Bryant, Philip Cantino, Kevin de Queiroz, Michael Donoghue, Torsten Eriksson, Jacques Gauthier, David Hibbett, Michel Laurin, Brent Mishler, Gerry Moore, Fredrik Pleijel, J. Mark Porter, Greg Rouse, Christoffer Schander, and Mikael Thollesson. Sixteen proposed changes in the rules and recommendations were discussed, 11 of which were approved. (Many other minor wording changes had already been circulated by e-mail and approved in advance of the workshop.)

In addition to specific rule changes, the 2002 workshop focused on several larger issues, the most fundamental of which concerned the governance of species names. The first public draft of the *PhyloCode* covered only clade names. Among the advisory group members, there was a diversity of opinions on how species names should be handled, ranging from those who thought that species names should never be governed by the *PhyloCode* to those who argued that their inclusion is so essential that the *PhyloCode* should not be implemented until rules governing species names have been added. The majority held the intermediate view that species names should eventually be included in the *PhyloCode* but that the controversy surrounding species and species names, both within the advisory group and in the systematics community as a whole, should not be allowed to delay implementation of the rules for clade names. Thus, it was decided, first, that rules for clade names and rules for species names would be published in separate documents and, second, that the timing of implementation of the two documents would be independent; thus, the rules for clade names would likely be implemented before those for species names. However, this decision was reconsidered in 2006, and a different approach to species names was adopted by the CPN in 2007 (see below).



A second major decision at the 2002 Yale workshop concerned the proposal of a publication that would define various clade names following the rules of the *PhyloCode* and serve as its starting point with regard to priority. Because the starting date of the *PhyloCode* will coincide with the publication of this "companion volume," the names and definitions published in the latter will have precedence over all others published either before or afterwards. As originally conceived, the companion volume would have included phylogenetic definitions of the most widely known names in most or all groups of organisms. It was soon realized that several volumes would be needed, that producing these volumes would be an immense job, and that linking the starting date of the *PhyloCode* to their publication would greatly delay its implementation. For this reason, the participants in the second workshop decided to reduce the scope of the companion volume. Instead of attempting a comprehensive treatment of widely known clade names for all major groups of organisms, the companion volume will include only examples involving taxa for which there are systematists who can be recruited to contribute entries. A plan for a conference was conceived in which participants would apply phylogenetic nomenclature to clades that they study. The definitions from the papers presented at the conference would form the nucleus of the companion volume. Michel Laurin offered to organize the meeting, and Kevin de Queiroz and Jacques Gauthier were chosen to edit the companion volume (Philip Cantino was enlisted in 2004 as a third editor).

The First International Phylogenetic Nomenclature Meeting took place July 6–9, 2004, at the Muséum National d'Histoire Naturelle in Paris, organized by a 10-member committee chaired by Michel Laurin. The meeting was described in detail by Laurin and Cantino (2004), and the program and abstracts are available at <http://www.phylocode.org> and <http://www.phylonames.org>. Unlike the first two workshops, this conference included paper presentations and was open to anyone interested in attending. It was attended by 70 people from 11 countries, and 36 papers were presented. The Paris conference also served as the inaugural meeting of the International Society for Phylogenetic Nomenclature (ISPN), including the election of a governing council and officers and approval of the bylaws (available at the subsequently established ISPN website: <http://www.phylonames.org>). The ISPN includes an elected Committee on Phylogenetic Nomenclature, whose responsibilities include ratifying the first edition of the *PhyloCode* and approving any subsequent modifications (for full responsibilities see Art. 22).

Papers were presented at the Paris meeting on the theory and practice of phylogenetic nomenclature and its applications to a wide variety of groups. Besides the inauguration of the ISPN, there were several other important outcomes of the meeting: 1) A proposal by K. de Queiroz and J. Gauthier to adopt "an integrated system of phylogenetically defined names," including the application of widely known names to crown clades and forming the names of the corresponding total clades by adding the prefix "*Pan-*" to the name of the crown (Lauterbach, 1989; Meier and Richter, 1992; Gauthier and de Queiroz, 2001 and Joyce et al., 2004), was introduced and vigorously discussed. Some participants were reluctant to make these conventions mandatory because doing so would result in replacing some names that had already been explicitly defined as the names of total clades (e.g., replacing *Synapsida* by *Pan-Mammalia*). A compromise that made exceptions for such names was acceptable to the majority of the participants, and it served as the basis for the set of rules and recommendations that was eventually adopted by the CPN (Rec. 10.1B and Arts. 10.3–10.8 in version 3 of the *PhyloCode*,

and after some modifications in 2007, Rec. 10.1B and Arts. 10.3–10.6 in version 4). 2) Benoît Dayrat proposed that phylogenetically defined species names consist of a single word (the epithet in the case of already existing names) plus the author of the name, year of publication, and (if necessary to ensure uniqueness) the page number where published (Dayrat et al., 2004). In practice, the name of a small clade (generally corresponding to a genus under the rank-based system) would likely be cited before the species name, but it would not be part of the species name. In conversation and in teaching, the name would likely be abbreviated to the epithet alone when doing so is unambiguous. Dayrat's proposal was well received by conference participants. 3) Julia Clarke proposed a flexible way of defining species names that is applicable to the wide variety of entities that are called species. The definitions would take the form "the species that includes specimen X" (de Queiroz, 1992), and the author would be required to explain what he/she means by "species." This approach is similar to the way species names are implicitly defined in rank-based nomenclature but differs in that the species category is not a rank, and the author is required to explain the kind of entity to which the name refers. 4) In a straw vote of meeting participants, it was decided that Clarke, Dayrat, Cantino, and de Queiroz would draft a code for species names based on the above-described proposals of Clarke and Dayrat. Consistent with the decision made at the 2002 Yale workshop, this code would be separate from, but compatible with, the code for clade names.

In the fall of 2004, Cantino and de Queiroz drafted a code for species names based on the proposals approved at the Paris meeting. After review of the draft by Dayrat and Clarke and e-mail discussion of unresolved issues, the four potential authors of the code met at the Smithsonian Institution on May 20–21, 2006. In the process of drafting the code, the seriousness of the drawbacks of extending the *PhyloCode* to species names using an epithet-based format had become more apparent. Most critically, species names would be different under rank-based and phylogenetic nomenclature (e.g., "*Homo sapiens*" vs. "*sapiens* Linnaeus 1758"), which would create confusion. Second, differences in the way types are handled under the *ICZN* and *ICBN* complicate the development of a universal code governing species names. Third, establishing and registering reformatted names for every species known to science would be an immense job—and one of questionable value given that there would be no fundamental difference in the way that the names would be defined. What emerged from the May 2006 meeting was an entirely different (and much simpler) way to reconcile the incompatibilities between traditional binominal species names and phylogenetic nomenclature—including the mandatory genus category and the fact that many genera are not monophyletic. This approach was subsequently adopted by the CPN (May, 2007) and incorporated into the current version of the code (as a new Article 21). Its features are detailed below (see Changes in Version 4).

The Second Meeting of the ISPN took place June 28–July 2, 2006, at the Peabody Museum of Yale University, organized by an 8-member committee co-chaired by Nico Cellinese and Walter Joyce. Most of the papers were presented in three symposia: phylogenetic nomenclature of species (organized by David Baum and Benoît Dayrat), implementing phylogenetic nomenclature (organized by Philip Cantino), and phyloinformatics (organized by Michael Donoghue and Nico Cellinese). The meeting was described in detail by Laurin and Cantino (2006, 2007), and the program and abstracts are available at <http://www.phylocode.org> and <http://www.phylonames.org>. At this second ISPN meeting, more time was devoted to open-ended discussions of issues raised in the presentations. The new approach to species names that

was developed at the May 2006 meeting in Washington was presented in talks by Clarke and Dayrat and was well received in the subsequent discussion. They and their coauthors (Cantino and de Queiroz) were encouraged to continue work on a set of rules and recommendations that would implement this approach.

Another issue that generated a lot of discussion at the second ISPN meeting was the integrated system of crown and total clade names that was introduced at the 2004 Paris meeting and incorporated into *PhyloCode* version 3. Although the rules and recommendations promoting an integrated system in version 3 represented a compromise, there was still a lot of dissatisfaction on the part of some discussants. An alternative means of referring to total clades using "pan" as a function name was proposed by T. Michael Keeseey. In the course of the discussion, it was suggested that the prefix "pan-" (lower case) be used to designate informal names for total clades that may or may not have a formal name. Because informal names do not compete with formal names for precedence, they can coexist without violating Principle 3 (that each taxon may have only one accepted name). Using this approach, a widely used name could be retained for a total clade and coexist with an informal name with the prefix "pan-". For example, the total clade of mammals might have the formal name *Synapsida* and the informal name pan-Mammalia. This suggestion led to changes in Article 10 that were approved by the CPN in January 2007 and included in this version of the code.

The Third Meeting of the ISPN took place July 20–July 22, 2008, at Dalhousie University in Halifax, Nova Scotia, organized by a 4-member committee chaired by Harold Bryant. It was coordinated with a joint meeting of the International Society of Protistologists and the International Society for Evolutionary Protistology. In addition to contributed papers (see Laurin and Bryant, 2009, for details), including a plenary talk by Sina Adl focusing on issues in protist nomenclature, the meeting focused on how to expedite completion of two critical projects that must reach fruition before implementation of the code: preparation of the "companion volume" and development of *RegNum*, the name registration database.

The companion volume, tentatively titled *Phylonyms: a Companion to the PhyloCode*, has three editors (K. de Queiroz, P. Cantino, and J. Gauthier), and specialists on a wide variety of organisms are contributing nomenclatural treatments. As noted above, the names and definitions published in the companion volume will be the first to be established under the *PhyloCode* and will have priority over subsequently defined names. The definitions and associated protologues will also serve as models for future users of phylogenetic nomenclature. The companion volume should ideally include definitions for all widely used names—i.e., the large and/or deep clades that are commonly discussed in textbooks and other works for non-specialists. However, it is inevitable that some groups (e.g., vertebrates, angiosperms) will be more thoroughly covered than others (e.g., insects) because there are more specialists who are not only knowledgeable about the phylogeny of the group but also proponents of phylogenetic nomenclature. Contracts with University of California Press have been secured to publish both the *PhyloCode* and *Phylonyms*. As reported at the Halifax meeting, progress has been slower than anticipated. However, two steps taken before and during that meeting have helped to expedite completion of the book: A 10-member editorial board was appointed to help review manuscripts, and a deadline was established for receipt of contributions (July 1, 2009).

The other task that must be completed before the *PhyloCode* can be implemented is implementation of the registration database, which has come to be known as *RegNum*. (Registration is required for establishment of names under the *PhyloCode*; Art. 8.) Torsten Eriksson and Mikael Thollesson initially designed the database structure and reported on it at the 2002 Yale workshop. Further development of the database and web/user interface was subsequently carried out at Uppsala University by Jonas Ekstedt and M. Thollesson. An alpha test site for this version was announced at the 2004 Paris meeting. A prototype of *RegNum* was demonstrated at a meeting of the ISPN Registration Committee (Mikael Thollesson, Torsten Eriksson, and Nico Cellinese) and other interested persons at Yale University on November 2–3, 2005, and it was subsequently demonstrated at both the 2006 and 2008 ISPN meetings. In 2009, a more flexible prototype was developed by Nico Cellinese, who is currently chairing the Registration Committee. The new version of *RegNum* was conceived in line with other developments concerning biological name repositories and resolution services (e.g., Global Name Architecture). *RegNum* was demonstrated at the 2009 Biodiversity Information Standards (TDWG) meeting in Montpellier, France, during a workshop that focused on its current functionality and future development. The *RegNum* database currently satisfies the requirements of the *PhyloCode*, and it will soon be integrated with several tools and data repositories (e.g., *TreeBASE*) that will enhance its relevance for phylogenetic research.

**Changes in Version 4.** Version 4 includes three major changes, all of which were discussed at the 2006 ISPN meeting and subsequently approved by the CPN. These concern species names (Art. 21), crown and total clade names (Art. 10), and emendations of definitions (Art. 15).

A new article (21), which was prepared by P. Cantino, J. Clarke, B. Dayrat and K. de Queiroz, concerns the use of species names in the context of phylogenetic nomenclature. It has the following features: 1) Regulation of species names is left entirely to the rank-based codes. 2) The genus portion of the binomen, called the "prenomen" (Griffiths, 1976) under the *PhyloCode*, is treated as simply the first part of the species name and need not be established under this code. 3) It is recommended that some mechanism be used to indicate whether the prenomens is also an established clade name under this code, and examples of possible symbols are provided. 4) Guidelines and examples are provided for selecting a prenomens when publishing a new species name in various situations. 5) It is recommended that the protologue include evidence indicating that the named species represents a separately evolving lineage (or citation of such evidence published elsewhere). 6) After a species name is published under the appropriate rank-based code, the second part of the binomen may be treated as though it were the name of the species. In this context, the species uninomen may be combined with the names of clades other than the prenomens. To avoid ambiguity, it is recommended that if the uninomen is not accompanied by the prenomens, the author and publication year of the uninomen be cited. Examples are provided showing various ways in which species names and their authors might be cited in the context of phylogenetic nomenclature.

The portion of Art. 10 that promotes an integrated system of clade names was modified along the lines proposed in discussions at the 2006 ISPN meeting (see above). Both the previous wording (in *PhyloCode* version 3) and the current one are compromises between those who see great value in an integrated system of crown and total clade names and those who put a premium on nomenclatural freedom. The current version leans more in the direction of nomenclatural

freedom, while not abandoning the goal of an integrated system. The following are the most important changes: 1) Elimination of the rule (Art. 10.6 in version 3) that a panclade name must be used if there is no preexisting name for a total clade. In lieu of old Art. 10.6, new Art. 10.3 requires that *if* a new name for a total clade is created by adding an affix to the name of the corresponding crown clade, the affix used must be the prefix *Pan-*. This rule places considerably less restriction on nomenclatural freedom than old Art. 10.6 because it does not prohibit the creation of a new non-panclade name for a total clade if the new name does *not* combine an affix with the crown clade name. 2) The elimination of the recommendation (Art. 10.7A in version 3) that a panclade name be used rather than a preexisting non-panclade name. 3) Addition of a recommendation (10.3A) providing for the use of informal panclade names. 4) Addition of a standard abbreviation (Note 10.5.1) for total clade definitions, using a function as suggested by T. Michael Keeseey. 5) Changes parallel to (1) and (2) above were also made for names derived from those of crown clades by adding the prefix *Apo-* (see Arts. 10.7 and 10.8 in this version).

Art. 15, which previously focused mainly on conservation of names, is expanded here to include new rules about emendation of definitions (Arts. 15.8–15.15). In previous versions of this code, all emendations required CPN approval. Based on ideas published by Sereno (2005), a new distinction is made (Art. 15.8) between restricted and unrestricted emendations. An unrestricted emendation can be published without CPN approval and is intended to preserve the original definitional author's conceptualization of the clade. It is a mechanism to prevent undesirable changes in the application of a name when the original definition is applied in the context of a revised phylogeny. In contrast, a restricted emendation requires CPN approval and is intended to change the conceptualization of the clade. It is a mechanism to correct a definition that fails to associate a name with the clade to which it has traditionally referred, even in the context of the reference phylogeny adopted by the original definitional author. Making it easier to emend definitions will reduce the problem of unstable clade composition, which has been one of the most frequent criticisms of phylogenetic nomenclature.

Other changes in versions 4a and 4b include: 1) clarification (Note 6.2.1) that new names that were phylogenetically defined prior to implementation of the *PhyloCode* are considered to be preexisting names after its implementation, even if they are not legitimate (*ICBN*, *ICNB*), potentially valid (*ICZN*) or valid (*ICVCN*); 2) requirement (Art. 9.6; previously a recommendation) that the protologue include citation of a reference phylogeny or an explicit statement about the distribution of putative synapomorphies, and stipulation (in Art. 7.2) that an established name must apply to a clade that appears on the reference phylogeny or is delimited by the cited synapomorphies; 3) clarification (Note 11.1.1) that when a species is cited as a specifier, the implicit specifier is the type of that species name; 4) a new recommendation (11F), based on the idea underlying Sereno's (1999, 2005) "node-stem triplet", on the choice of specifiers if one wishes to establish names as necessarily applying to sister-groups regardless of the phylogeny; and 5) clarification (in Art. 20.1) that citation of the authors of taxon names is optional. Other minor changes were made in Art. 4.2, Art. 5.1, Note 9.8A.3 Ex. 1, Note 10.1B.1 Ex. 1, Rec. 10D, Rec. 11.4A, Art. 20.4 Ex. 1, and Note 20.4.1 Ex. 1.

Additional changes in version 4c include: 1) a recommendation (Rec. 9.6B) that a single figure or tree be designated as the primary reference phylogeny for a definition; 2) a requirement (Art. 11.8) that either the specifiers be included in the reference phylogeny, or the protologue indicate

how the specifiers are related to taxa that are included in the reference phylogeny; 3) a clarification (Note 11.1.1) on how to handle changes in the taxonomic status (under the rank-based system) of specifier species; 4) an extension of Art. 11.7 (which requires use of the type as an internal specifier for clade names that are based on a preexisting genus name) to clade names that are based on typified preexisting names of any rank; 5) a clarification (Art. 9.4) of the meaning of "extant" in relation to the specifiers in crown clade definitions; and 6) clarification that when a species uninomen is combined with names other than the prenamen, the names do not have to agree in gender and number (plural vs. singular). Other minor modifications were the addition of three Notes (2.2.1, 9.6.2, and 21.4A.1), the transfer of most of Art. 20.1 and Note 20.1.1 to a new Art. 19.1, and changes in Art. 2.2 (formerly Note 2.1.4), Art. 4.2, Art. 8.1, Art. 8.4, Note 9.3.1, Art. 9.6 (with the related addition of Rec. 9.6A), Art. 9.8, Note 9.8.2 (and the addition of an example), Rec. 9A, Art. 10.1, Art. 10.2, Art. 10.5 and its Notes, Art. 10.9, Rec. 10D, Rec. 11A Ex. 1, Art. 15.11, Art. 17.1 (with the related deletion of former Art. 9.2), Art. 19.5, and Appendix A. Table 1 is now Appendix C.

As in Version 3, the terms "branch-based" and "branch-modified" are used here in place of "stem-based" and "stem-modified," which were used in earlier drafts of this code, but the following justification has been removed from the code itself (as of version 4c): Although the term "stem-based definition" has been used extensively in the literature on phylogenetic nomenclature to refer to definitions that tie names to particular branches, this use of "stem" is inconsistent with its broader usage in phylogenetic systematics. The word "stem" has traditionally been used for only a subset of all branches (those from which total clades originate, as in the terms "stem-lineage" and "stem-group"). Furthermore, the word "branch" is widely used in the literature on phylogenetic trees as a general term for all internodes. Therefore, adopting the term "branch-based" makes the terminology of phylogenetic nomenclature more consistent with that in related fields.

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## Preamble

1. Biology requires a precise, coherent, international system for naming clades and species of organisms. Species names have long been governed by the traditional codes (listed in Preamble item 4), but those codes do not provide a means to give stable, unambiguous names to clades. This code satisfies that need by providing rules for naming clades and describing the nomenclatural principles that form the basis for those rules.
2. This code is applicable to the names of all clades of organisms, whether extant or extinct.
3. This code may be used concurrently with the rank-based codes.
4. Although this code relies on the rank-based codes (i.e., *International Code of Botanical Nomenclature (ICBN)*, *International Code of Zoological Nomenclature (ICZN)*, *International Code of Nomenclature of Bacteria: Bacteriological Code (ICNB)*, *International Code of Virus Classification and Nomenclature (ICVCN)*) to determine the acceptability of preexisting names, it governs the application of those names independently from the rank-based codes.
5. This code includes rules, recommendations, notes and examples. Rules are mandatory in that names contrary to them have no official standing under this code. Recommendations are not mandatory in that names contrary to them cannot be rejected on that basis. Systematists are encouraged to follow them in the interest of promoting nomenclatural uniformity and clarity, but editors and reviewers should not require that they be followed. Notes and examples are intended solely for clarification.
6. This code will take effect on the publication of *Phylonoms: a Companion to the PhyloCode*, and it is not retroactive.

## **Division I. Principles**

1. Reference. The primary purpose of taxon names is to provide a means of referring to taxa, as opposed to indicating their characters, relationships, or membership.
2. Clarity. Taxon names should be unambiguous in their designation of particular taxa. Nomenclatural clarity is achieved through explicit definitions, which describe the concept of the taxon designated by the defined name.
3. Uniqueness. To promote clarity, each taxon should have only one accepted name, and each accepted name should refer to only one taxon.
4. Stability. The names of taxa should not change over time. As a corollary, it must be possible to name newly discovered taxa without changing the names of previously discovered taxa.
5. Phylogenetic context. This code is concerned with the naming of taxa and the application of taxon names in the context of phylogenetic concepts of taxa.
6. Taxonomic freedom. This code permits freedom of taxonomic opinion with regard to hypotheses about relationships; it only concerns how names are to be applied within the context of a given phylogenetic hypothesis.
7. There is no "case law" under this code. Nomenclatural problems are resolved by the Committee on Phylogenetic Nomenclature (CPN) by direct application of the code; previous decisions will be considered, but the CPN is not obligated by precedents set in those decisions.

## **Division II. Rules**

### Chapter I. Taxa

#### Article 1. The Nature of Taxa

1.1. The groups of organisms whose names are governed by this code are called taxa (singular: taxon). Taxa may be clades or species, but only clade names are governed by this code.

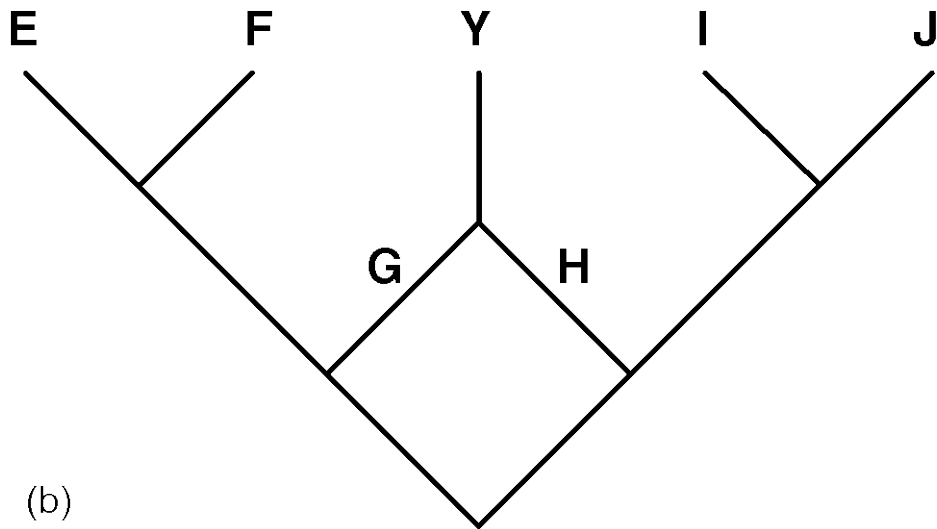
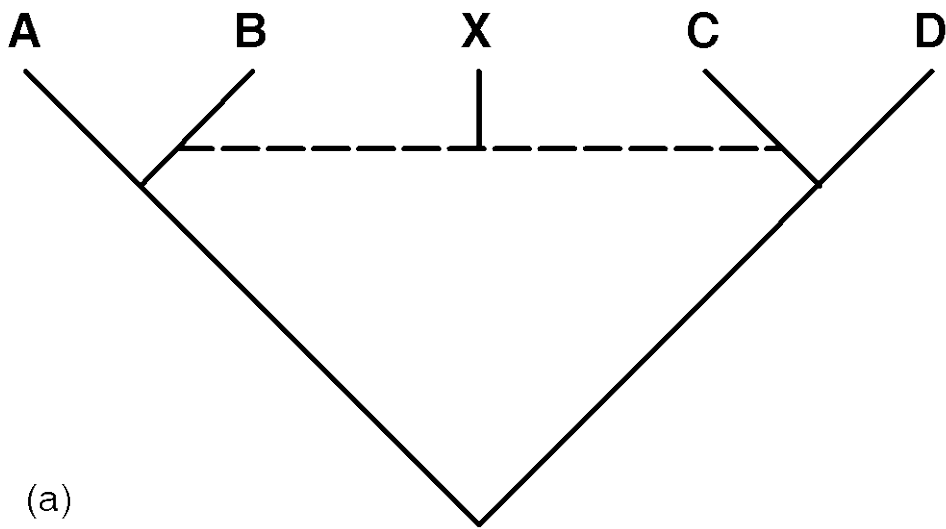
#### Article 2. Clades

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 (see Figure below).



Speciation via hybridization (a) and species fusion (b) can result in clades that are partially overlapping. In (a), the origin of species X via hybridization (represented by the dashed line) between members of species B and C results in partial overlap between the most inclusive clade containing A but not D (or the least inclusive clade containing both A and B), which is composed of A, B and X, and the most inclusive clade containing D but not A (or the least inclusive clade containing C and D), which is composed of C, D, and X, in that X is part of both clades. In (b), fusion of species G and H to form species Y (with the two parent species disappearing in the process) results in partial overlap between the most inclusive clade containing E but not J (or the least inclusive clade containing both E and G), which is composed of E, F, G, and Y, and the most inclusive clade containing J but not E (or the least inclusive clade containing both H and J), which is composed of H, I, J, and Y, in that Y is part of both clades.

2.2. In this code, the following categories of clades are recognized based on how they are conceptualized with respect to the components of a phylogenetic tree. This list is not necessarily exhaustive.

- A node-based clade is a clade originating with a particular node on a phylogenetic tree, where the node represents a lineage at the instant of a splitting event.
- A branch-based clade is a clade originating with a particular branch (internode) on a phylogenetic tree, where the branch represents a lineage between two splitting events.
- An apomorphy-based clade is a clade originating with the ancestor in which a particular derived character state (apomorphy) originated.
- A crown clade is a node-based clade originating with the most recent common ancestor of two or more extant species (or organisms).
- A total clade is a branch-based clade composed of a crown clade and all organisms (and species) that share a more recent common ancestor with that crown clade than with any extant organisms or species that are not members of that crown clade.

Note 2.2.1. Here and elsewhere in this code, "phylogenetic tree" is used loosely to include any directed graph, specifically those with additional connections representing phenomena such as hybridization (see Note 2.1.3).

### Article 3. Hierarchy and Rank

3.1. The system of nomenclature described in this code is independent of categorical rank. Although clades are hierarchically related, and therefore intrinsically ranked in the sense that some are more inclusive than others, assignment of categorical ranks (e.g., genus, family, etc.) is not part of the formal naming process and has no bearing on the spelling or application of clade names.

Example 1. If the name *Iguanidae* were defined as referring to a clade originally ranked as a family, and if that clade were later ranked as a subfamily and (at the same time) a more inclusive clade ranked as a family, the reference of the name *Iguanidae* would not change to the more inclusive clade, nor would the spelling of that name change (i.e., to *Iguaninae*) to reflect the new rank of the clade to which it refers.

Note 3.1.1. In this code, the terms "species" and "clade" refer to different kinds of biological entities, not ranks.

Note 3.1.2. This code does not prohibit, discourage, encourage, or require the use of taxonomic ranks.

3.2. The concepts of synonymy, homonymy, and precedence adopted in this code (see Arts. 12–14) are, in contrast to the rank-based codes, independent of categorical rank.

## Chapter II. Publication

### 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 distribution of text (but not sound), with or without images. To qualify as published, works must be peer-reviewed, consist of numerous (at least 50 copies), simultaneously obtainable, identical, durable, and unalterable copies, some of which are distributed to major institutional libraries (in at least five countries on three continents) so that the work is generally accessible as a permanent public record to the scientific community, be it through sale or exchange or gift, and subject to the restrictions and qualifications in the present article.

Note 4.2.1. 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 4.2.2. Approval of a work by a thesis or dissertation committee does not constitute peer review.

4.3. The following do not qualify as publication: (a) dissemination of text or images solely through electronic communication networks (such as the Internet) or 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 published 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 biologists, abstracting journals, trade catalogues, and seed exchange lists; (h) anonymous works. See also Art. 7.3.

Note 4.3.1. If a name is disseminated through electronic publication (see Art. 4.3a), it must also satisfy the requirements in Art. 4.2.

### Article 5. Publication Date

5.1. The publication date for names established under this code is the date on which publication, as defined in Art. 4, took place. More specifically, it is the date on which the publisher or publisher's agent delivered the printed matter to a carrier for distribution to the public. In the absence of proof establishing some other date, the one appearing in the publication itself must be accepted as correct.

5.2. If the date appearing in the publication specifies the month but not the day, the last day of that month is to be adopted as the publication date.

5.3. If the date appearing in the publication specifies the year but not the month, the last day of that year is to be adopted as the publication date.

5.4. When separates are issued in advance of the work (periodical or book) that contains them, the date of the work, not of the separate, constitutes the date of publication.

## Chapter III. Names

### Section 1. Status

#### Article 6

6.1. Established names are those that are published in accordance with Art. 7 of this code. Unless a 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 2006 edition of the *ICBN* but not with the 1999 edition of the *ICZN*.

Recommendation 6.1B. In order to indicate which 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.

Example 1. The letter "P" (bracketed or in superscript) might be used to designate names governed by this code, and the letter "R" to designate names governed by the rank-based codes. Using this convention, the name "*Ajugoideae*[R]" would apply to a plant subfamily which may or may not be a clade, whereas "*Teucroideae*[P]" would apply to a clade which may or may not be a subfamily.

Example 2. If the name *Teucroideae* applied to both a clade (this code) and a subfamily (*ICBN*), they could be distinguished as Clade *Teucroideae* versus Subfamily *Teucroideae*.



6.2. Preexisting names are scientific names that, prior to their establishment under this code, were either: (a) "legitimate" (*ICBN*, *ICNB*), "potentially valid" (*ICZN*), or "valid" (*ICVCN*); or (b) in use but not governed by any code (e.g., zoological names ranked above the family group). In addition, scientific names governed by the *ICBN* that are in current or recent use but have never been published with a Latin description or diagnosis (and therefore violate *ICBN* [2006] Art. 36) are considered under this code to be preexisting names, provided that they have been published with a description or diagnosis in some other language and otherwise qualify as legitimate names under the *ICBN*.

Note 6.2.1. Names that were phylogenetically defined in publications (Art. 4) prior to the starting date of this code (Art. 7.1) and are not "legitimate" (*ICBN*, *ICNB*), "potentially valid" (*ICZN*), or "valid" (*ICVCN*) are considered to be preexisting names after the starting date of this code. They fall under Art. 6.2b because they are in use but were not governed by any code at the time they were published.

6.3. Converted names are preexisting names that have been established according to this code.

6.4. An acceptable name of a taxon is one that is in accordance with the rules of this code; that is, it is both (a) established and (b) not a non-conserved (Art. 15) later homonym.

6.5. The accepted name of a taxon is the name that must be adopted for it under this code. It must (1) be established (Art. 7), (2) have precedence (Arts. 12–15) over alternative uses of the same name (homonyms) and alternative names for the same taxon (synonyms), and (3) not be rendered inapplicable by a qualifying clause in the context of a particular phylogenetic hypothesis (Art. 11.9).

6.6. Once a name has been established, its status as an acceptable and/or accepted name is not affected by inaccurate or misleading connotations; thus, a name is not to be rejected because of a claim that it denotes a character, distribution, or relationship not possessed by the taxon.

## Section 2. Establishment

### Article 7. General Requirements

7.1. Establishment of a name can only occur after the publication date of *Phylonoms: a Companion to the PhyloCode*, the starting date for this code.

7.2. In order to be established, a name of a taxon must: (a) be published as provided for by Art. 4; (b) be adopted by the author(s), not merely proposed for the sake of argument or on the condition that the group concerned will be accepted in the future; (c) apply to a clade that either appears on the reference phylogeny or is delimited by the cited synapomorphy(-ies) (see Art. 9.6); (d) comply with the provisions of Arts. 7 and 9–11; (e) be registered as provided for in Art. 8, and the registration number be cited in the protologue; and (f) comply with the provisions of Art. 17.

Note 7.2.1. The protologue is everything associated with a name when it was first established (this code), validly published (*ICBN*, *ICNB*), or made available (*ICZN*), for example, description or diagnosis, phylogenetic definition, registration number, designation of type, illustrations, references, synonymy, geographical data, specimen citations, and discussion.

7.3. When a publication contains a statement to the effect that names or nomenclatural acts in it are not to be considered for nomenclatural purposes, names that it may contain are considered as not established.

## Article 8. Registration

8.1. In order for a name to be established under this code, the name and other required information must be submitted to the registration database for phylogenetically defined names (see Art. 22.2). A name may be submitted to the database prior to acceptance for publication, but it is given only a temporary registration number at that time. The registration number will become permanent after the author notifies the database that the paper or book in which the name will appear has been published, provides a full reference to the publication, and confirms that the definition in the database is identical to that in the publication.

Note 8.1.1. Specification of the data that are required for registration can be obtained via the Internet or directly from the database administrator. The registration procedure, a provisional list of required data, and the pertinent addresses are found in Appendix A.

Recommendation 8.1A. A name should not be submitted to the registration database more than one month before it is submitted for publication, to prevent names from being reserved indefinitely in anticipation of possible publication.

Recommendation 8.1B. Registration of a name whose spelling or definition is identical to one that already exists in the database should generally be avoided (but see Recs. 8B, 8C). However, such names are not treated by this code as homonyms or synonyms until published.

8.2. At the submitter's request, a name or definition that he or she proposed can be changed or removed from the registration database if it is not yet published.

Recommendation 8.2A. The submitter of an unpublished registered name or definition who decides to change it or not to publish it should notify the database administrator promptly.

8.3. If the registered definition of a name disagrees with the definition in the protologue or the name is defined more than one way in the protologue, the author should determine which is correct and notify the registration database administrator promptly.

Note 8.3.1. If the author notifies the database administrator that the registered definition is incorrect, the administrator will correct the database and insert a note that the change was made. If one or more definitions in the protologue are incorrect, the administrator will annotate the database to alert users that this is the case.

8.4. If the registered definition of a name disagrees with the definition in the protologue or the name is defined more than one way in the protologue, and the author is no longer alive or is otherwise unable to determine which definition is correct, the following guidelines are to be used: If it is clear that the differences between the definitions are due to typographical errors, the definition that lacks typographical errors is treated as correct. If it is not clear that the differences between the definitions are due to typographical errors, the definition immediately associated with the designation "new clade name," "converted clade name," etc. is treated as correct. If two or more definitions are equally closely associated with the designation "new clade name" or "converted clade name," the decision as to which is considered correct is to be based on an interpretation of the author's intent. Such decisions regarding the correct definition of a name, if made by anyone other than the author, must be published (Art. 4) before the registration database administrator is notified (see Rec. 8A). Once published, such decisions can be reversed only by the CPN.

Note 8.4.1. If the author of a published correction notifies the database administrator that the registered definition is incorrect, the administrator will correct the database and insert a note that the change was made. If one or more definitions in the protologue are incorrect, the administrator will annotate the database to alert users that this is the case.

8.5. If the registered definition of a name and the definition in the protologue agree but contain a typographical error, the author may publish a correction. If the author is no longer alive or is otherwise unable to correct the error, any person may publish a correction (see Rec. 8A).

Note 8.5.1. After the registration database administrator is notified, the definition will be corrected in the database and a note will be added stating that the change was made.

Note 8.5.2. A correction slip inserted in the original publication does not qualify as a published correction. Publication of corrections must satisfy the requirements of Art. 4.

8.6. Accidental errors in a definition that appear in print subsequent to establishment are not to be treated as new definitions (i.e., establishment of homonyms) but as incorrect statements of the established definition. The same is true of unjustified corrections (i.e., any correction that does not fall under Arts. 8.3–8.5).

Recommendation 8A. The person making corrections of the sort covered by Arts. 8.4 and 8.5 should notify the database administrator promptly after publishing it.

Recommendation 8B. If a name or definition has been registered, but there is no indication in the registration database whether it was ever published, the name or definition should not be published by another person who has not first attempted to determine whether it was ever published. If bibliographic databases fail to resolve the question, a serious effort should be made to contact the person who registered the name or definition. (Contact information submitted with the name and maintained in the database may facilitate this.)

Recommendation 8C. If a serious but unsuccessful attempt has been made to determine whether a registered name was ever published, and the name is new (not based on a preexisting name), it is better to choose a different name, rather than use the same name and risk creating a homonym. If, in the same situation, the registered name is based on a preexisting name, it is better to publish a definition of this name, even at the risk of creating a homonym, rather than choose another, less appropriate name. This is particularly true if the registered name is widely used.

## Chapter IV. Clade Names

### Article 9. General Requirements for Establishment of Clade Names

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 "*nomen cladi conversum*." New clade names must be identified as such by the designation "new clade name" or "*nomen cladi novum*."

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.

Note 9.3.1. The following are examples of phylogenetic definitions (this list is not exhaustive):

- A node-based definition may take the form "the clade originating with the most recent common ancestor of A and B" (and C and D, etc., as needed) or "the least inclusive clade containing A and B" (and C and D, etc.), where A–D are specifiers (see Art. 11.1). A node-based definition may be abbreviated "<A&B" or "<A&B&C&D [etc.]".
- A branch-based definition may take the form "the clade consisting of A and all organisms or species that share a more recent common ancestor with A than with Z" (or Y or X, etc., as needed) or "the most inclusive clade containing A but not Z" (or Y or X, etc.). A branch-based definition may be abbreviated ">A~Z" or ">A~Z∨Y∨X [etc.]".
- An apomorphy-based definition may take the form "the clade originating with the first organism or species to possess apomorphy M as inherited by A" or "the most inclusive clade exhibiting character (state) M synapomorphic with that in A." An apomorphy-based definition may be abbreviated ">M(A)".

- A branch-modified node-based definition may take the form "the clade originating with the most recent common ancestor of A and all extant organisms or species that share a more recent common ancestor with A than with Z" (or Y or X, etc., as needed) or "the most inclusive crown clade containing A but not Z" (or Y or X, etc.), where (in both wordings) A is an extant specifier. This kind of definition may be abbreviated " $>\nabla A \sim Z$ " or " $>\nabla A \sim Z \vee Y \vee X$  [etc.]". If this kind of definition is used and "extant" is intended to mean anything other than extant on the publication date of the definition, the author should specify the meaning of "extant" in the first wording or of "crown clade" in the second wording (within the restrictions described in Art. 9.4)—e.g., the internal specifiers were extant (and thus the clade was a crown clade) at a particular time in human history.
- An apomorphy-modified node-based definition may take the form "the clade originating with the most recent common ancestor of A and all extant organisms or species that possess apomorphy M as inherited by A" or "the most inclusive crown clade exhibiting character (state) M synapomorphic with that in A," where (in both wordings) A is an extant specifier. This kind of definition may be abbreviated " $>\nabla M(A)$ ." If this kind of definition is used and "extant" is intended to mean anything other than extant on the publication date of the definition, the author should specify the meaning of "extant" in the first wording or of "crown clade" in the second wording (within the restrictions described in Art. 9.4)—e.g., the internal specifiers were extant (and thus the clade was a crown clade) at a particular time in human history.

The last two definition types are designed to tie names to crown clades (i.e., a clade originating with the most recent common ancestor of two or more extant species or organisms). These and standard node-based definitions that use extant specifiers may be termed crown clade definitions.

The system of abbreviations used here adopts the following conventions:  $>$  = "the most inclusive clade containing";  $<$  = "the least inclusive clade containing";  $\&$  = "and";  $\vee$  = "or";  $\sim$  = "but not"; A, B, C, etc. = species or specimens used as internal specifiers; Z, Y, X, etc. = species or specimens used as external specifiers; M = an apomorphy;  $()$  = "of" or "synapomorphic with that in";  $>\nabla$  = "the most inclusive crown clade containing";  $<\nabla$  = "the least inclusive crown clade containing". The inverted triangle meaning "crown clade" resembles the representation of a crown clade on a phylogenetic tree diagram.

For the definition of total clade names, see Art. 10.5.

Note 9.3.2. The application of a phylogenetic definition, and thus also of a phylogenetically defined clade name, requires a hypothesized phylogeny. To accommodate phenomena such as speciation via hybridization, species fusion, and symbiogenesis (see Note 2.1.3), the hypothesized phylogeny that serves as the context for the application of a phylogenetically defined name need not be strictly diverging.

Recommendation 9.3A. If a name is intended to refer to a crown clade, all of the internal specifiers used in the definition of that name should be extant.

Recommendation 9.3B. Because poorly chosen wordings of phylogenetic definitions can lead to undesirable consequences (i.e., the application of the name in a way that contradicts the author's intent), the wordings provided in Note 9.3.1 should generally be used for the corresponding kinds of definitions. If an alternative wording is used, it should be accompanied by the standard abbreviation (as provided in Note 9.3.1) to clarify the intent of the author in case the alternative wording is ambiguous or confusing. If the definition in words and its abbreviated form appear to be in conflict, the latter should be weighted most heavily in interpreting the author's intent. This recommendation does not preclude the use of other kinds of definitions that are not addressed in Note 9.3.1.

Art. 9.4, It is permissible to establish a name with a crown clade definition using an internal specifier that is not extant on the publication date under the following conditions: If that internal specifier is a species, either the specifier must have been extant as of 1500 CE or there must be specimens of the specifier species in existence that were collected when that species was extant. If that internal specifier is a specimen, the organism must either have died in or after 1500 CE or have been alive when it was collected.

9.5. If the author of a crown clade definition (Note 9.3.1) did not specify the meaning of "extant" or "crown clade", then subsequent authors are to interpret that definition as referring to organisms or species that were extant on its publication date (Art. 5).

9.6. In order for a clade name to be established, the protologue must include citation of a published reference phylogeny or an explicit statement about the distribution of one or more putative apomorphies supporting the existence of the clade being named. A reference phylogeny is a phylogenetic hypothesis that provides a context for applying a clade name by means of its phylogenetic definition. See Art. 11.8 concerning the inclusion of specifiers in the reference phylogeny.

Note 9.6.1. A reference phylogeny is not part of the definition and does not prevent the name from being applied in the context of alternative phylogenies.

Note 9.6.2. The reference phylogeny may be published in the same work in which the name is being established, or a previously published phylogeny may be cited.

Recommendation 9.6A. A reference phylogeny should be derived via an explicit, reproducible analysis.

Recommendation 9.6B. If more than one reference phylogeny is cited in the protologue, one of them, and ideally a single figure or tree, should be designated as the primary reference phylogeny.

9.7. In order for a clade name to be established, the protologue must include a statement about the hypothesized composition of the clade (e.g., a list of included species or subclades or reference to such a list).

9.8. In order for conversion to be effected, the preexisting name that is being converted to a phylogenetically defined clade name must be indicated. Direct and unambiguous bibliographic citations (as detailed in Art. 9.9) must be provided demonstrating (a) prior application of the name to a taxon approximating the clade for which it is being established (or to a paraphyletic group originating with the same ancestor; see Art. 10.1) and (b) authorship of the preexisting name (but see Rec. 9.8A) for the purpose of attribution (see Arts. 19, 20). In some cases, a single bibliographic citation will serve both purposes, but two different publications will have to be cited if the composition associated with the name by the original author differs substantially from that of the clade for which the converted name is being established.

Note 9.8.1. Errors in the bibliographic citation for a preexisting name should be corrected by subsequent authors, but they do not invalidate the establishment of the corresponding converted name.

Note 9.8.2. Demonstrating "prior application of the name to a taxon approximating the clade for which it is being established" does not necessarily require a modern phylogenetic analysis, and it does not require that the author of the prior application conceptualized the taxon as a clade. Application of a name in an earlier publication to a taxon approximating the clade for which it is being converted can be demonstrated based on information in that work—e.g., a list of subordinate taxa that are broadly consistent with, though not necessarily identical to, the composition of that clade, a description including diagnostic characters that we now understand to be synapomorphies of that clade, or statements and diagrams about phylogenetic relationships. When composition is used to assess the prior application of a name, the historical inclusion of taxa that are no longer considered to belong to the clade in question, or the historical exclusion of taxa that are now considered to belong to this clade, does not necessarily disqualify it as a preexisting name for the clade, provided that its application to that clade approximates traditional use to the degree that it is consistent with the contemporary concept of monophyly.

Example 1. Olmstead and Judd (20xx) applied the preexisting name *Lamianae* to the least inclusive clade containing *Gentianales*, *Solanales*, *Lamiales*, *Boraginaceae*, and *Vahliaceae*. The name *Lamianae* was first used by Takhtajan (1967), who applied it to a taxon that included *Gentianales*, *Solanales*, *Lamiales*, and *Boraginaceae* (though in some cases under different names) as well as some smaller taxa (e.g., *Dipsacales*, *Polemoniaceae*) that render his *Lamianae* polyphyletic in the context of currently accepted phylogenies. Takhtajan's inclusion of these taxa that are now considered to lie well outside the clade in question, and his omission of *Vahliaceae*, which is now thought to be part of that clade, do not disqualify *Lamianae* as a preexisting name for that clade.

Recommendation 9.8A. If possible, the bibliographic citation demonstrating authorship of the preexisting name should refer to the original publication of the name, spelled the same way as when converted and regardless of the rank and composition originally associated with the name (provided it is not a homonym; see Note 9.8A.1). If the original publication of the name cannot be determined, the earliest publication that can be found in which the name is valid (*ICBN*, *ICNB*) or available (*ICZN*) may be cited. If the publication cited is likely not to be the one in which the name was originally published, it should be explicitly stated that the author cited is likely not to be the nominal author (see Art. 19.1) of the name. Under certain conditions (see

Notes 9.8A.2 and 9.8A.3), a differently spelled name may be cited. If a citation is for a different spelling than the one adopted in the converted name, the difference in the spelling of the name should be explicitly stated.

Note 9.8A.1. In order for two uses of identically spelled preexisting names to be considered the same name rather than homonyms (under a rank-based code), one use must have been derived from the other or both derived from a third use of the name. If later uses of a name are not accompanied by a reference to an earlier use, absence of any overlap in the compositions associated with identically spelled names can be taken as evidence that they are homonyms (Example 1). However, even if there is some overlap, evidence in the protologues may still indicate that the names are homonyms (Example 2).

Example 1. If the name *Pholidota* is to be established for a clade of mammals including the pangolins, Weber (1904) should be cited as the author of this name, even though an identically spelled name was published earlier by Merrem (1820). Merrem's (1820) *Pholidota* is considered a homonym, as it was used to refer to a non-overlapping group of organisms later known as *Reptilia*.

Example 2. If the name *Angiospermae* is to be established for the clade comprising the crown clade of flowering plants (or for the clade comprising all flowering plants), Lindley (1830) should be cited as the author of this name, even though an identically spelled name was published earlier by Crantz (1769). Crantz's (1769) *Angiospermae* is considered a homonym even though it was used to refer to a subset of the taxon that Lindley named *Angiospermae*. Crantz's *Angiospermae* was restricted to 13 genera of flowering plants within the clade that is now known as *Lamiales*. Lindley did not refer to Crantz's use of the name, and it is clear that Crantz did not intend the name to refer to all flowering plants.

Note 9.8A.2. For cases in which a preexisting name is attributed to the author of a differently spelled name in the same rank group (e.g., the family group) following the Principle of Coordination of the *ICZN*, that author is not considered under this code to be the author of the preexisting name, nor should the publication of the differently spelled name be cited as an example of use of the preexisting name. The author of the preexisting name is the author of the name as spelled for the purpose of conversion, even if an earlier author who spelled the name differently is considered to be the author of the name under the Principle of Coordination of the *ICZN*, and "the earliest publication that can be found in which the name is valid (*ICBN*, *ICNB*) or available (*ICZN*)" (in Rec. 9.8A) refers only to the converted spelling. However, in such cases, if the earliest author to spell the name as converted is difficult to determine, the person who is considered to be the author of the name under the Principle of Coordination of the *ICZN* may be cited instead, provided that the difference in the spelling of the name is explicitly stated.

Example 1. Under the *ICZN* (1999: Art. 36), Bell is considered to be the author of the name *Iguaninae* because this name was automatically established through the Principle of Coordination when Bell (1825) published *Iguanidae*, even though the first published use of the name *Iguaninae* was by Cope (1886). In contrast, under this code, Cope is considered to be the author of *Iguaninae*. However, if the first author(s) to use the name *Iguaninae* could not be determined, the author could be cited as Bell (1825; as *Iguanidae*).



Note 9.8A.3. For cases in which a preexisting name is attributed to the author of a differently spelled name whose ending has been "corrected" under a rank-based code to the standard ending designated for the rank at which it was published, that author is not considered under this code to be the author of the preexisting name, nor should the publication of the differently spelled name be cited as an example of use of the preexisting name. The author of the preexisting name is the author of the name as spelled for the purpose of conversion, even if an earlier author who spelled the name differently is considered to be the author of the name under the applicable rank-based code, and "the earliest publication that can be found in which the name is valid (*ICBN*, *ICNB*) or available (*ICZN*)" (in Rec. 9.8A) refers only to the converted spelling. However, in such cases, if the earliest author to spell the name as converted is difficult to determine, the person who is considered to be the author of the name under the applicable rank-based code may be cited instead, provided that the difference in the spelling of the name is explicitly stated.

Example 1. Under the *ICBN* (Art. 16.3), Jussieu (1789) is considered to be the author of the name *Hypericaceae*, even though he spelled the name *Hyperica*. Under the *ICBN*, the name is to be attributed to Jussieu but its spelling is "corrected" to *Hypericaceae*. In contrast, under this code, the author of the name is not considered to be Jussieu, but rather Horaninow (1834) [see Hoogland and Reveal in *Bot. Rev.* 71: 114 (2005)], who was the first person to publish it with the spelling *Hypericaceae* and in a form that satisfies the other requirements of the *ICBN* (see Art. 6.2). However, if the first author to spell the name "*Hypericaceae*" could not be determined, the authorship could be cited as Jussieu (1789; as *Hyperica*).

9.9. In order for a bibliographic citation to be direct and unambiguous, it must include author(s) (see Art. 19), year, title, journal name (where applicable), editors (where applicable), title of the edited book (where applicable), page(s), and plate or figure reference (where applicable). The author(s)' and (where applicable) editor(s)' surname(s) must be cited in full, not abbreviated.

Note 9.9.1. If the protologue or subsequent use of the name to which a bibliographic citation refers is part of a publication with consecutive pagination, the page on which the protologue or subsequent use appears should be cited, as opposed to citing only the range of pages of the entire publication.

Recommendation 9.9A. To avoid confusion, the author(s)' given name(s) should also be cited, either as initials or, if the surname is particularly common, in full.

9.10. If the author of an apomorphy-based definition based on a complex apomorphy did not identify which aspect(s) of that apomorphy must be present in order for an organism to be considered to belong to the clade whose name is defined by that apomorphy (Rec. 9E), or if an aspect that the author did identify is later found to be a complex apomorphy itself, then subsequent authors are to interpret the definition as applying to the most inclusive clade diagnosed by the presence of all of the components of the complex apomorphy described by the author of the definition or present in the taxa or specimens that the author considered to possess that apomorphy.

Recommendation 9A. Establishment of clade names should be done with careful consideration of possible nomenclatural consequences if the phylogenetic hypothesis turns out to be incorrect. It may frequently be advisable to use only informal names for poorly supported clades.

Recommendation 9B. Conversion of preexisting names to clade names should only be done with a thorough knowledge of the group concerned, including its taxonomic and nomenclatural history and previously used diagnostic features. Wholesale conversion of preexisting names by authors who have not worked on the systematics of the group concerned is strongly discouraged.

Recommendation 9C. In order to facilitate the referral of species that are not specifiers of the clade name, the protologue should include a description, diagnosis, or list of synapomorphies.

Note 9C.1. A diagnosis or description is required for simultaneous valid publication (*ICBN*, *ICNB*) or availability (*ICZN*) of the name under the appropriate rank-based code.

Recommendation 9D. If an apomorphy-based definition is used, or if an apomorphy is cited in a qualifying clause, the apomorphy should be described or illustrated in sufficient detail that users of the definition will understand the author's intent.

Recommendation 9E. If an apomorphy-based definition is used, and if the apomorphy is a complex character that could have evolved in a stepwise fashion, then the author should identify which aspect(s) of that apomorphy must be present in order for an organism to be considered to belong to the clade whose name is defined by that apomorphy.

## Article 10. Selection of Clade Names for Establishment

10.1. Clade names are generally to be selected in such a way as to minimize disruption of current and/or historical usage (with regard to composition, diagnostic characters, or both) and to maximize continuity with existing literature. Therefore, except under the conditions described in Art. 10.2, a preexisting name that has been applied to a taxon approximating the clade to be named (see Note 9.8.2), or to a paraphyletic group originating with the same ancestor, must be selected. If there is a preexisting name for a paraphyletic group originating with the same ancestor as a particular clade and that name is much better known than any preexisting name for that clade, or if there is no preexisting name for that clade, the name of the paraphyletic group may be (but need not be) chosen.

Note 10.1.1. Art. 10.1 and Rec. 10.1A are not intended either to encourage or to discourage the application of preexisting names to crown, apomorphy-based or total clades. Because the associations of preexisting names with precisely identified clades commonly are ambiguous, reasonable arguments can often be made for applying a particular name to any one of several nested clades between crown and total (inclusive).

Recommendation 10.1A. If more than one preexisting name has been applied to a particular clade (including those applied to paraphyletic groups originating with the same ancestor), the name that is most widely and consistently used for it should generally be chosen, though a less widely used name may be chosen if it is a panclade name (see Note 10.3.1). Similarly, if a preexisting name has been applied to more than one clade, it should generally be established for the clade to which it has been most widely and consistently applied (but see Note 10.1.1). If the most widely and consistently used name is not selected for conversion, a rationale should be provided.

Note 10.1A.1. In selecting "the name that is most widely and consistently used," considerable discretion is left to the converting author. It is not necessary to choose a name that is slightly more widely used than its closest competitor. As a general guideline, if there is less than a twofold difference in the frequency of use of two or more names, the converting author may choose any of them without providing a compelling justification.

Recommendation 10.1B. The name that is more commonly used than any other name to refer to (e.g., discuss or describe) a particular crown clade should generally be defined as applying to that crown clade, even if the name is commonly considered to apply to a clade that includes extinct taxa outside of the crown. If there is a conflict between Recs. 10.1A and 10.1B, Rec. 10.1B should be given precedence. If the name that is more commonly used than any other name to refer to a crown clade is instead defined as applying to a more inclusive clade (e.g., an apomorphy-based or total clade) that contains that crown, a justification should be provided.

Note 10.1B.1. In older works and in works dealing only with extant organisms, names have sometimes been used as if they apply to particular crown clades, though it is unclear whether the author considered the name to apply to the crown or to a more inclusive clade (i.e., including some or all of the stem). In such cases, the name may be interpreted as applying to the crown for the purpose of this recommendation.

Example 1. If a publication stated that all members of clade X (e.g., *Mammalia*) exhibit a particular feature M (e.g., lactation), and this feature has only been observed in extant species, the name X would have been used in that publication as if it applied to the crown clade. Given this situation, name X could be interpreted as a candidate name for the crown.

10.2. A new name may be selected for a clade only under one of the following circumstances: (a) the clade has no preexisting name (but see Note 10.2.1); (b) the most widely used preexisting name for the clade has already been established for another clade or is best applied to another clade (see Recs. 10.1A and 10.1B), and there are no other preexisting names for the clade; (c) the most widely used preexisting name for the clade has a preexisting homonym that has already been established under this code (see Recs. 10D–F); (d) the group to be named is a total clade, in which case a panclade name (see Arts. 10.3–10.6) may be used instead of a preexisting name; (e) the group to be named is an apomorphy-based clade, and the name of the most inclusive crown clade exhibiting the apomorphy of concern refers etymologically to that apomorphy (see Arts. 10.7–10.8).

Note 10.2.1. In the absence of a preexisting name for a particular clade, the choice between a new name and a preexisting name for a paraphyletic group originating with the same ancestor as the clade is left to the discretion of the author.

10.3. If a new name (as opposed to a converted name) is to be established for a total clade by adding an affix to the name of the corresponding crown clade, the prefix *Pan-* must be used. The prefix is separated from the base name, which retains an initial capital letter, by a hyphen. Such names are called panclade names and may only be used to designate total clades.

Example 1. If *Testudines* is established as the name of a crown clade, the panclade name for the corresponding total clade is *Pan-Testudines*.

Note 10.3.1. Although most panclade names will be new, some panclade names may have been defined in a publication prior to the starting date of this code, and these qualify as preexisting names (see Note 6.2.1).

Recommendation 10.3A. Informal panclade names may be useful in referring to total clades that may or may not have formal (established) panclade names. In order to distinguish informal panclade names from formal panclade names, the informal names should not be capitalized or italicized (see Rec. 6.1A).

Example 1. The non-capitalized, non-italicized names pan-Rosidae and pan-rosids are informal panclade names for the total clade corresponding to the crown clade *Rosidae*.

10.4. A panclade name may only be formed from a base name that has a crown clade definition (i.e., a branch- or apomorphy-modified node-based definition or a standard node-based definition in which all of the specifiers are extant; see Note 9.3.1).

Example 1. If the names *Trilobita* and *Tyrannosaurus* were established as the names of non-crown clades, then the names *Pan-Trilobita* and *Pan-Tyrannosaurus* could not be established as clade names.

Recommendation 10.4A. Some converted clade names will necessarily begin with *Pan*, but the initial letters *Pan* should be avoided in new clade names that are not intended as panclade names to reduce the likelihood of confusion between panclade and non-panclade names.

10.5. The definition of a panclade name is branch-based and will take the form "the total clade composed of the crown clade [name of the crown clade] and all extinct organisms or species that share a more recent common ancestor with [name of the crown clade] than with any extant organisms or species that are not members of [name of crown clade]" or "the total clade of the crown clade [name of the crown clade]".

Example 1. The definition of *Pan-Testudines* is "the total clade composed of the crown clade *Testudines* and all extinct organisms or species that share a more recent common ancestor with *Testudines* than with any extant organisms or species that are not members of *Testudines*" or "the total clade of the crown clade *Testudines*."

Note 10.5.1. Equivalent to the abbreviations provided in Note 9.3.1 for other kinds of definitions, the definition of a panclade name may be abbreviated "total (X)", where X is the name of a crown clade.

Example 1. The abbreviated form of the definition in Art. 10.5, Example 1 is "total (*Testudines*)".

Note 10.5.2. This format for the definitions of panclade names differs from the other recommended definition formats (see Note 9.3.1) in not listing any specifiers, which are implicit. The internal specifiers of the panclade name are those of the crown clade name on which the panclade name is based. The external specifiers of the panclade name are all extant species or organisms that are not members of the crown clade on whose name the panclade name is based.

Note 10.5.3. Extinction of crown clades after establishment of a panclade name does not affect the composition of the clade to which the panclade name refers. A crown clade that is extant at the time of establishment of a panclade name is forever treated nomenclaturally as though it were still extant. This treatment applies both to the crown clade that provides the base name for the panclade name and to other crown clades whose members are implicit external specifiers (see Note 10.5.2).

10.6. If there is a preexisting name that has been applied to a particular total clade, that name may be converted or a panclade name may be established instead.

10.7. If the name of a crown clade refers etymologically to an apomorphy, and a new name (as opposed to a converted name) is to be established for the clade originating with that apomorphy by adding an affix to the name of the crown clade, the prefix *Apo-* must be used. The prefix is separated from the base name, which retains an initial capital letter, by a hyphen.

Example 1. If *Spermatophyta* (meaning "seed plants") were established as the name of a crown clade, the name *Apo-Spermatophyta* would refer to the most inclusive clade exhibiting the apomorphy "seeds."

Note 10.7.1. Although most names that take the form described in Art. 10.7 will be new, some such names may have been defined in a publication prior to the starting date of this code, and these qualify as preexisting names (see Note 6.2.1).

10.8. If there is a preexisting name that has been applied to a particular apomorphy-based clade, and the name of the most inclusive crown clade exhibiting the apomorphy of concern refers etymologically to that apomorphy, the preexisting name may be converted or a name formed in accordance with Art. 10.7 may be established instead.

10.9. A clade name may not be converted from a preexisting specific or infraspecific epithet (*ICBN* and *ICNB*) or from a name in the species group (*ICZN*). However, a clade name may be converted from a supraspecific name that is spelled identically to a specific or infraspecific epithet or name.

Example 1. A clade cannot take the name *Paradoxa* if the name was converted from the specific epithet in *Oenothera paradoxa* Hudziok 1968; however, a clade can take the name *Paradoxa* if the name was converted from the genus name *Paradoxa* Mattiolo 1935.

Recommendation 10A. In selecting new clade names, an effort should be made to avoid any name that, under a rank-based code, applies to a non-overlapping (mutually exclusive) group.

Recommendation 10B. In selecting new clade names, an effort should be made to avoid names that are so similar to names that were previously established under this code that they are likely to be confused.

Recommendation 10C. In selecting new clade names an effort should be made to avoid names that have misleading connotations.

Recommendation 10D. In rank-based nomenclature, there are many examples of identically spelled names being applied to different taxa under different codes (cross-code homonyms). Only one member of each set of cross-code homonyms is, after conversion, an acceptable name under this code (Art. 13.3). If the preexisting name that has been most widely used for a particular clade cannot be converted because an identically spelled name has already been converted and established for a different clade, another preexisting name that has been widely and recently applied to the clade concerned (or to a paraphyletic group originating with the same ancestor) may be selected. On the other hand, continuity with existing literature and consistency with rank-based nomenclature are not well served by resurrecting old and little-known names. Therefore, if there is no other name that has been widely applied to the clade in the recent past, a new name should be selected that consists of the most widely used preexisting name with a taxon-related prefix added, such as *Phyto-* for plants, *Phyco-* for "algae" excluding cyanobacteria, and *Myc-* for fungi (three groups of organisms whose names are governed by the *ICBN*), *Zoo-* for animals and other organisms whose names are governed by the *ICZN*, and *Monero-* for organisms whose names are governed by the *ICNB* and cyanobacteria (governed by the *ICBN*). If there is another preexisting name that has been widely applied to the clade in the recent past, the choice between converting this name and establishing a new name with a taxon-related prefix is left to the discretion of the author.

Example 1. Under rank-based nomenclature, the name *Prunella* applies to a genus of birds (*ICZN*) and to a genus of angiosperms (*ICBN*). If this name were to be established under this code for a clade of birds, the name selected for the clade corresponding in composition to the plant genus *Prunella* (provided that there is no other preexisting name that has been widely and recently applied to this clade) would be *Phyto-Prunella*.

Recommendation 10E. In rank-based nomenclature, previously undiscovered homonymy occasionally occurs within a single rank-based code, although only one of the homonyms can be legitimate (*ICBN*, *ICNB*) or potentially valid (*ICZN*) once the homonymy is discovered. Only one member of each set of homonyms is, after conversion, an acceptable name under this code (Art. 13.3). Once a case of homonymy within a rank-based code is discovered, it is generally rectified by replacing the junior homonym with an already existing synonym or a new replacement name. However, if a user of this code is the first to discover a case of homonymy within one of the rank-based codes, the names should be defined in a manner that is consistent with the way in which they will likely be applied under the rank-based code when the situation is rectified. Specifically, the homonym that will likely have precedence under the rank-based code (i.e., generally the one that was published earlier) should be the one that is converted under this code. For the other homonym, the synonym (if one exists) that will likely be applied to this taxon under the rank-based code should be converted, provided that this synonym qualifies as a preexisting name for the clade of concern (see Art. 9.8).

Note 10E.1. In the situation described in Rec. 10E, it is not necessary that an author who converts one homonym (or its synonym) also convert the other one (or its synonym).

Recommendation 10F. Under rank-based nomenclature, the name (or epithet; see below) of a subdivision of a genus that contains the type species must be the same as that of the genus. Only one member of each such pair of names is, after conversion, an acceptable name under this code (Art. 13.3). Furthermore, under the *ICBN*, names of subdivisions of genera (e.g., subgenera, sections, series) consist of a generic name combined with a subdivisional epithet. These epithets, like specific epithets, are not necessarily unique; the same epithet may be combined with the names of different genera without creating homonyms. Only one member of each set of identically spelled subdivisional epithets is, after conversion, an acceptable name under this code (Art. 13.3). If the preexisting subdivisional name (*ICZN*, *ICNB*) or epithet (*ICBN*) that has been most widely used for a particular clade cannot be converted because an identically spelled name has already been converted and established for a different clade, another preexisting name or epithet that has been widely and recently applied to the clade concerned (or to a paraphyletic group originating with the same ancestor) may be selected. On the other hand, continuity with existing literature and consistency with rank-based nomenclature are not well served by resurrecting old and little-known names. Therefore, if there is no other name or epithet that has been widely applied to the clade in the recent past, a new name should be selected that consists of the most widely used preexisting name or epithet, preceded by the name of the genus in rank-based nomenclature, with both words capitalized and connected by a hyphen. If there is another preexisting name or epithet that has been widely applied to the clade in the recent past, the choice between converting this name or epithet and establishing a new name that combines the preexisting genus name and subdivisional name or epithet is left to the discretion of the author.

Example 1. If one were selecting a name for the plant clade corresponding in composition to *Arenaria* sect. *Parviflorae* McNeill, and if the subdivisional epithet *Parviflorae* could not be converted because a clade name *Parviflorae*, based on *Dracula* ser. *Parviflorae* Luer, had already been established under this code, the name that should be selected is *Arenaria-Parviflorae* (provided that there is no other preexisting name that has been widely and recently applied to this clade).

Note 10F1.1. This is a hypothetical example in that these subdivisions of genera may not correspond to clades.

Example 2. If one were selecting a name for the animal clade corresponding in composition to the subgenus *Crotaphytus* of the genus *Crotaphytus* Holbrook, and if the name *Crotaphytus* could not be converted for that clade because that name had already been established under this code for a clade corresponding in composition with the genus, the name that should be selected is *Crotaphytus-Crotaphytus* (provided that there is no other preexisting name that has been widely and recently applied to this clade).

Recommendation 10G. When establishing a name for a crown clade that, under rank-based nomenclature, corresponds to a monogeneric "higher" taxon, the genus name should be converted for that clade rather than any of the suprageneric names that have been applied to it. Doing so will permit the use of the "higher" taxon names for more inclusive clades that extend beyond the crown.

Example 1. In rank-based nomenclature, the names *Equisetophyta*, *Equisetopsida*, *Equisetales*, *Equisetaceae*, and *Equisetum* have all been used to refer to the same crown clade, which is widely understood to include only the genus *Equisetum*. (Most of these names have also been used to refer to more inclusive clades that contain extinct species outside the crown.) When selecting a name to convert for the crown clade, *Equisetum* should be chosen. The names *Equisetaceae*, *Equisetales*, etc. are better applied to clades that are more inclusive than the crown.

## Article 11. Specifiers and Qualifying Clauses

11.1. Specifiers are species, specimens, or apomorphies cited in a phylogenetic definition of a name as reference points that serve to specify the clade to which the name applies. All specifiers used in node-based and branch-based definitions of clade names, and one of the specifiers used in apomorphy-based definitions of clade names, are species or specimens. The other specifier used in an apomorphy-based definition of a clade name is an apomorphy.

Note 11.1.1. When a species is cited as a specifier, the implicit specifier is the type of that species name (if a type has been designated) under the appropriate rank-based code. Therefore, whichever currently accepted species includes the type specimen of the species name cited in the definition is the specifier. If the species name originally cited as a specifier is no longer accepted, either because the species has been recircumscribed or assigned to a different genus under rank-based nomenclature, then the species name with which it has been synonymized automatically becomes the name of the specifier species. However, the type of the name originally used as a specifier, rather than that of the currently accepted species name, remains the implicit specifier. If the type of a specifier species name changes under the rank-based code, the implicit specifier changes accordingly. A species may be used as a specifier even if it lacks a type.



Note 11.1.2. Although subordinate clades cannot be specifiers, they may be cited in a phylogenetic definition of the name of a more inclusive clade to clarify the phylogenetic position of a specifier.

Example 1. Aves could be defined as "the crown clade originating with the most recent common ancestor of *Struthio camelus* Linnaeus 1758 (*Ratitae*), *Tinamus major* Gmelin 1789 (*Tinamidae*), and *Vultur gryphus* Linnaeus 1758 (*Neognathae*)." Alternatively, the definition could be worded "the crown clade originating with the most recent common ancestor of *Ratitae* (*Struthio camelus* Linnaeus 1758), *Tinamidae* (*Tinamus major* Gmelin 1789), and *Neognathae* (*Vultur gryphus* Linnaeus 1758)." In both definitions, *Ratitae*, *Tinamidae* and *Neognathae* are not specifiers; they simply provide additional information about the phylogenetic position of the true specifiers.

11.2. An internal specifier is a species, specimen or apomorphy that is explicitly included in the clade whose name is being defined; an external specifier is a species or specimen that is explicitly excluded from it. All specifiers in apomorphy-based, standard node-based and apomorphy-modified node-based definitions are internal, but branch-based and branch-modified node-based definitions always have at least one specifier of each type.

11.3. When a species is used as a specifier, the author and publication year of the species name must be cited.

Note 11.3.1. Names of species used as specifiers are governed by the rank-based codes (e.g., *ICBN*, *ICZN*); see Art. 21.

Note 11.3.2. The *ICBN* and *ICZN* differ in their conventions for citing authorship and publication year when the author of the currently accepted binominal combination differs from the author of the epithet (i.e., the author of the original combination). Because the purpose of citing authorship and year is to identify the specifiers unambiguously, the conventions used by the appropriate rank-based code should be used for species names governed by that code.

11.4. When a type specimen is used as a specifier, the species name that it typifies and the author and publication year of that species name must be cited.

Recommendation 11.4A. The use of specimens that are not types as specifiers is strongly discouraged. This should be done only under the following two circumstances: 1) if the specimen that one would like to use as a specifier cannot be referred to a named species, so that there is no type specimen that could be used instead; or 2) if the clade to be named is within a species.

Recommendation 11.4B. If a specimen that is not a type is used as a specifier in the first situation described in Rec. 11.4A, and a species that includes this specimen is subsequently named under the appropriate rank-based code, this specimen should be chosen as the type of the species name.

11.5. When a specimen that is not a type is used as a specifier in a phylogenetic definition, the institution or collection in which the specifier is conserved must be identified, as well as the collection number or other information needed to establish the identity of the specimen.

11.6. When a specimen that is not a type is used as a specifier in a phylogenetic definition, a brief description of the specimen must be provided, sufficient to convey a mental image and distinguish the specimen from organisms with which it might be confused.

11.7. In the interest of consistency with the rank-based codes, it would be desirable for a clade whose name is converted from a typified name under a rank-based code, or is derived from the stem of such a name, to include the type of that name. Therefore, when a clade name is converted from a preexisting typified name or is a new or converted name derived from the stem of a typified name, the definition of the clade name must use the type species of that preexisting typified name or of the genus name from which it is derived (or the type specimen of that species) as an internal specifier.

Example 1. If the preexisting name *Magnoliales*, which is based on the genus name *Magnolia*, is converted to a clade name, its definition must use the type species of *Magnolia* or its type specimen as an internal specifier.

Example 2. If *Ajugina*, which is not a preexisting name but is based on the preexisting genus name *Ajuga*, is adopted as the name of a clade, the definition of *Ajugina* must use the type species of *Ajuga* or its type specimen as an internal specifier.

Example 3. If the preexisting subgenus name *Calosphace* is converted to a clade name, the definition of *Calosphace* must use the type species of subgenus *Calosphace* or its type specimen as an internal specifier.

Recommendation 11.7A. If it is questionable whether a type species of a preexisting name is part of the clade to be named, then the type species should not be used as a specifier (see Rec. 11B), and neither that preexisting name nor a name derived from the stem of that name should be defined as referring to that clade.

Example 1. If it is questionable whether the type species of *Magnolia* belongs to a clade that is to be named, this species should not be used as a specifier, and the clade should not be named *Magnolia*, *Magnoliales* or any other name based on the stem of the name *Magnolia*.

Note 11.7A.1. Failure to include the type species of a preexisting name in an analysis is not, in itself, reason to invoke Rec. 11.7A. There may be evidence suggesting that another species that was included in the analysis shares a recent common ancestor with the type.

Recommendation 11.7B. If it is questionable whether the type specimen of a preexisting name belongs to the clade to be named (e.g., because of the fragmentary nature of the specimen), then that preexisting name (or its type) should not be used as a specifier (see Rec. 11C), and the corresponding name should not be converted to a clade name.

Example 1. Under the *ICBN*, the names *Cordaites*, *Cordaixylon*, and *Mesoxylon* refer to genera of extinct seed plants. The types of the latter two names are fossil stems, but it has been possible to reconstruct whole plants that belonged to each genus. The oldest of the three names, *Cordaites*, is typified by fossil leaf material that could have been produced by a member of either *Cordaixylon* or *Mesoxylon*. If a clade is named that includes plants with *Cordaixylon*-type stems but not *Mesoxylon*-type stems, the type species of *Cordaites* should not be cited as a specifier because its type specimen may not belong to this clade, and the clade should not be named *Cordaites*.

11.8. In order for the reference phylogeny to be useful, either the specifiers used in the phylogenetic definition must be included in the reference phylogeny (see Art. 9.6) or the protologue must include a statement indicating how the specifiers are related to the taxa that are included in the reference phylogeny.

Note 11.8.1. An acceptable mechanism for indicating how the specifiers are related to the taxa in the reference phylogeny is to cite a taxon name that is labeled on the reference phylogeny parenthetically after the name of the specifier in the definition.

Note 11.8.2. If a clade name is converted from a typified name under a rank-based code, or is derived from the stem of such a name, and the type of that name is not included in the reference phylogeny, the type must still be used as an internal specifier (see Art. 11.7), and its relationship to taxa included in the reference phylogeny must be stated in the protologue.

11.9. In order to restrict the application of a name with respect to clade composition (i.e., under alternative hypotheses of relationship), phylogenetic definitions may include qualifying clauses specifying conditions under which the name cannot be applied to any clade (see Example 1). It is also possible to restrict clade composition under alternative hypotheses of relationship through careful wording of definitions (see Examples 2 and 3).

Example 1. The name *Pinnipedia* is traditionally applied to a group composed of sea lions (*Otariidae*), walruses (*Odobenidae*), and seals (*Phocidae*). However, under some phylogenetic hypotheses, the sister group of one or more of these taxa is a group of terrestrial carnivorans. If the name *Pinnipedia* is defined as "the clade originating with the most recent common ancestor of *Otaria byronia* de Blainville 1820, *Odobenus rosmarus* Linnaeus 1758, and *Phoca vitulina* Linnaeus 1758, provided that it possessed flippers homologous with those in the aforementioned species," then the name would not be applicable to any clade in the context of phylogenetic hypotheses in which the most recent common ancestor of these species was inferred not to have had flippers. The phrase "provided that it possessed flippers homologous with those in the aforementioned species" is a qualifying clause. (However, the apomorphy "flippers" should be illustrated or described because it is a complex apomorphy (see Recs. 9D, 9E).)

Example 2. Suppose the name *Lepidosauriformes* were defined as referring to the most inclusive clade containing *Lacerta agilis* Linnaeus 1758 but not *Youngina capensis* Broom 1914 (Fig. 1).

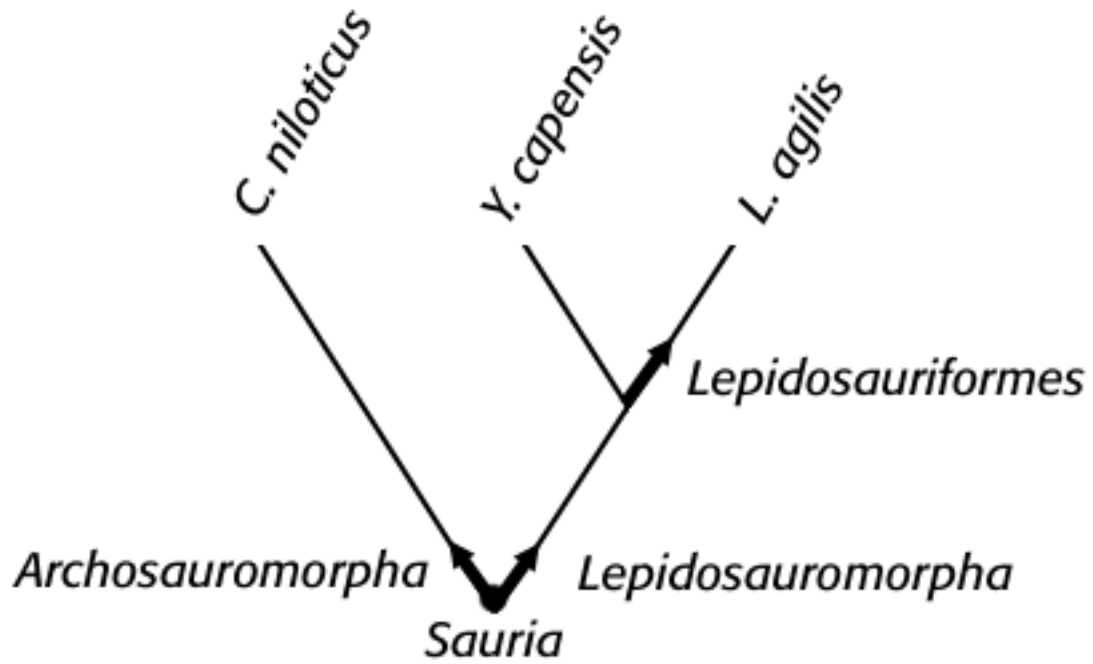


Figure 1

Further suppose that all three of these taxa were considered to be included within the larger clade *Lepidosauromorpha* (Clade (*Lacerta agilis* not *Crocodylus niloticus* Laurenti 1768)), which was considered the sister group of the clade named *Archosauromorpha* (Clade (*Crocodylus niloticus* not *Lacerta agilis*)). If *Youngina capensis* turned out to be outside of the clade originating with the most recent common ancestor of *Lacerta agilis* and *Crocodylus niloticus* (a node-based clade named *Sauria*), then the name *Lepidosauriformes* would refer to a clade more inclusive than the clade named *Lepidosauromorpha*, reversing the former hierarchical relationships of the names (Fig. 2).

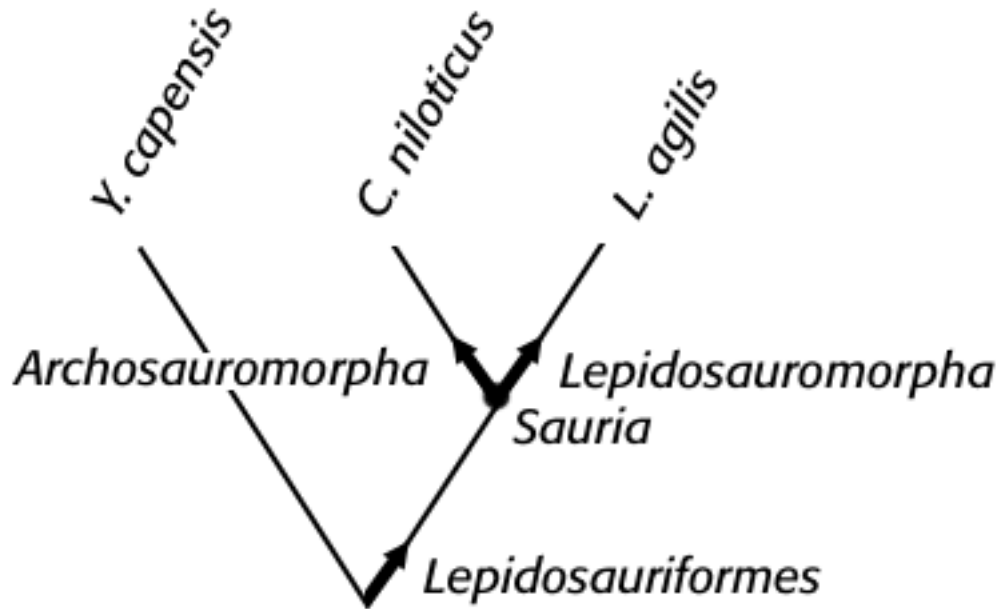


Figure 2

In order to prevent these names from reversing their hierarchical relationships, the name *Lepidosauriformes* could be defined as "the most inclusive subclade of *Sauria* (Clade (*Lacerta agilis* and *Crocodylus niloticus*)) containing *Lacerta agilis* but not *Youngina capensis*," in which case *Lepidosauriformes* would become a synonym of *Lepidosauromorpha* (rather than the name of a more inclusive clade) in the context of the new phylogenetic hypothesis (Fig. 3).

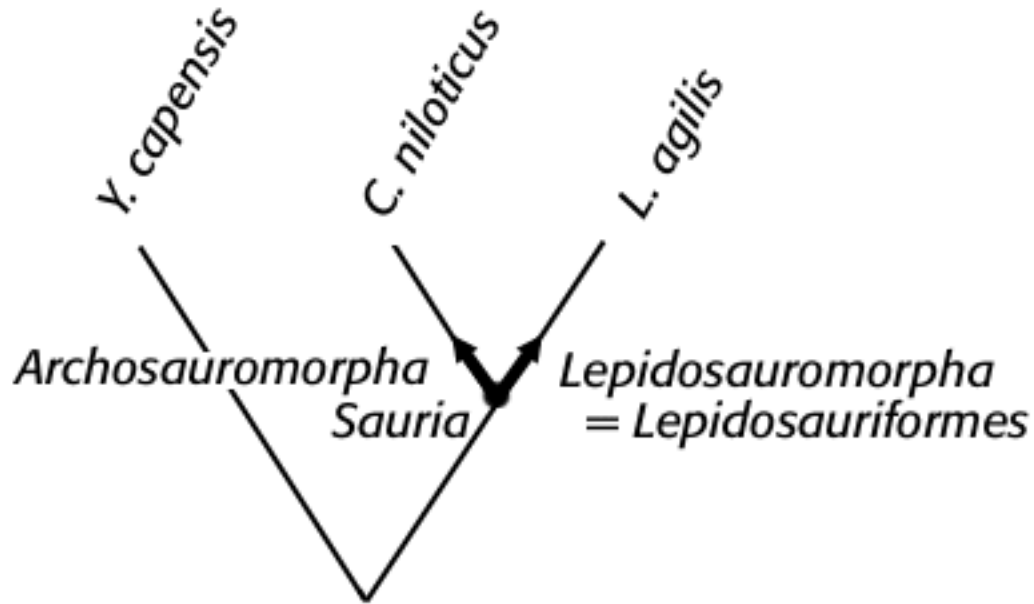


Figure 3

The first definition leaves the application of the name *Lepidosauriformes* unrestricted; the second definition restricts its application to a subclade of *Sauria*. However, the same restriction can be achieved by defining *Lepidosauriformes* as the most inclusive clade containing *Lacerta agilis* but not *Youngina capensis* or *Crocodylus niloticus*.

Example 3. If a name is defined through a branch-based definition with more than one internal specifier, and one internal specifier is later found to share a more recent common ancestor with the external specifier than with the other internal specifier, the definition does not apply to any clade. For example, suppose the name *Halecostomi* had been defined as referring to the most inclusive clade containing *Amia calva* Linnaeus 1766 and *Perca fluviatilis* Linnaeus 1758 but not *Lepisosteus osseus* Linnaeus 1758. And suppose that subsequent analyses indicated that *Lepisosteus osseus* and *Perca fluviatilis* share a more recent common ancestor with one another than either does with *Amia calva*. If so, then there is no clade that fits the definition of *Halecostomi* (because there is no clade that includes both *Amia calva* and *Perca fluviatilis* but not *Lepisosteus osseus*), and that name cannot be used in the context of the accepted phylogeny.

11.10. Provided that a clade name is acceptable, it remains eligible for use even if there is no clade that fits its definition under a subsequently proposed phylogenetic hypothesis. The name would not be used in the context of that hypothesis, but it would remain eligible for future use under any hypotheses in which there is a clade that fits its definition.

Example 1. Although the name *Pinnipedia* is inapplicable under certain phylogenetic hypotheses if the qualifying clause in Art. 11.9, Example 1 is used, the name remains eligible for use under other hypotheses.

Recommendation 11A. Definitions of converted clade names should be stated in a way that attempts to capture the spirit of traditional use to the degree that it is consistent with the contemporary concept of monophyly. Consequently, they should not necessitate, though they may allow, the inclusion of subtaxa that have traditionally been excluded from the taxon, as well as the exclusion of subtaxa that have traditionally been included in the taxon. To accomplish this goal, internal specifiers of converted clade names should be chosen from among the set of taxa that have been considered to form part of a taxon under traditional ideas about the composition of that taxon, and they should not include members of subtaxa that have traditionally been considered not to be part of the taxon.

Example 1. The name *Dinosauria* was coined by Owen for the taxa *Megalosaurus*, *Iguanodon*, and *Hylaeosaurus*, and traditionally the taxon designated by that name has included these and certain other non-volant reptiles. It has not traditionally included birds. Although birds are now considered part of the dinosaur clade, the name *Dinosauria* should not be defined using any bird species as internal specifiers. Such a definition would force birds to be dinosaurs, thus trivializing the question of whether birds are dinosaurs. Instead, internal specifiers should be chosen from among taxa that have traditionally been considered dinosaurs; e.g., *Megalosaurus bucklandii* Mantell 1827, *Iguanodon bernissartensis* Boulenger in Beneden 1881, and *Hylaeosaurus armatus* Mantell 1833.

Note 11A.1. Traditional use may refer to early or recent traditions. Because it is not always possible to be faithful to all traditions simultaneously, which tradition is most important to maintain is left to the discretion of the author of the converted name.

Recommendation 11B. If there is reason to question that a species is a member of a particular clade, that species should not be used as a specifier in the definition of the name of that clade.

Recommendation 11C. It follows from Rec. 11B that phylogenetic definitions of clade names should not use as specifiers species whose type specimens are ambiguous (e.g., because they are lost or fragmentary). Because they are commonly based on ambiguous types, ichnotaxa (taxa based on the fossilized work of organisms, including fossilized trails, tracks, and burrows; *ICZN* [1999] glossary, Art. 1.2.1), ootaxa (taxa based on fossilized eggs), and morphotaxa (fossil taxa that, for nomenclatural purposes, comprise only the parts, life history stages, or preservational states represented by the corresponding nomenclatural types; *ICBN* [2006] Art. 1.2) should not be used as specifiers. When this recommendation is combined with Art. 11.7, it follows that clade names should not be based on the names of ichnotaxa, ootaxa, or morphotaxa.

Recommendation 11D. In a node-based definition, it is best to use a set of internal specifiers that includes representatives of all subclades that credible evidence suggests may be basal within the clade being named, unless doing so would be contrary to Rec. 11A and/or 11B. Constructing a node-based definition in this way will reduce the chance that, under a new phylogenetic hypothesis, the name will refer to a less inclusive clade than originally intended.

Recommendation 11E. In a branch-based definition, it is best to use a set of external specifiers that includes representatives of all clades that credible evidence suggests may be the sister group of the clade being named. Constructing a branch-based definition in this way will reduce the chance that, under a new phylogenetic hypothesis, the name will refer to a more inclusive clade than originally intended.

Recommendation 11F. If it is important to establish two names as applying to sister clades regardless of the phylogeny, reciprocal branch-based definitions should be used in which the single internal specifier of one is the single external specifier of the other, and vice versa. To establish a name as applying to the larger clade composed of those two sister-clades, the name of the former should be given a node-based definition using the same two internal specifiers (Example 1). A similar approach may be used to establish two names as referring to crown clades that are each other's closest extant relatives by using reciprocal branch-modified node-based definitions (Example 2).

Example 1: If one wishes to define the names *Saurischia* and *Ornithischia* such that they will always refer to sister clades, *Saurischia* might be defined as the most inclusive clade containing *Megalosaurus bucklandii* von Meyer 1832 but not *Iguanodon bernissartensis* Boulenger in Beneden 1881, and *Ornithischia* would be defined as the most inclusive clade containing *Iguanodon bernissartensis* but not *Megalosaurus bucklandii*. To stabilize the name *Dinosauria* as referring to the clade comprising *Saurischia* and *Ornithischia*, *Dinosauria* should be defined as the least inclusive clade containing *Megalosaurus bucklandii* and *Iguanodon bernissartensis*.

Example 2: If one wishes to define the names *Lamioideae* and *Scutellarioideae* such that they will always refer to crown clades that are each other's closest extant relatives, *Lamioideae* might be defined as the most inclusive crown clade containing *Lamium purpureum* L. 1753 but not *Scutellaria galericulata* L. 1753, and *Scutellarioideae* would be defined as the most inclusive crown clade containing *Scutellaria galericulata* but not *Lamium purpureum*.

Recommendation 11G. Clade names created by adding certain prefixes or suffixes to another clade name (the base name) should be defined in a manner consistent with the hierarchical relationships implied by the prefix or suffix and the phylogenetic definition of the base name (if established), unless doing so would be inconsistent with the predominant current use of a preexisting name.



Example 1. If preexisting names *Parahebe* and *Hebe* are converted, the internal specifiers of each name should not include any member of the other clade, but this alone will not ensure the mutual exclusivity implied by the name *Parahebe*. Mutual exclusivity can be ensured by using the type of each name as an external specifier for the other name, or by including a qualifying clause making the name *Parahebe* inapplicable in the context of any phylogeny in which the two clades are not mutually exclusive. However, neither of these approaches should be taken if the accepted usage (at the time when the definition is prepared) treats *Hebe* and *Parahebe* as nested.

Note 11G.1. The following prefixes and suffixes imply greater inclusiveness than the base name: *Holo-*, *Pan-*, *-formes*, *-morpha*. The following prefixes imply lesser inclusiveness than the base name: *Eo-*, *Eu-*, *Neo-*, *Proto-*. The following prefixes imply mutual exclusivity with the base name: *Pseudo-*, *Para-*. These are not intended to be exhaustive lists.

## Chapter V. Selection of Accepted Names

### 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 Art. 15.

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).

## Article 13. Homonymy

13.1. Homonyms are names that are spelled identically but refer to different taxa. In this code, all homonyms are established and identically spelled clade names based on different phylogenetic definitions. However, not all identically spelled clade names based on different phylogenetic definitions are necessarily homonyms because different definitions may refer to the same clade under some phylogenetic hypotheses but not under others.

Example 1. Suppose that Pedersen defined *Lamiaceae* as the name of the least inclusive clade containing *Lamium purpureum* Linnaeus 1753 and *Congea tomentosa* Roxburgh 1819, and Ramírez defined *Lamiaceae* as the name of the least inclusive clade containing *Lamium purpureum* Linnaeus 1753 and *Symphorema involucratum* Roxburgh 1798. If so, these two definitions would refer to the same clade in the context of any phylogeny in which *Congea tomentosa* and *Symphorema involucratum* share a more recent common ancestor with each other than either does with *Lamium purpureum*, but not if *Congea tomentosa* shares a more recent common ancestor with *Lamium purpureum* than it does with *Symphorema involucratum*.

13.2. Phylogenetic definitions are considered to be different if either: 1) they are of the same kind (e.g., node-based, branch-based, etc.) but cite different specifiers and/or have different restrictions specified in their qualifying clauses (if any), or 2) they are of a different kind.

Note 13.2.1. Alternative wordings of node-based definitions such as those provided in Note 9.3.1 are not considered to be different, provided they are based on the same specifiers and have the same restrictions. The same is true of alternative wordings of branch-based definitions (e.g., those in Note 9.3.1), apomorphy-based definitions, branch-modified node-based definitions, apomorphy-modified node-based definitions, and other types of phylogenetic definitions that are not explicitly mentioned in this code.

Note 13.2.2. A species and its type specimen are considered to be the same specifier (see Note 11.1.1).

Note 13.2.3. Homonyms result when an author establishes a name that is spelled identically to, but defined differently than, an earlier established name. This situation can occur either when an author is unaware of the earlier establishment of an identically spelled but differently defined name (Example 1) or when an author knowingly adopts an earlier established name but proposes, either deliberately or inadvertently, a different definition for that name (Example 2). Although names in the second scenario can be considered the same name in the sense that one use is derived from the other (see Note 9.8A.1), the identically spelled names in both scenarios are treated as homonyms under this code because they have different definitions.

Example 1. If Mukherjee defined *Prunella* as the name of the least inclusive clade containing *Prunella modularis* Linnaeus 1758 and *Prunella collaris* Scopoli 1769 (which are birds), and Larsen defined *Prunella* as the name of the least inclusive clade containing *Prunella laciniata* Linnaeus 1763, *Prunella grandiflora* Scholler 1775, *Prunella vulgaris* Linnaeus 1753, and *Prunella hyssopifolia* Linnaeus 1753 (which are plants), *Prunella* of Mukherjee and *Prunella* of Larsen would be homonyms.

Example 2. Gauthier et al. (1988) defined the name *Lepidosauromorpha* as referring to the clade composed of *Lepidosauria* and all organisms sharing a more recent common ancestor with *Lepidosauria* than with *Archosauria* (a branch-based definition). Laurin (1991) defined the name *Lepidosauromorpha* as referring to the clade originating with the most recent common ancestor of *Palaeagama*, *Saurosternon*, *Paliguana*, *Kuehneosaurus*, and *Lepidosauria* (a node-based definition). If this code had been in effect when these names were published, *Lepidosauromorpha* of Gauthier et al. and *Lepidosauromorpha* of Laurin would have been homonyms.

13.3. If two or more definitions have been established for identically spelled names, the only acceptable name (i.e., the combination of name and definition; see Note 12.1.1) is the first one established under this code. A later homonym, unless conserved, is not an acceptable name of any taxon.

13.4. When two or more homonyms have the same publication date (Art. 5), the one that was registered first (and therefore has the lowest registration number) takes precedence.

13.5. If the oldest name of a taxon is not acceptable because it is a later homonym, it is to be replaced by the established name that has precedence. If all established names that apply to the taxon are not acceptable because they are later homonyms, a replacement name may be explicitly substituted for the earliest-established name that applies to the taxon. A replacement name must be established, following the procedures in Art. 7, Art. 13.6, and Art. 13.7. The definition of a replacement name for a clade is the definition of the name it replaces.

13.6. In order to be established, a replacement name must be clearly identified as such in the protologue where the replacement is published, by the designation "replacement name" or "*nomen substitutum*."

13.7. In order for a replacement name to be established, the replaced name on which it is based must be clearly indicated by a direct and unambiguous bibliographic citation (see Art. 9.9) that includes its author, date, and the journal or book in which the name was originally published. The registration number of the replaced name must also be cited.

## Article 14. Synonymy

14.1. Synonyms are names that are spelled differently but refer to the same taxon. In this code, synonyms must be established and may be homodefinitive (based on the same definition) or heterodefinitive (based on different definitions). The criteria for determining whether definitions are different are described in Art. 13.2, including Notes 13.2.1–13.2.3.

Note 14.1.1. Homodefinitive synonyms are synonyms regardless of the phylogenetic context in which the names are applied. However, in the case of names with different definitions, the phylogenetic context determines whether the names are heterodefinitive synonyms or not synonymous.

Example 1. Suppose that *Hypothetica* were defined as the least inclusive clade containing species A and B, and *Cladia* were defined as the least inclusive clade containing species C and B. In the context of any hypothesized phylogeny in which A shares a more recent common ancestor with C than either does with B, *Hypothetica* and *Cladia* would be heterodefinitive synonyms. However, in the context of an alternative hypothesis that A and B are more closely related to each other than either is to C, *Hypothetica* and *Cladia* would not be synonymous.

Note 14.1.2. Node-based, apomorphy-based, and branch-based definitions (Note 9.3.1) usually designate different clades, although they may be nested clades that differ only slightly in inclusiveness. Therefore names based on two or more of these different kinds of definitions usually are not synonyms. (In theory, it is possible for different types of definitions to designate the same clade. For example, in cases in which doubling of the chromosomes (autopolyploidy) causes speciation, the apomorphic chromosome number arises simultaneously with the splitting of a lineage. In such cases, an apomorphy-based definition that uses this chromosome number as a specifier will refer to the same clade as a branch-based definition that uses the species in which the chromosome doubling occurred, or one of its descendants, as the internal specifier.)

14.2. If there are two or more synonyms for a clade, the accepted name for that clade is the earliest acceptable one that applies to it, except in cases of conservation.

14.3. When two or more synonyms have the same publication date (Art. 5), the one that was registered first (and therefore has the lowest registration number) takes precedence.

## Article 15. Conservation, Suppression and Emendation

15.1. Conservation of names and emendation of definitions are means of overriding precedence based on date of establishment (Art. 12.2) in the interest of stability (e.g., in terms of composition and/or diagnostic characters).

15.2. Conservation of names is possible only under extraordinary circumstances and requires approval of the Committee on Phylogenetic Nomenclature (CPN; see Art. 22).

15.3. Once a name has been conserved, the entry for the affected name in the registration database is to be annotated to indicate its conserved status relative to other names that are simultaneously suppressed. The entries for suppressed names are to be similarly annotated.

15.4. In the case of heterodefinitive synonyms, the earlier name may be conditionally suppressed so that it may be used when not considered synonymous with the later name. In the case of homonyms and homodefinitive synonyms, suppression is unconditional.

15.5. When a name is unconditionally suppressed, there are no conditions under which it has precedence with regard to either synonymy or homonymy. Therefore, if a homodefinitive synonym has been suppressed, that name can be established subsequently with a different definition as an acceptable name.

15.6. When a conserved name competes with names against which it has not been explicitly conserved, the earliest established of the competing names has precedence.

15.7. Although names are normally suppressed only when a synonym or homonym is conserved, the CPN may unconditionally suppress a name if it is nomenclaturally disruptive, without necessarily conserving an alternative. An unconditionally suppressed name can be established subsequently with a different definition as an acceptable name.

15.8. An emendation is a formal change in a phylogenetic definition. A restricted emendation requires approval by the CPN (see Art. 22), while an unrestricted emendation may be published without CPN approval.

15.9. All emendations must be published (Art. 4) and registered (Art. 8).

15.10. A restricted emendation (see Art. 15.8) is intended to change the application of a particular name through a change in the conceptualization of the clade to which it refers. Restricted emendations may involve changes in definitional type, clade category, specifiers, and/or qualifying clauses.

Note 15.10.1. A restricted emendation is a mechanism to correct a definition that fails to associate a name with the clade to which it has traditionally referred, even in the context of the reference phylogeny adopted by the original definitional author.

Example 1. Suppose the name *Angiospermae* had been defined as the least inclusive clade containing *Zea mays* Linnaeus 1753 and *Gnetum gnemon* Linnaeus 1767. By including *Gnetum*, this definition specifies a more inclusive clade than the one to which the name *Angiospermae* traditionally refers. Correcting the definition would qualify as a restricted emendation (i.e., it would require approval by the CPN).

15.11. An unrestricted emendation (see Art. 15.8) is intended to preserve the application of a particular name in terms of the conceptualization of the clade to which it refers. Unrestricted emendations may involve changes in specifiers or qualifying clauses, or clarification of the meaning of "extant", but must retain the same definition type (node-based, branch-based, or apomorphy-based), the same clade category (i.e., crown clade, total clade) if category was specified in the protologue, and the same clade conceptualization as interpreted from the protologue.

Note 15.11.1. An unrestricted emendation is a mechanism to prevent undesirable changes in the application of a particular name (in terms of clade conceptualization) when the original definition is applied in the context of a revised phylogeny.

Example 1. Several recent phylogenetic analyses suggest that *Amborella trichopoda* is sister to the rest of *Angiospermae*, but evidence for this basalmost position of *Amborella* was not discovered until the late 1990s. If, prior to this discovery, *Angiospermae* had been given a node-based definition that did not include *Amborella trichopoda* as an internal specifier, *Angiospermae* would not have included *Amborella* after its basal position was discovered. However, the definitional author would presumably have intended for *Amborella* to be included in *Angiospermae* because it has most of the apomorphies of that taxon and has always been included in it. In such a situation, an unrestricted emendation that adds *Amborella trichopoda* to the list of internal specifiers would avoid an undesirable change in clade composition and would be consistent with the clade conceptualization of the original definitional author and with historical use.

Note 15.11.2. In the context of this article, node-based, branch-modified node-based and apomorphy-modified node-based definitions are all considered the same definition type, so it is permissible for an unrestricted emendation to change from one to another of these three variants of the node-based definition, provided that all internal specifiers are extant.

Example 1. In the situation described in Note 15.11.1, Example 1, as an alternative to adding *Amborella trichopoda* to the list of specifiers, it might be preferable to change the original node-based definition to a branch-modified node-based definition such as "the most inclusive crown clade containing *Zea mays* Linnaeus 1753 but not *Cycas circinalis* Linnaeus 1753, *Gnetum gnemon* Linnaeus 1767, *Ginkgo biloba* Linnaeus 1771, and *Pinus sylvestris* Linnaeus 1753." Such a definition avoids the need for further emendation if some other species (i.e., other than *Amborella trichopoda*) or subclade is inferred in the future to be sister to the rest of the angiosperms.

Note 15.11.3. If it is specified in the protologue that the name refers to a crown clade or a total clade, this clade category may not be changed through an unrestricted emendation. If the clade category is not specified in the protologue, the category may still play a role in determining the author's conceptualization of the clade (see Note 15.11.4 and Art. 15.13, Example 1). The category of crown clade is considered to be specified in the protologue if the definition is: 1) branch-modified node-based; 2) apomorphy-modified node-based; or 3) standard node-based and the author states in the protologue that the name applies to a crown clade. The category of total clade is considered to be specified in the protologue if: 1) a panclade name and definition (Arts. 10.3, 10.5) are used; or 2) a branch-based definition is used and the author states in the protologue that the name applies to a total clade.

Note 15.11.4. Interpretation of the original definitional author's clade conceptualization is based on the definition and all other information in the protologue. Important components of the definitional author's conceptualization of the clade include (but are not necessarily restricted to) composition, synapomorphies, clade category (e.g., crown versus non-crown; see Art. 15.13, Example 1), the existence of a basal dichotomy into two particular subclades (see Art. 15.13, Example 2), and conceptualization of a clade as an entire branch regardless of composition (see Art. 15.13, Example 3).

15.12. The protologue of an unrestricted emendation must provide evidence that the conceptualization of the clade is the same as that of the original definitional author. The protologue must also explain why the emended definition is preferable to the definition being emended.

15.13. If conflicting evidence from the protologue (see Note 15.11.4) makes it unclear whether a proposed emendation is consistent with the original conceptualization of the clade, the emendation must be considered by the CPN (i.e., it must be a restricted emendation). Disagreements within the systematics community as to whether a published unrestricted emendation changes the conceptualization of a clade (i.e., whether the emendation should have been restricted) are to be resolved by referring the issue to the CPN for a decision (see Art. 22).

Example 1. Suppose that the name *Mammalia* had first been defined phylogenetically as the least inclusive clade containing *Ornithorhynchus anatinus* (Shaw 1799) and *Homo sapiens* Linnaeus 1758, both of which are extant, without explicitly stating that the name refers to a crown clade. Further, suppose that the definitional author had considered *Mammalia* to include *Multituberculata* (a wholly extinct group). If, under a newly proposed phylogenetic hypothesis, *Multituberculata* is no longer included in *Mammalia* under the stated definition, and if the definitional author did not indicate whether reference to a crown clade or inclusion of *Multituberculata* was more fundamental to his or her use of the name *Mammalia*, conflicting evidence exists concerning the original conceptualization of that taxon. Therefore, adding a member of *Multituberculata* to the set of internal specifiers in the definition of *Mammalia*, or otherwise modifying the definition of *Mammalia* so that it refers to a clade that includes *Multituberculata*, would require consideration by the CPN.

Example 2. Suppose that the name *Dinosauria* had first been defined phylogenetically as the least inclusive clade containing *Megalosaurus bucklandii* von Meyer 1832 (*Saurischia*) and *Iguanodon bernissartensis* Boulenger in Beneden 1881 (*Ornithischia*). Further, suppose that the definitional author had considered *Dinosauria* to include *Herrerasauridae*. If, under a newly proposed phylogenetic hypothesis, *Herrerasauridae* is no longer included in *Dinosauria* under the stated definition, and if the definitional author did not indicate whether inclusion of *Herrerasauridae* or application to the clade whose basal dichotomy is represented by *Saurischia* and *Ornithischia* was more fundamental to his or her use of the name *Dinosauria*, conflicting evidence exists concerning the original conceptualization of that taxon. Therefore, adding a species of *Herrerasauridae* to the set of internal specifiers in the definition of *Dinosauria*, or otherwise modifying the definition of *Dinosauria* so that it refers to a clade that includes *Herrerasauridae*, would require consideration by the CPN.

Example 3. Suppose that the name *Saurischia* had first been defined phylogenetically as referring to the most inclusive clade containing *Allosaurus fragilis* Marsh 1877 but not *Stegosaurus armatus* Marsh 1877 (*Ornithischia*). Further, suppose that the definitional author had considered *Saurischia* to include *Herrerasauridae*. If, under a newly proposed phylogenetic hypothesis, *Herrerasauridae* is no longer included in *Saurischia* under the stated definition, and if the definitional author did not indicate whether inclusion of *Herrerasauridae* or application to the sister clade of *Ornithischia* was more fundamental to his or her use of the name *Saurischia*, conflicting evidence exists concerning the original conceptualization of that taxon. Therefore, adding a species of *Herrerasauridae* to the set of internal specifiers in the definition of *Saurischia*, or otherwise modifying the definition of *Saurischia* so that it refers to a clade that includes *Herrerasauridae*, would require consideration by the CPN.

15.14. Although anyone may publish an unrestricted emendation, it is preferable that the emendation be authored or coauthored by the author or authors of the original definition. If one or more of the original definitional authors are still alive, another worker who thinks that an unrestricted emendation is warranted must provide evidence when registering the emendation that the first author of the original definition (or the second, third authors, etc., if the first author is deceased or otherwise unable to respond) was contacted and offered the opportunity to co-author the emendation.

Note 15.14.1. Minimal evidence required for registration of an unrestricted emendation includes the e-mail address or phone number of the original definitional author(s) contacted and the date when the contact was made. If all of the original definitional authors are deceased or otherwise unable to respond, this information must be submitted to the registration database as well. Supplementary information such as the text of the definitional author(s)' response may also be submitted.

Note 15.14.2. Although the author or authors of the original definition must be offered the opportunity to co-author an emendation of the original definition, it is not necessary that they be offered the opportunity to co-author the entire publication in which the emendation appears (see Art. 19.2).



15.15. Within a phylogenetic context in which the original definition and an unrestricted emendation apply to the same clade, the original definition has precedence.

## Chapter VI. Provisions for Hybrids

### Article 16.

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

### 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 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 is the name of an apomorphy-based clade formed in accordance with Art. 10.7, or is based on the preexisting name of a subdivision of a genus (see Rec. 10F), or is based on the preexisting name preceded by a taxon-related prefix such as *Phyto-*, *Phyco-*, *Myc-*, *Monero-*, or *Zoo-* in the situation covered by Rec. 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.

Example 1. *Vffenbachia* Fabr. (1763) would be changed to *Uffenbachia* when converted.

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 *ICBN*, *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.

Example 1. "Tricolpates" (a plant clade) is an informal name and should therefore not be adopted as the formal scientific name for this (or any other) clade. However, a name derived by latinizing "tricolpates" (e.g., *Tricolpatae*) may be used.

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.

Example 1. If a clade is named in honor of a person whose surname is Woodson, the clade name must not be *Woodson* but may be *Woodsonia*.

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.

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 Arts. 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 nullify the establishment of names under this code.

#### Article 18. Subsequent Use and Correction of Established Names

18.1. The original spelling of a name established under this code is the correct spelling and should be retained in subsequent publications, except for the correction of typographical errors (see Art. 18.5). The original spelling is the one that is used in the protologue at the time of establishment and that is registered (see Art. 8).

Note 18.1.1. The original spelling of a converted name is correct so long as it is based on one of the spellings of the preexisting name, even if the prevailing spelling was not adopted (see Rec. 17.5A).

Note 18.1.2. Use of a diaeresis to indicate that a vowel is to be pronounced separately from the preceding vowel is not part of the spelling (orthography) of a name, but it may be included in an established name as an optional pronunciation guide. Similarly, use of an apostrophe to indicate a break between syllables is not part of the spelling of a name, but it may be included in an established name as an optional pronunciation guide.

18.2. Spellings that do not follow Rec. 17B (for example, incorrect latinization or use of an inappropriate connecting vowel) and spellings that contain incorrect transliterations are not to be corrected.

18.3. If the registered spelling of a name disagrees with the spelling in the protologue or the name is spelled more than one way in the protologue, the author should determine which is correct and notify the registration database administrator promptly.

Note 18.3.1. If the author notifies the database administrator that the registered spelling is incorrect, the administrator will correct the database and insert a note that the change was made. If one or more spellings in the protologue are incorrect, the administrator will annotate the database to alert users that this is the case.

18.4. If the registered spelling of a name disagrees with the spelling in the protologue or the name is spelled more than one way in the protologue, and the author is no longer alive or is otherwise unable to determine which spelling is correct, the following guidelines are to be used: If it is clear that all but one of the spellings are typographical errors, the remaining one is treated as correct. If it is not clear which spellings are typographical errors, the one that is most consistent with Rec. 17B is treated as correct. If it is not clear which spellings are typographical errors, and it is not clear that one is more consistent with Rec. 17B than the others, the one immediately associated with the designation "new clade name," "converted clade name," etc. is treated as correct. Such decisions regarding the correct spelling of a name if made by anyone other than the author, must be published (Art. 4) before the registration database administrator is notified (see Rec. 18A).

Note 18.4.1. If the author of a published correction notifies the database administrator that the registered spelling is incorrect, the administrator will correct the database and insert a note that the change was made. If one or more spellings in the protologue are incorrect, the administrator will annotate the database to alert users that this is the case.

Recommendation 18.4A. The person making an orthographic correction of the sort covered by Art. 18.4 should notify the database administrator promptly after publishing it.

18.5. If the registered spelling of a name and the spelling in the protologue agree but contain a typographical error, the author may publish a correction. If the author is no longer alive or is otherwise unable to correct the error, any person may publish a correction (see Rec. 18A).

Note 18.5.1. After the registration database administrator is notified, the spelling will be corrected in the database and a note will be added stating that the change was made.

Note 18.5.2. A correction slip inserted in the original publication does not qualify as a published correction. Publication of corrections must satisfy the requirements of Art. 4.

18.6. Accidental misspellings of a name that appear in print subsequent to establishment are not to be treated as new names but as incorrect spellings of the established name. The same is true of unjustified corrections (i.e., any correction that does not fall under Arts. 18.3–18.5, particularly those that violate Art. 18.2).

Recommendation 18A. The person making an orthographic correction of the sort covered by Arts. 18.4 and 18.5 should notify the database administrator promptly after publishing it.

## Chapter VIII. Authorship of Names and Definitions

### Article 19.

19.1. The nominal author(s) of a clade name is (are) the person(s) who first published the name, regardless whether it was phylogenetically defined. 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. For a new name (except a new replacement name), the nominal and definitional authors are the same. For a converted name or a replacement name, the nominal and definitional authors are frequently different.

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.

Note 19.2.1. In some cases, a breadth of evidence may need to be considered to determine the correct author attribution, including ascription of the name, statements in the introduction, title, or acknowledgements, typographical distinctions in the text, and even statements made in other volumes and editions in the same series or in entirely different publications.

Note 19.2.2. In the absence of evidence to the contrary, the authorship of the protologue can be assumed to be the same as the authorship of the entire publication in which it appears.

19.3. The nominal author(s) of a replacement name is (are) the author(s) of that name, not the author(s) of the replaced name. However, because the definition remains the same (Art. 13.5), the definitional author(s) of the replacement name is (are) the definitional author(s) of the replaced name.

19.4. A preexisting clade name is to be attributed to the author(s) of the protologue when only the name, but not the rest of the protologue, is attributable to a different author or authors (see Art. 20.8).

19.5. When the prevailing spelling of a preexisting name differs from the original spelling due to correction of orthographic or typographical errors in the original spelling or orthographic standardizations, whether imposed by a rank-based code or accepted by convention, the prevailing spelling is to be attributed to the author of the publication in which the original spelling was used.

Example 1. *Iguana*, which is the prevailing spelling of the name, is attributed to Linnaeus even though he used the spelling *Igvana* in the original publication.

Note 19.5.1. Art. 19.5 does not apply to names whose spellings have been "corrected" under a rank-based code to the standard ending for the rank at which it was published (see Note 9.8A.3).

## Chapter IX. Citation of Authors and Registration Numbers

### Article 20.

20.1. Citation of nominal and definitional authors (Art. 19.1) is optional, but if authors are cited, Arts. 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 are to be cited within enclosing symbols. The author of the original definition (i.e., the definitional author of a new or converted name) is to be cited in square brackets ([ ]; Art. 20.4, Example 1). The author of an emended definition is to be cited in braces ({ }; Art. 20.6, Example 1).

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

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

Example 1. Suppose that Larson established a converted clade name *Hypotheticus* in 2010 based on the preexisting name *Hypotheticus* of Meekins (published in 1956). In this situation, the citation of the converted name would be *Hypotheticus* Meekins [Larson]. Meekins is the nominal author; Larson is the definitional author.

Example 2. If Larson established a converted clade name *Hypotheticus* based on the preexisting name *Hypotheticus*, and if the authorship of this name were unknown, the citation of the converted name would be *Hypotheticus* [Larson].

Note 20.4.1. The publication years of the preexisting name and converted name may follow the names of the respective authors.

Example 1. Using Example 1 of Art. 20.4, the citation with publication years would be *Hypotheticus* Meekins 1956 [Larson 2010].

Recommendation 20.4A. If a preexisting name was used in association with more than one rank or composition, and authorship is cited, the nominal author cited should be the original author of the name, as spelled for the purpose of conversion, rather than the first author who applied the name later in association with a different rank or composition (but see Rec. 9.8A).

Recommendation 20.4B. If a preexisting name has been attributed to an author other than the first author who used the name being converted (as can occur under the Principle of Coordination of the *ICZN*), the nominal author cited should not be the former but rather the author of the name as spelled for the purpose of conversion (but see Note 9.8A.2 and its Example 1.)

20.5. If the nominal author of a replacement name is cited, the definitional author of the replacement name (i.e., the definitional author of the replaced name; see Arts. 13.5, 19.3) must also be cited.

Example 1. Suppose that Holmes was the definitional author of the name *Cladus*, which turned out to be a later homonym of *Cladus* (established by a different author), and then Clarke published the new name *Imaginarius* as a replacement name for *Cladus* Holmes. The full citation of the replacement name would be *Imaginarius* Clarke [Holmes]. If, instead, Clarke had converted the replacement name from the preexisting name *Fabricatus* Merriam, the full citation of the replacement name would be *Fabricatus* Merriam [Holmes].

20.6. If the author of an emended definition (see Art. 15) is cited, the author of the original definition must also be cited.

Example 1. If *Fictitius* was established as a new name by Stein, and Maki subsequently emended Stein's definition, the full citation would be *Fictitius* Stein {Maki}. If, instead, Stein had converted *Fictitius* from the preexisting name *Fictitius* Merriam, the full citation would be *Fictitius* Merriam [Stein] {Maki}.

20.7. When authorship of a name differs from authorship of the publication in which it is established, both may be cited, connected by the word "in." In such a case, "in" and what follows are part of a bibliographic citation and are only to be included if the publication is referred to, at least by its year.

20.8. The optional use of "ex" under the *ICBN* to cite author(s) to whom the name, but not the rest of the protologue, is attributable is not adopted in this code.

Recommendation 20A. Bibliographic references to the protologue of established names are available in the registration database and may be accessed by either clade name or registration number. However, only the registration number is reliably unique. Therefore, in cases of potential ambiguity, the registration number should be cited at least once in any publication in which the corresponding name is used.

## Chapter X. Species Names

### Article 21.

21.1. This code does not govern the establishment or precedence of species names. To be considered available (*ICZN*) or validly published (*ICBN*, *ICNB*), a species name must satisfy the provisions of the appropriate rank-based code (e.g., *ICNB*, *ICBN*, *ICZN*). This article describes how species names governed by the rank-based codes are to be interpreted and used under this code.

Note 21.1.1. Article 21 applies to all species names, including replacement names (deliberate substitutes of the *ICNB*, avowed substitutes of the *ICBN*, new replacement names of the *ICZN*).

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 (*ICNB*, *ICBN*) (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 instead as simply the first part of the species name (a premen; see Art. 21.4), and the second part of a species binomen is associated with the species as a kind of biological entity, not as a rank (Note 3.1.1).

21.3. This code also does not govern the establishment of names associated with ranks below that of species under the rank-based codes ("infraspecific names"); however, such names may be used in conjunction with phylogenetic nomenclature. Because this code is independent of categorical ranks (Art. 3.1), the third (and subsequent) part(s) of an infraspecific name is (are) associated with the species as a biological entity rather than with the subspecific (and varietal) rank of traditional nomenclature. Thus, infraspecific names may be used to refer to incompletely separated species, but their use to refer to patterns of variation that do not reflect even partial species (lineage) separation (e.g., polymorphism, ecophenotypic variation, and some examples of local adaptation and geographic variation in conspicuous characters) is discouraged.

21.4. A prenom is the first part of a species binomen. A prenom has no necessary tie to any categorical rank under this code. However, to satisfy the requirements of the rank-based codes, a prenom must be used (and implicitly or explicitly associated with the rank of genus) when establishing a new species name, even though it may not have been established as a clade name under this code.

Recommendation 21.4A. When establishing a new species name (binomen) under the appropriate rank-based code, some mechanism should be used to indicate whether the generic name (prenom) is an established clade name under this code. If symbols are used, their meaning should be made clear.

Example 1. ©*Hypotheticus* could indicate that the prenom *Hypotheticus* is an established clade name, while *Hypotheticus* (with no symbol) could indicate that this prenom has not been established as a clade name under this code. If so, the meaning of the symbol © should be clearly indicated.

Example 2. *Hypotheticus* (with no symbol) could indicate that this prenom has been established as a clade name under this code, while [R]*Hypotheticus* could indicate that the prenom *Hypotheticus* is not an established clade name ("R" meaning governed by a rank-based code). If so, the meaning of the symbol [R] should be clearly indicated.

Note 21.4A.1. Although Examples 1 and 2 each use only one symbol, it may be clearer to use symbols to indicate both situations. Using absence of a symbol to designate nomenclatural status is potentially confusing because its absence may simply result from accidental omission of the symbol. Furthermore, some readers may misinterpret absence of a symbol because they are unaware of the author's convention.

Note 21.4A.2. If a symbol (e.g., quotation marks) is used to indicate non-monophyly of the taxon designated by the prenom, it is not necessary to indicate that the prenom is not an established clade name under this code.

Note 21.4A.3. If a symbol is used to indicate non-monophyly or questionable monophyly of the taxon designated by the prenom, 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 *ICBN* (2006) Art. 34.1.



Recommendation 21.4B. When publishing the name of a new species, selection of a generic name (prenomen) will require consideration of the nomenclatural consequences under both the appropriate rank-based code and this code. In general, a generic name (*ICNB*, *ICBN*) or genus-group name (*ICZN*) 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 generic (or genus-group) name may be used, even if the monophyly of the associated taxon under the rank-based code is unknown or doubtful, or a new generic name (prenomen) may be used. If the species to be named cannot be assigned to any taxon with which a generic (or genus-group) 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 (a prenomens under this code). This name may be simultaneously established as a clade name under this code.

Example 1. If a new species is to be given the binomen *Sorex hockingensis*, and the name *Sorex* has already been established both as a clade name under this code and as the name of a genus under the *ICZN*, then the binomen should appear as *Sorex hockingensis*, new species (or an equivalent expression such as n. sp.), with or without a symbol (e.g., ©) indicating that *Sorex* is an established clade name (see Rec. 21.4A Examples 1 and 2).

Example 2. If the taxon associated with the genus name *Sorex* in Example 1 is thought to be monophyletic but has not previously been established as a clade name, the clade name *Sorex* could be established simultaneously with the publication of the binomen *Sorex hockingensis*.

Example 3. If the only preexisting genus to which a new species (for which the epithet *vulgaris* is selected) can be assigned (*Hypotheticus*) is thought to be non-monophyletic or its monophyly has not been investigated, and the species is part of a clade (*Cladius*) that could be named as a genus under the appropriate rank-based code, then the binomen could appear as *Cladius vulgaris*, new genus and species (or an equivalent expression), with or without a symbol (e.g., ©) indicating that *Cladius* is an established clade name (see Rec. 21.4A, Examples 1 and 2). If this is done, *Cladius* should be validly published (*ICNB*, *ICBN*) or made available (*ICZN*) simultaneously as a genus name under the appropriate rank-based code, and it should also be established as a clade name under this code if it has not previously been established. Alternatively, if it were considered premature to establish the name *Cladius*, the binomen could appear as *Hypotheticus vulgaris*, new species (or an equivalent expression), with or without a symbol (e.g., [R]) indicating that *Hypotheticus* is not an established clade name (see Rec. 21.4A Examples 1 and 2) or a symbol (e.g., quotation marks) indicating that *Hypotheticus* is not monophyletic (see Note 21.4A.2).

Example 4. In the situation described in Example 3, if there is not sufficient evidence that the new species is part of any clade that could be named as a genus under the appropriate rank-based code, then the binomen could appear as *Hypotheticus vulgaris*, new species (or an equivalent expression), with or without a symbol (e.g., [R]) indicating that *Hypotheticus* is not an established clade name (see Rec. 21.4A, Examples 1 and 2) or a symbol (e.g., quotation marks) indicating that *Hypotheticus* is not monophyletic (see Note 21.4A.2). Alternatively, a new generic name (prenomen) could be published in combination with the new specific name or epithet under the rank-based code.

Example 5. If a new species, to be named *campestris*, cannot be assigned to any taxon (whether monophyletic or not) with which a generic name (*ICNB*, *ICBN*) or genus-group name (*ICZN*) has been associated under the appropriate rank-based code, it would be necessary to publish a new generic name (e.g., *Imaginarius*) in combination with the new specific name or epithet under the rank-based code. If *Imaginarius* is simultaneously established under this code as a clade name, then the binomen should appear as *Imaginarius campestris*, new genus and species (or an equivalent expression), with or without a symbol (e.g., ©) indicating that *Imaginarius* is an established clade name (see Rec. 21.4A, Examples 1 and 2).

Example 6. If, in the previous example, the name *Imaginarius* is not simultaneously established as a clade name under this code, then the binomen should appear as *Imaginarius campestris*, new genus and species (or an equivalent expression), with or without a symbol (e.g., [R]) indicating that *Imaginarius* is not an established clade name (see Rec. 21.4A, Examples 1 and 2).

Recommendation 21.4C. When establishing a new species name under the appropriate rank-based code, the protologue should include a description of the evidence indicating that the named species represents a separately evolving lineage from other named species, or an unambiguous bibliographic citation (Art. 9.9) to a previous publication containing this information.

Note 21.4C.1. The evidence indicating that the named species represents a separately evolving lineage from other named species may take various forms, including (but not restricted to) those commonly adopted as species criteria (e.g., absence of interbreeding and/or gene flow, reciprocal monophyly, a unique combination of character states).

Note 21.4C.2. The provision of the evidence used to infer that the species represents a separately evolving lineage does not imply that subsequent users of the name must rely on the same evidence or adopt the same species criteria.

21.5. Subsequent to a species binomen becoming available (*ICZN*) or validly published (*ICBN*, *ICNB*) under the appropriate rank-based code, the second part of the species binomen may be treated as the name of the species (i.e., a species uninomen) under this code. In this context, the species uninomen may be combined with the names of clades other than the prenomens (see Rec. 21A).

Recommendation 21.5A. When the prenomens is used subsequent to the species binomen becoming available (*ICZN*) or validly published (*ICBN*, *ICNB*), some mechanism should be used to indicate whether the generic name (prenomens) is an established clade name under this code (see examples under Rec. 21.4A).

Recommendation 21.5B. When the second part of a species binomen is treated as the name of a species subsequent to the species binomen becoming available (*ICZN*) or validly published (*ICBN*, *ICNB*), it should be accompanied by one or both of the following: (a) the prenomens; (b) the author(s) and year of the publication in which the epithet (*ICNB*, *ICBN*) or specific name (*ICZN*) was validly published (*ICNB*, *ICBN*) or made available (*ICZN*).

Note 21.5B.1. Under the *ICBN*, the author(s) of the binomen is (are) commonly cited but the year is commonly not cited. In contrast, both the author and year are commonly cited under the *ICZN*. Under this code, if the prenomens is not used in combination with the specific name or epithet, both the author and year of the specific name or epithet should be cited. If the prenomens is used, citation of the author and year are optional.

Example 1. The species that is referred to as *Vultur gryphus* or *Vultur gryphus* Linnaeus under the *ICZN* may be referred to under this code as *Vultur gryphus* or *Vultur gryphus* Linnaeus or *gryphus* Linnaeus 1758. Any of these forms of the species name may be associated with additional clade names to indicate hierarchical relationships (see Rec. 21A); for example, *Aves/gryphus* Linnaeus 1758 or *Aves/Vultur gryphus* Linnaeus.

Recommendation 21A. When species names are used in the context of this code, it will often be useful to associate them with one or more prenomina as well as the names of more inclusive clades. Hierarchical relationships among the taxa designated by those names can be indicated in a variety of ways, but the taxa should be listed in order of decreasing inclusiveness from left to right. In addition, symbols such as those in the examples under Rec. 21.4A may be used not only with prenomina but also with names associated with groups above and below the rank of genus under the rank-based codes (but for simplicity, such symbols are not included in the following examples).

Example 1. The species originally named *Anolis auratus* Daudin 1802 has been placed in at least two different genera, named *Anolis* and *Norops*. If those names were to be established under this code as the names of (nested) clades, the name and relationships of the species could be indicated in any of the following ways (not an exhaustive list): *Anolis/auratus* Daudin 1802, or *Norops: auratus* Daudin 1802, or *Anolis/Norops/auratus* Daudin 1802, or *Anolis Norops auratus* Daudin 1802. For optional use of parentheses to indicate that a specific name or epithet was originally combined with a different generic name, see Note 21A.3.

Example 2. If the name of a species under the *ICZN* is *Diaulula sandiegensis* (Cooper 1863), and if *Diaulula* has not been established as a clade name under this code (for example, because there is presently insufficient data to establish monophyly), and if the name *Discodorididae* has been established as the name of a more inclusive clade under this code, then the name and relationships of the species could be indicated in any of the following ways (not an exhaustive list): *Diaulula sandiegensis* Cooper 1863, or *Discodorididae Diaulula sandiegensis* Cooper 1863, or *Discodorididae/sandiegensis* Cooper 1863, or *Discodorididae sandiegensis* Cooper 1863. For optional use of parentheses to indicate that a specific name or epithet was originally combined with a different generic name, see Note 21A.3.

Note 21A.1. When a species unimon is combined with other names than the premon, the names do not have to agree in gender and number (plural vs. singular). Therefore, the ending of the unimon does not have to change. The unimon can be viewed as a name in its own right, rather than as an adjectival modifier of the clade name.

Note 21A.2. By combining the second part of a species binomen with the name of a clade that is not a genus under the appropriate rank-based code (see variants that do not use the name *Diaulula* in Rec. 21A, Example 2), it is possible to provide phylogenetic information for a species without using a generic name (*ICNB*, *ICBN*) or genus-group name (*ICZN*) that has not been established as a clade name under this code.

Note 21A.3. If a specific name (*ICZN*) or epithet (*ICNB*, *ICBN*) is associated with just one premon, so the combination resembles a binomen, parentheses enclosing the name of the author and year of publication of the specific name (*ICZN*) or the author of the epithet (*ICNB*, *ICBN*) may be used to indicate that the specific name or epithet was originally combined with a different generic name, following the conventions of the appropriate rank-based code (which differ in whether the year is commonly cited and whether the author of the accepted combination should also be cited). The use of parentheses for this purpose is optional, which is consistent with the decreased emphasis on taxonomic ranks under this code. Parentheses may also be used if a specific name (*ICZN*) or epithet (*ICNB*, *ICZN*) is associated with just one clade name of supra-generic rank under the rank-based codes.

Example 1. In the name *Norops auratus* (Daudin 1802), the use of parentheses indicates that Daudin originally published (made available; *ICZN*) the specific name *auratus* in combination with a different generic name. Use of parentheses in this case is optional (e.g., see the citation of this same name and author without parentheses in Rec. 21A, Example 1).

Example 2. In the name *Physostegia/virginiana* (Linnaeus) Bentham, the use of parentheses indicates that Linnaeus originally published the specific epithet *virginiana* in combination with a different generic name and that Bentham first validly published (*ICBN*) the binomen *Physostegia virginiana*.

Example 3. In the name *Discodorididae sandiegensis* (Cooper 1863) (see Rec. 21A, Example 2), the use of parentheses indicates that Cooper originally published the specific name *sandiegensis* in combination with a different taxon name.

## Chapter XI. Governance

### Article 22.

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 for suppression or conservation of names and emendation of 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 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 may not be voted upon until at least six 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 must be approved by a two-thirds vote of the CPN. Any decision adopted by CPN will be published and announced on a web site administered by the ISPN. Decisions take effect immediately upon publication.

## Glossary

*acceptable name*. An established name that is not a (non-conserved) later homonym and thus may potentially be an accepted name.

*accepted name*. The name that must be adopted for a taxon under this code.

*ancestor*. An entity from which another entity is descended.

*apomorphy*. A derived character state; a new feature that arose during the course of evolution.

*apomorphy-based clade*. A clade originating from the ancestor in which a particular derived character state (apomorphy) originated; a clade whose name is defined using an apomorphy-based definition.

*apomorphy-based definition*. A definition that associates a name with a clade originating with the first ancestor of specified organisms and/or species (internal specifier taxa) to evolve a particular apomorphy (internal specifier apomorphy). See Note 9.3.1.

*apomorphy-modified node-based definition*. A node-based definition that incorporates wording from apomorphy-based definitions to include all extant organisms as internal specifiers without explicitly naming them. See Note 9.3.1. Apomorphy-modified node-based definitions can be used to associate names with crown clades when basal relationships within the crown are poorly understood or when the author intends to include in the named taxon subsequently discovered extant organisms that possess a particular apomorphy.

*binomen (binomina)*. A name composed of two words; commonly used to refer to species names composed of a generic name and a specific name (ICZN) or epithet (ICNB, ICBN) under the rank-based codes, or of a prenomens and a species name under this code.

*branch*. An edge or internode (connection between two nodes) on a tree (graph theory); on a phylogenetic tree, a branch is commonly used to represent a lineage, whether ancestral or terminal. The term is sometimes also used for an internode and all nodes and internodes distal to (descended from) it.

*branch-based clade*. A clade originating from a particular branch (internode) on a phylogenetic tree; a clade encompassing a particular branch on a phylogenetic tree and all nodes and branches descended from that branch; a clade whose name is defined using a branch-based definition. See Art. 2.2.

*branch-based definition*. A definition that associates a name with a clade originating with a branch (on a phylogenetic tree) representing the ancestral lineage of specified organisms and/or species (internal specifiers) after its divergence from the ancestral lineage of other specified organisms and/or species (external specifiers). See Note 9.3.1.

*branch-modified node-based definition.* A node-based definition that incorporates wording from branch-based definitions to include all extant organisms as internal specifiers without explicitly naming them. See Note 9.3.1. Branch-modified node-based definitions can be used to associate names with crown clades when basal relationships within the crown are poorly understood or when the author intends to include in the named taxon subsequently discovered extant organisms that share a more recent common ancestor with the currently known members of the named taxon than with other currently known taxa.

*categorical rank.* A formal category denoting position in a hierarchy of nested taxa. The categorical ranks commonly used in taxonomy comprise seven principal categories (kingdom, phylum, class, order, family, genus, and species), which are often treated as mandatory, as well as additional primary categories (e.g., cohort, tribe) and secondary categories (e.g., superorder, subfamily). Note that the species category is treated as a rank in rank-based nomenclature but as a level of biological organization in phylogenetic nomenclature.

*clade.* An ancestor (an organism, population, or species) and all of its descendants.

*conditionally suppressed name.* A name that is suppressed only in phylogenetic contexts in which it is a synonym of a particular conserved name (see *suppressed name*).

*conserved name.* An established name that the Committee on Phylogenetic Nomenclature has ruled should have precedence over earlier synonyms or homonyms.

*conversion.* The act of establishing a preexisting name in accordance with the rules of this code.

*converted (clade) name.* A preexisting name that has been established in accordance with the rules of this code (see *new (clade) name*).

*crown clade.* A clade originating with the most recent common ancestor of two or more extant species (or organisms). Crown clades are a subset of node-based clades. See Art. 2.2.

*crown clade definition.* Any definition that necessarily ties a name to a crown clade—e.g., branch- and apomorphy-modified node-based definitions and standard node-based definitions in which all the specifiers represent extant species or organisms.

*definition.* A statement specifying the meaning of a name (i.e., the taxon to which it refers).

*definitional author.* The person(s) who published a phylogenetic definition for a name—either the original definition or an emended one (see *nominal author*).

*description.* A statement of the features of a taxon (or its component organisms), not limited to those that distinguish it from other taxa with which it might be confused (see *diagnosis*).

*diagnosis (diagnoses).* A brief statement of the features of a taxon that collectively distinguish it from other taxa with which it might be confused.



*emendation*. A formal change in the phylogenetic definition of a name.

*epithet*. In the *ICBN*, a word that, when combined with the name of a genus, forms the name of an infrageneric taxon (e.g., species, subgenus, section, series) or, when combined with the name of a species, forms the name of an infraspecific taxon (e.g., subspecies, variety, form). The *ICNB* also uses the term "epithet" but only at and below the species rank.

*established name*. A name that is published in accordance with Art. 7 of this code, which may or may not be an acceptable or accepted name.

*extant (of a taxon)*. Having one or more living representatives (organisms) at the present time, or at some specified time since humans began keeping written historical records.

*external specifier*. A species or specimen that is explicitly excluded from the clade whose name is being defined (see *internal specifier*). Branch-based and branch-modified node-based definitions have external specifiers, but apomorphy-based, standard node-based, and apomorphy-modified node-based definitions do not.

*genus (genera)*. One of the categorical ranks of rank-based nomenclature; more specifically, it is the primary rank above the rank of species and below that of family. The genus rank is mandatory in rank-based nomenclature not only because it is one of the seven principal ranks (kingdom, phylum, class, order, family, genus, species), which are commonly treated as mandatory, but also because the generic name is part of the species binomen.

*heterodefinitional*. Based on different phylogenetic definitions (see *synonym*).

*homodefinitional*. Based on the same phylogenetic definition (see *synonym*).

*homologous*. Shared by virtue of inheritance from a common ancestor. A character or character state shared by two organisms (which may represent different species or clades) is said to be homologous if that character or character state was present in all of their ancestors back to and including their most recent common ancestor.

*homonym*. A name that is spelled identically to another name that refers to a different taxon. See Art. 13.1.

*hybrid formula*. An expression consisting of the names of two taxa separated by a multiplication sign, designating a single organism or set of organisms of hybrid origin.

*ICBN*. *International Code of Botanical Nomenclature*.

*ICNB*. *International Code of Nomenclature of Bacteria: Bacteriological Code*.

*ICVCN*. *International Code of Virus Classification and Nomenclature*.

*ICZN*. *International Code of Zoological Nomenclature*.

*infraspecific name*. Under the *ICZN*, the third word in a subspecific or infrasubspecific trinomen.

*internal specifier*. A species, specimen or apomorphy that is explicitly included in the clade whose name is being defined (see *external specifier*). Every phylogenetic definition has at least one internal specifier, and all of the specifiers in standard node-based, apomorphy-modified node-based, and apomorphy-based definitions are internal.

*lineage*. A series of entities (e.g., organisms, populations) that form a single unbroken and unbranched sequence of ancestors and descendants. That a lineage is unbranched does not deny the existence of side-branches, which are not parts of the lineage in question, or of branching at lower organizational levels (e.g., organelle lineages within a population lineage). There may even be branching at the organizational level in question as long as it is judged to be temporary.

*monophyletic*. A set consisting of an ancestor and all of its descendants; usually used for groups the members of which share a more recent common ancestor with one another than with any non-members, though monophyletic groups of organisms within sexually reproducing species/populations may not have this property.

*name*. A word or words used to designate (refer to) an organism or a group of organisms. See *acceptable name*, *accepted name*, *established name*, *replacement name*, *scientific name*, *taxon name*.

*new (clade) name*. A newly proposed name that has been established in accordance with the rules of this code (see *converted (clade) name*).

*node*. A point or vertex on a tree (graph theory); on a phylogenetic tree, a node is commonly used to represent the split of one lineage to form two or more lineages (internal node) or the lineage at the present time (terminal node).

*node-based clade*. A clade originating from a particular node on a phylogenetic tree; a clade encompassing a particular node on a phylogenetic tree and all branches (internodes) and nodes descended from that node; a clade whose name is defined using a node-based definition. See Art. 2.2.

*node-based definition*. A definition that associates a name with a clade originating at a node (on a phylogenetic tree) representing the most recent common ancestor of specified descendant organisms and/or species (internal specifiers). See Note 9.3.1.

*nomen cladi conversum*. See *converted (clade) name*.

*nomen cladi novum*. See *new (clade) name*.

*nomen substitutum*. See *replacement name*.

*nominal author*. The person(s) who first published a name, regardless whether it was phylogenetically defined (see *definitional author*).

*orthography*. The spelling of a name.

*panclade name*. A name that is derived from the name of a crown clade by the addition of the prefix *Pan-* and is used to designate the total clade of that crown clade. See Arts. 10.3–10.6.

*paraphyletic*. A set including an ancestor but excluding some or all of its descendants.

*phylogenetic*. Of or pertaining to the history of ancestry and descent.

*phylogenetic definition*. A statement explicitly linking a taxon name with a particular clade.

*phylogenetic hypothesis (hypotheses)*. A proposition about the relationships among biological entities (e.g., species) in terms of common ancestry.

*phylogenetic system (of nomenclature)*. An integrated set of principles and rules governing the naming of taxa and the application of taxon names that is based on the principle of common descent. This code describes a phylogenetic system of nomenclature.

*phylogenetic tree*. The diagrammatic representation of phylogeny as a tree in the sense of a minimally connected graph (number of branches = number of nodes minus one).

*phylogeny*. Evolutionary history; the history of descent with modification, whether in general or a particular part thereof. The term is also sometimes used for a hypothesis of phylogenetic relationships (as in the term *reference phylogeny*).

*precedence*. The order of preference among established names, used to select the accepted name from among them. In general, precedence is based on the date of establishment, with earlier-established names having precedence over later ones, but later-established names may be conserved over earlier ones.

*preexisting name*. A scientific name that, prior to its establishment under this code, was either: (a) "legitimate" (*ICBN, ICNB*), "potentially valid" (*ICZN*), or "valid" (*ICVCN*); or (b) in use but not governed by any code (e.g., zoological names ranked above the family group).

*preomen (prenomina)*. The first part of a species binomen in phylogenetic nomenclature. The preomen of a species binomen in phylogenetic nomenclature is spelled the same as a genus name of rank-based nomenclature, but is not necessarily associated with the rank of genus.

*protologue*. Everything associated with a name when it was first established (under this code), validly published (*ICBN, ICNB*), or made available (*ICZN*), for example, description, diagnosis, phylogenetic definition, registration number, designation of type, illustrations, references, synonymy, geographical data, specimen citations, and discussion.

*qualifying clause.* A part of a phylogenetic definition that specifies conditions under which the defined name cannot be applied.

*rank.* The position in a hierarchy; in the case of biological nomenclature, the position in a hierarchy of nested taxa.

*rank-based codes.* The codes that govern the rank-based system of nomenclature —specifically, the *International Code of Botanical Nomenclature*, the *International Code of Zoological Nomenclature*, the *International Code of Nomenclature of Bacteria* and the *International Code of Virus Classification and Nomenclature*.

*rank-based system (of nomenclature).* An integrated set of principles and rules governing the naming of taxa and the application of taxon names that is based on taxonomic ranks (e.g., kingdom, phylum, etc.). Also referred to as the "traditional system."

*reference phylogeny.* A phylogenetic hypothesis that provides a context for applying a clade name by means of its phylogenetic definition.

*replacement name.* A new name explicitly substituted for a previously established name that is not acceptable because it is a later homonym. A replacement name is equivalent to a *nomen substitutum* in this code. (The term "replacement name" has been used in a broader sense under the *ICZN* to include what the *ICBN* refers to as a superfluous name and the *ICZN* refers to as an unnecessary substitute name.)

*restricted emendation.* A formal change in a phylogenetic definition that requires approval by the Committee on Phylogenetic Nomenclature; a restricted emendation is intended to change the application of a name through a change in the conceptualization of the clade to which it refers. See *unrestricted emendation*.

*scientific name.* A name that either is formed and governed by one of the codes of biological nomenclature or is of a similar Latinized form (e.g., zoological names ranked above the family group).

*sister clade.* One member of a pair of clades originating when a single lineage splits into two. Sister clades thus share an exclusive common ancestry and are mutually most closely related to one another in terms of common ancestry.

*species.* A segment of a population-level lineage that is evolving separately from other such lineage segments as indicated by one or more lines of evidence (e.g., distinguishability, reproductive isolation, monophyly, etc.).

*specific name.* Under the *ICZN*, the second word in a species binomen.

*specifier.* A species, specimen, or apomorphy cited in a phylogenetic definition of a name as a reference point that serves to specify the clade to which the name applies.

*stem-based definition.* See *branch-based definition*.

*stem-modified node-based definition.* See *branch-modified node-based definition*.

*suppressed name.* A name that would normally have precedence but does not, due to a decision by the Committee on Phylogenetic Nomenclature to give precedence to a later synonym or homonym.

*synapomorphy.* A shared, derived character state. In this code, a synapomorphy is a shared, derived character state inherited from a common ancestor that possessed that state; a shared, independently derived character state is not considered to be a synapomorphy in the sense the term is used in this code.

*synonym.* A name that is spelled differently than another name that refers to the same taxon. In the case of clade names, synonyms may be homodefinitive or heterodefinitive.

*taxon (taxa).* A taxonomic group of organisms. In this code, taxa may be clades or species.

*taxon name.* The word (or, in rank-based codes, words) used to designate a taxon.

*total clade.* A clade composed of a crown clade and all organisms (and species) that share a more recent common ancestor with that crown clade than with any extant organisms or species that are not members of that crown clade. Total clades are a subset of branch-based clades. See Art. 2.2.

*type (= nomenclatural type).* In the rank-based codes, the specimen, specimens, or subordinate taxon to which a taxon name is permanently attached; the type provides the standard of reference that determines the application of a name.

*typified name.* A name whose application is determined by a type under a rank-based code.

*unconditionally suppressed name.* A name that has been suppressed by the Committee on Phylogenetic Nomenclature in all phylogenetic contexts (see *suppressed name*); there are no conditions under which it would have precedence over any other name.

*uninomen (uninomina).* A name composed of a single word; in this code, the term is used to refer to the second part of a species binomen that is being treated as the name of a species (though the names of clades are also uninomina).

*unrestricted emendation.* A formal change in a phylogenetic definition that does not require approval by the Committee on Phylogenetic Nomenclature; an unrestricted emendation is intended to prevent undesirable changes in the application of a particular name (in terms of clade conceptualization) when the original definition is applied in the context of a revised phylogeny. See *restricted emendation*.

## Appendix A. Registration Procedures and Data Requirements

Most recent revision: June 2, 2006

This appendix may be revised more frequently than the main body of the code and without a formal meeting of the CPN. The most recent information is available on the Internet [URL will be inserted here] or from the database administrator: [address will be inserted here].

### I. Registration procedures

After a name is submitted to the database, the registration submission is checked for missing data and the data are entered into a publicly available database under the auspices of the International Society for Phylogenetic Nomenclature. No registration number is issued at this time if the paper or book in which the name will appear has not yet been accepted. Once the paper or book has been accepted for publication, the author must submit the information that it has been accepted in order to receive a registration number. Alternatively, an author may wait until after acceptance for publication before submitting the name, in which case the registration number will be issued immediately.

If the spelling or definition of a submitted name is identical to one that already exists in the registration database, the author will be warned.

Registration should, if possible, make use of the Internet interface to the registration database. Submission of registration forms by mail is also permitted.

### II. Data fields (mandatory data indicated with an asterisk)

#### 1. Data common to all clade names

Contact information (for each author): name\*, mailing address\*, phone number\*, fax number, email address, home page URL.

Name to be registered\*

Type of name\* (new clade name, converted clade name)

Date of registration\*

Bibliographic reference to publication

Date of publication

Definition type\* (node-based, branch-based, apomorphy-based, other ...)

Phylogenetic definition\*

List of specifiers\*

- For a species cited as a specifier: name\*, author\*, year of publication\*, code which governs the name\*, URL of taxonomic database holding information
- For an apomorphy cited as a specifier: description\*

- For a type specimen cited as a specifier: species name typified\*, author of species name typified\*, year of publication of species name typified\*, code governing typified name\*
- For a specimen (other than a type) cited as a specifier: repository institution\*, collection data needed to locate the specimen\*, description\*

Qualifying clause

Status of definition as emended (if appropriate)

Reference phylogeny (bibliographic reference, URL, or accession number in public repository)

Status of name as conserved or suppressed (if appropriate)

Author's comments

Administrator's annotations

## 2. Data particular to converted clade names

Preexisting name\*

Author of preexisting name\*

Direct bibliographic reference to original publication of preexisting name (including year)\*

Code governing the preexisting name\*

URL of taxonomic database holding information about the name

## 3. Data particular to new clade names

For a replacement name: replaced name\*

## Appendix. B. Code of Ethics

1. Authors proposing new names or converting preexisting names should observe the following principles, which together constitute a code of ethics.
2. An author should not publish a new name or convert a preexisting one if he or she has reason to believe that another person has already recognized the same taxon and intends to establish a name for it (or that the taxon is to be named in a posthumous work). An author in such a position should communicate with the other person (or their representatives) and only attempt to establish a name if the other person has failed to do so in a reasonable period (not less than a year).
3. An author should not publish a replacement name (a *nomen substitutum*) for a later homonym without informing the author of the latter name about the homonymy and allowing that person a reasonable time (at least a year) to establish a replacement name.
4. An author should not propose a name that, to his or her knowledge or reasonable belief, would be likely to give offense on any grounds.
5. An author should not use offensive or insulting language in any discussion or writing that involves phylogenetic nomenclature. Debates about phylogenetic nomenclature should be conducted in a courteous and professional manner.
6. Editors and others responsible for the publication of works dealing with phylogenetic nomenclature should avoid publishing any material that appears to them to contain a breach of the above principles.
7. Adherence to these principles is a matter for the conscience of individual persons. The CPN is not empowered to rule on alleged breaches of them.



### Appendix C. Equivalence of Nomenclatural Terms

Equivalence table of nomenclatural terms used in this code, the Draft *BioCode* and the current biological codes, except the *International Code of Virus Classification and Nomenclature* (patterned after a similar table in the Draft *BioCode*). The criteria represented by terms treated here as equivalent are not always exactly the same (e.g., establishment of a clade name in this code requires a phylogenetic definition, which is not a requirement of any other code). *BioCode* = Draft *BioCode* (Taxon 47: 127–150 [1997]). *Bacteriological Code* = *International Code of Nomenclature of Bacteria* (1992). *Botanical Code* = *International Code of Botanical Nomenclature* (2006). *Zoological Code* = *International Code of Zoological Nomenclature* (1999).

<b>This Code</b>	<b><i>BioCode</i></b>	<b><i>Bacteriological Code</i></b>	<b><i>Botanical Code</i></b>	<b><i>Zoological Code</i></b>
<i>Publication and precedence of names</i>				
published	published	effectively published	effectively published	published
precedence earlier	precedence earlier	priority senior	priority earlier	precedence senior
later	later	junior	later	junior
<i>Nomenclatural status</i>				
established	established	validly published	validly published	available
converted	-----	-----	-----	-----
acceptable registration	acceptable registration	legitimate validation	legitimate registration	potentially valid
<i>Taxonomic status</i>				
accepted	accepted	correct	correct	valid
<i>Synonymy and homonymy</i>				
homodefinitonal	homotypic	objective	nomenclatural	objective
heterodefinitonal	heterotypic	subjective	taxonomic	subjective
replacement name	replacement name	deliberate substitute	avowed substitute	new replacement name
-----	-----	-----	superfluous name	unnecessary substitute name
<i>Conservation and suppression</i>				
conserved	conserved	conserved	conserved	conserved
suppressed	suppressed/ rejected	rejected	rejected	suppressed

## INDEX

The references are not to pages but to the Articles, Recommendations, etc. of this Code, as follows: Pre. = Preamble; Pri. = Principles; Numerals = Articles; Numerals followed by letters = Recommendations; Ex. = Examples; N. = Notes; App. = Appendix; G. = Glossary. The Preface is not covered by the Index.

The index is currently not exhaustive but will be expanded before this code is published in hard copy.

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