

Best practice in the use of the scientific names of animals: Support for editors of technical journals

David Notton¹, Ellinor Michel², Natalie Dale-Skey², Svetlana Nikolaeva² & Steven Tracey²

1 *Department of Entomology, The Natural History Museum, Cromwell Road, London*

2 *I.C.Z.N. Secretariat, c/o Natural History Museum, Cromwell Road, London, SW7 5BD, U.K. (e-mail: iczn@nhm.ac.uk)*

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1. Introduction

The International Commission on Zoological Nomenclature, also known as the 'ICZN' and 'the Commission', supports editors of technical journals in applying best practice to zoological nomenclature.

This paper brings together selected topics of relevance to editors based on mentions of editors in the Code and experience of recent enquiries received by the ICZN Secretariat. It is necessarily technical but includes selected examples. Some topics could not be covered in detail but the Commission website has the complete and authoritative text of the 4th edition of the International Code of Zoological Nomenclature, also known as 'the Code', and a selection of FAQs:

What is the remit of the ICZN?; What is the code?; How should zoological names be written?; What are type specimens for?; What is the difference between availability and validity of names?; I think I have a new species, how can I get it named?; If a name is incorrectly spelled, what do I do?; What are the critical works in zoological nomenclature?; Who is the type of *Homo sapiens*?; Is there such thing as 'page priority'?; What is the status of ZooBank and registration?; Selling scientific names; Should I use Phylocode?; What is the status of the ICZN ruling on electronic-only publication of nomenclatural acts?; How can I help the ICZN?

We advise editors to state that nomenclature must follow the 4th edition of the Code (1999) in your instructions to authors. We recommend that you cite the web address of the Commission where the online version of the Code can be accessed: <http://iczn.org>.

Please make enquiries through the Commission's website: <http://iczn.org>.

2. The Commission and the Code

The Commission acts as adviser and arbiter for the zoological community mainly by producing the International Code of Zoological Nomenclature or 'the Code' – the set of rules for the scientific names of animals – and by resolving nomenclatural problems. The main purpose of the Code is to facilitate the communication of scientists by ensuring the stability and universality of zoological names. The introductory sections of the Code are worth reading for a general overview and the rules or 'Articles' of the Code are supplemented by 'Recommendations' which are advisory, not mandatory. Occasionally in specific cases where the precise application of the rules would threaten stability of nomenclature or cause confusion, the Commission has the power to issue rulings, called 'Opinions' or 'Declarations', suspending or modifying the rules in order to resolve the problem.

The Code does not regulate vernacular (common) names, nor does it regulate taxonomists in subjective matters of taxonomic judgement. For example, the choice of which classification is correct for a particular group of animals is entirely a matter for taxonomists.

3. General advice

To ensure effective peer review of taxonomic papers, we recommend that journals include expertise in zoological nomenclature among the editorial board and that this

is considered when selecting reviewers. ICZN Commissioners can be approached to serve on editorial boards; a list of current Commissioners can be found here: <http://iczn.org/commissioners>.

Editors should avoid publishing material which appears to contain any discourtesy, or potentially offensive behaviour, or language (Appendix A: Code of Ethics).

The Code does not yet recognise electronic publication (see section 9 below for more details)

The Commission does not recognise the Phylocode and, to avoid confusion, recommends that the Phylocode is not used for publishing zoological names and nomenclatural acts.

4. Key concepts

Some words used in nomenclature have technical definitions which differ from their everyday meanings; definitions are found in the Glossary of the Code. Key concepts are:

Binominal names – Editors should ensure scientific names of animals are written following the Principle of binominal nomenclature (Article 5) so they can be easily recognised as such. *See section 5 below for more on the format of names.*

Publication – For the purposes of the Code, publication is the issuing of a work: a) as a permanent scientific record; b) obtainable free of charge or by purchase; and c) simultaneously in numerous durable identical copies (Articles 8, 9). Published works have authorship (Chapter 11) and date (Chapter 5). Valid publication is a requirement for the availability of names. Authors, editors or publishers may disclaim their own published works for the purposes of nomenclature (Article 8.3) if they do not wish new names to become available. Establishing publication dates is essential to determine the precedence of names which are synonyms or homonyms. *See below for more details on publication (section 6) and electronic publication (section 9).*

Availability – Taxonomic papers commonly include descriptions of new taxa and the establishment of new names for the newly described taxa. Availability is a status which a name must gain before it is taken into account as a part of zoological nomenclature (Chapter 4). Names that are not available effectively do not exist for the purposes of zoological nomenclature and cannot be used. Names should be unique, unambiguous and universal and formed following precise rules (Formation of names, Chapter 7). Names are based on name-bearing types, the objective standard of reference for the application of scientific names of animals (Chapter 16). *See section 7 below for more details on availability and the publication of new names.*

Nomenclatural Acts – Published acts which affect the nomenclatural status of a scientific name or the typification of a nominal taxon.

5. Format of names – how to write names correctly

Standard formats for names

- Following the Principle of Binominal Nomenclature (i.e. composed of two names) a species name or ‘binomen’ is a combination of a genus name (such as *Apis*) and a specific name (such as *mellifera*). The genus name is first, and must start with an upper-case letter, the specific name second, starting with a lower-case letter (Article 28; Appendix B.6). This shows the hierarchy between

genus and species; a genus may include a number of different species. A subspecies name follows the specific name of the species. A subgenus name is placed in parentheses between the name of the genus and the specific name.

- Citing the author and date of publication is optional but often advisable (Article 51) and is added after the binominal name – *Apis mellifera* Linnaeus, 1758. This helps to avoid confusion between similar names and allows readers to find the original description.

Use of italics – Binomens (genus and specific names) are conventionally written in italics (or other contrasting typeface) to distinguish the name from surrounding text. This is advisable, although not mandatory (Appendix B.6). Subgenera and subspecies are treated similarly. Family-group names, including superfamily, family, subfamily, tribe and subtribe, are not italicised.

Alphabets and symbols that can be used – Only the 26-letters of the Latin alphabet 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, z are used for scientific names of animals (Article 11.2). Usually the spelling in the original description is followed (Article 32), but accents or other marks, such as ‘é’, ‘ø’, ‘ü’, must be corrected by later users; gaps, apostrophes and hyphens are removed (except where the first element is a Latin letter used to describe a character of the taxon, e.g. *c-album*, Article 32.5.2.4.3) and numbers spelled out in letters (Article 32.5.2).

Shortening names to save space

- After its first mention in a work (excepting the title) the genus name in a binominal name can be shortened to one or more letters (Appendix B.11) for example, *Apis mellifera* can be written as *A. mellifera*. Two- (or more) letter abbreviations may be used when using two genus names with the same initial letter(s), e.g. *Ae.* for *Aedes* and *An.* for *Anopheles*, as they are often discussed in the same work.
- It is advisable to write a species name with its author(s) and date at least once in a work (Recommendation 51A; Appendix B.10), usually on first mention. The author and date can be omitted elsewhere if this will not cause confusion.
- The names of authors of scientific names are not usually abbreviated, however when a name was published by more than three authors, the name of the first author (as given in the original publication) may be cited alone in the text and followed by the term ‘et al.’ (from Latin meaning ‘and others’); the full names of all the authors should be cited in the bibliography (Appendix B.12) when practical.

Use of brackets around author name – If a species has been transferred to a genus other than the one in which it was originally described, the original author’s name and date are put in parentheses (curved brackets). The lion, for example, was originally described by Linnaeus as *Felis leo*, in full *Felis leo* Linnaeus, 1758, but as knowledge of the cat family developed the genus *Felis* was split, the lion was placed in the new genus *Panthera*, and so the name is now *Panthera leo* (Linnaeus, 1758) (Article 51.3).

Punctuation of names – Apart from a parenthesis there must be no other punctuation between the species name and the name of the original author (Article 51.2). However, punctuation can be used to indicate a citation (Article 51.2.1), for

example, *Apis mellifera* Linnaeus, 1758 was originally named by Linnaeus in a book published in the year 1758, whereas, *Apis mellifera*: Michener, 2000 or *Apis mellifera*, sensu Michener, 2000, means the bee species *Apis mellifera* as later referred to by Michener (2000), thus helping to avoid confusion over who is the original author of a name.

Basing a specific name on a personal name – A specific name based on a personal name should follow Latin grammar; it may be a noun in the genitive case, a noun in apposition (nominative case) or an adjective or participle (Article 31). A noun in the genitive case is formed by adding a standard ending to the name or to the stem of the name if the Latin equivalent of the personal name is used. The standard endings are *-ae* for a woman, *-i* for a man, *-arum* for more than one woman, *-orum* for more than one man or a mixed group. The standard endings *-ensis*, *-ense* are used for place names, and not personal names. A Latin equivalent for a personal name can be used. Names in languages using non-Latin characters must be transliterated into Latin characters. Care should be taken because incorrectly formed names usually cannot be changed afterwards (Articles 32, 34). Examples are given in Table 1 below.

Table 1. Basing a specific name on a personal name

Personal name	Latinized?	Name or stem of name	Gender ending	Specific name
Margaret	No	margaret-	-ae	<i>margaretae</i>
Margaret	Margarita <i>or</i> Margaretha	margarit- <i>or</i> margareth-	-ae	<i>margaritae or</i> <i>margarethae</i>
Karl	No	karl-	-i	<i>karli</i>
Karl	Carolus <i>or</i> Karlius	carol- <i>or</i> karli-	-i	<i>caroli or karlii</i>
Margaret Smith	No	smith-	-ae	<i>smithae</i>
Karl Smith	No	smith-	-i	<i>smithi</i>
Margaret and Jane Smith	No	smith-	-arum	<i>smitharum</i>
Karl and John Smith	No	smith-	-orum	<i>smithorum</i>
Margaret and Karl Smith	No	smith-	-orum	<i>smithorum</i>
Margaret Smith	Smithia	smithi-	-ae	<i>smithiae</i>
Karl Smith	Smithius	smithi-	-i	<i>smithii</i>
Margaret & Jane Smith	Smithiae	smithi-	-arum	<i>smithiarum</i>
Karl & John Smith	Smithii	smithi-	-orum	<i>smithiorum</i>
Margaret & Karl Smith	Smithii	smithi-	-orum	<i>smithiorum</i>

We do not recommend nouns in apposition because the ending of the specific name is unchanged, and could easily be confused with an author's name (Recommendation 31A). Do not use a name which may give offence (Appendix A); authors should check that living persons agree with the way their name is to be used.

6. Publication of works on paper and other durable media

Authors, editors and publishers have a responsibility to ensure that works containing new names or nomenclatural acts are self-evidently published within the meaning of the Code. Works should contain the date of publication, and information about where copies may be obtained (Recommendation 8D).

Desirability of works on paper – We strongly urge authors and publishers to ensure new scientific names or nomenclatural acts are first published in a work printed on paper (Recommendation 8B).

Wide dissemination – Authors and editors should widely publicise new scientific names, nomenclatural acts, and information affecting nomenclature. This can be by publication in appropriate scientific journals or well-known monographic series and by ensuring new names are entered into *Zoological Record*. This is most easily done by sending a copy of the work to the *Zoological Record* (Recommendation 8A; Appendix B.9) published by Thomson Reuters.

Public accessibility of published works – Copies of published works which contain new scientific names or nomenclatural acts should be permanently conserved in public libraries (Recommendation 8C).

Inclusion of disclaimers – Works that are not issued for public and permanent scientific record (such as symposium abstracts, or notices of papers to be delivered at a meeting, minutes, etc.) are not valid publications and do not make names and taxonomic acts available. To avoid confusion, authors, editors and publishers should not include in these kinds of publications information that appears to make new names and taxonomic acts available. If names and acts must be included in these kinds of documents, editors should ensure that they contain a disclaimer (Article 8.2), for instance ‘This work is not issued for the purpose of zoological nomenclature’, so that the names and acts are clearly not available and do not enter zoological nomenclature unintentionally (Recommendations 8E). Disclaimers can also be used to avoid unintentional publication in works which are validly published but which are not intended to be used for the publication of zoological names (Recommendation 9A).

Completeness of descriptions of new taxa – Editors should ensure that the whole of the description and illustrations relating to a new nominal taxon, and particularly any nomenclatural acts or data needed to confer availability on its name, are published in the same work and on the same day (Recommendation 10A). This is particularly important in cases where supplementary information is removed from hard-copy publications and published online only, as electronic publications are not valid and the availability of a name will depend only on what is published in the hard copy. Publishing nomenclaturally critical information in a supplemental source risks making the name unavailable and can create confusion for later users of the name.

Specification of date Editors or publishers should state the day of publication of a work, and of each component part of a serial publication. In a volume made up of parts brought out separately, the day of publication of each separate part, including pages, plates, maps, etc. that constitute it, should be specified (Recommendation 21C).

Bibliographic information on separates and preprints – An author, editor or publisher should ensure that a ‘separate’ (reprint or offprint) contains a complete bibliographic citation of the original work (including its date of publication) and has the same pagination as that work. Preprints, with their own date of publication, should be identified clearly as such (Recommendation 21E).

Publication on specified date – An author, editor or publisher should not publish, permit to be published, or distribute a work, in whole or in part, for the first time other than on the specified date of publication. An author who receives separates before the specified date of publication should not distribute them until the work has been published (Recommendation 21A).

Correction of date – An author or publisher of a new scientific name or other nomenclatural act who is aware that the date specified in the work containing it is incorrect or incomplete should publish a correction (Recommendation 21F).

Recent changes to the Code affecting publication

- A work not printed on paper issued after 1999 in numerous identical, durable and unalterable copies (such as read-only laser disks) is published if the work itself contains a statement that copies (in the form in which it was published) have been deposited in at least five major publicly accessible libraries named in the work itself (Article 8.6). The deposition of paper copies is not required in this case. This article does not apply to non-durable electronic media which are not published works (Article 9.8).
- Hence the following are not validly published: (a) electronically distributed text or illustrations, such as e-mails, PDFs or web-pages; (b) downloaded copies or printouts of these; (c) abstracts of papers, posters, lectures, etc., issued at congresses, symposia and other meetings but not otherwise published; (d) offprints (separates) distributed after 1999 before the date of publication specified in the work (Article 9).
- Deposition of paper print-outs of PDFs in libraries does not make the original PDF a published work, but the paper print-out may become a published work in its own right provided it meets the criteria of publication for works printed on paper. This is not advisable as a method of publication; traditional hard-copy scientific journals are better as they usually have wider dissemination and a more durable format.

7. Publication of new species names

Authors, editors and publishers are responsible for ensuring that names are self-evidently made available within the meaning of the Code. To become available, new names must be published following the criteria in Articles 1.3 & 10–20. The criteria have become stricter over time, reflecting improved standards. Some of the main criteria currently are:

- Names must be spelled with the 26 letters of the Latin alphabet – accents and upper case letters at the beginning of specific names do not make names unavailable but must be corrected (Article 11.2).
- Binominal nomenclature must be used (Article 11.4).
- Specific names must contain two or more letters (Articles 11.8–9).
- Specific names must be published in combination with a genus name (Articles 11.9).
- There must be a description that is meant to distinguish the taxon from other taxa, or a reference to a previously published description, or the name must be expressly proposed as a new replacement name for an older available name (Article 13).
- Anonymously published names are not available (Article 14).
- Names published for varieties or forms are not available (Article 15).
- New names must be indicated as new (Article 16).
- Types must be fixed for species names (Article 16).
- Names are not available if proposed for:

- things which are not living or extinct animals (or their fossils or works);
- hypothetical concepts;
- teratological specimens as such;
- hybrid specimens;
- taxa below the rank of subspecies;
- temporary reference (not for formal taxonomic use);
- the works of extant animals, such as nests and tracks.

See Articles 1.1, 1.2, 1.3, 10.2, 13.6

- For example, the name '*Nessiteras rhombopteryx*', coined for the mythical Loch Ness Monster by Sir Peter Scott & Robert Rines (1975) *Nature* 258: 466–468, is unavailable because it does not refer to a living or extinct animal, and is a hypothetical concept. The name is an anagram of 'Monster hoax by Sir Peter S'. Journal editors beware!

Recent changes to the Code affecting the availability of new names – A new species-group name published after 1999 is not made available unless:

- it is explicitly indicated as being new (preferably by the use of a term such as 'sp. nov.' or by a directly equivalent term in the language in which the paper is written) (Article 16.1);
- its name-bearing type is fixed (a holotype or expressly indicated syntypes) (Article 16.4.1);
- if the name-bearing type of a species-group taxon proposed after 1999 is a preserved specimen or specimens, the author includes a statement with the name and location of the collection where the name-bearing type is or will be deposited (Article 16.4.2).

General advice on the establishment of new names

- An author, when drawing up the description of a new nominal taxon, should include comparisons with similar taxa to assist later identification of the taxon, and illustrate name-bearing types (Appendix B.3).
- An author establishing a new nominal taxon should state the higher (more inclusive) taxa (such as family, order and class) to which the taxon is assigned (Appendix B.4).
- An author establishing a new species-group name should state its etymology. New names should be in Latin form; they should be euphonious and easily memorable, and should not be liable to confusion with those of other taxa of any rank, or with vernacular words (Appendix B.5).
- If a new nominal taxon is established in a work written in a language which is not in wide international use for scientific purposes, the work should include an abstract which draws attention to the new name and is written in a widely used language (Appendix B.7).
- New names should be established in a work which is printed on paper, which has a wide circulation, and which zoologists would not regard as unlikely to contain new names in the taxonomic field concerned. Names should be established in the main text of the work, not in keys, tables, abstracts, footnotes or similar items (Appendix B.8).

Citation of names – A name should not be cited before its intended establishment (see also Appendix A, the 'Code of Ethics'), and should not be called 'new' except at the time of its establishment (Appendix B.10).

Further advice on nomenclatural and taxonomic aspects of describing new species can be found in the following works:

- Taylor, M. *et al.* 2011. Checklist for new zoological genus and species names: <http://sypow.wordpress.com/checklist-for-new-zoological-genus-and-species-names-draft/>
- Winston, J.E. 1999. *Describing species: Practical taxonomic procedure for biologists*. 518 pp. Columbia Univ. Press.

8. Lectotype designations

Lectotype designations must now contain an express statement of deliberate designation (Article 74.7.3, as amended by Declaration 44), such as 'lectotype hereby designated'.

9. The future for electronic publication

Electronic publication, e.g. PDFs and web pages, is currently not valid for the purposes of nomenclature, and hard copy is still required. However, recognising the increasing importance of electronic publication, the Commission has issued a proposed amendment to the Code that outlines ways to allow publication of nomenclatural acts in electronic-only journals, but not on websites or other transient electronic media. This was published in a range of journals and available for public input for a year, then submitted to the IUBS at its meeting in Cape Town, South Africa, in November 2009, where it was ratified in principle. Further discussion is ongoing, with a decision from the Commission anticipated soon. <http://iczn.org/content/availability-electronic-publication>.

So, for journals comprising electronic and paper versions, the availability of acts, names, and dates of publication is currently defined only by the paper version. We recommend that editors of electronically published journals who wish to make the nomenclatural acts contained in them valid/available follow the joint approach for providing paper copies agreed by ICZN and the Public Library of Science: Information and guidelines for PLoS authors submitting a new taxon name (zoological nomenclature only) at: <http://www.plosone.org/static/guidelines.action>.

We also recommend that electronic preprints are not circulated as there is a danger that names and nomenclatural acts may be inadvertently or unscrupulously published by third parties who copy and publish the content in print form before the official publication of the paper copy. Hence posting electronic preprints is not good practice for nomenclatural works.

The Commission supports open access of electronic publications, e.g. following the principles of the Creative Commons license (creativecommons.org).

10. ZooBank and the registration of names

ZooBank is a Commission website for the registration of the following:

- *Nomenclatural Acts* – published usages of scientific names of animals, which affect the nomenclatural status of a scientific name or the typification of a nominal taxon;
- *Publications* – publications that contain nomenclatural acts, as defined above;
- *Authors* – names of authors of publications, as defined above;

- *Type Specimens* – type specimens for zoological names. The registration of types is provisional, with the expectation that natural-history collections holding types will implement their own registries, to which ZooBank will link.

ZooBank is currently functional, and is in a phase of rapid improvement (see <http://www.zoobank.org>). Names and acts can be registered and LSIDs are assigned for each registered component. Input is currently via a small number of editors; the interface is expected to allow greater public access in late 2011. Development is proceeding in partnership with the development of the Global Names Architecture (see <http://www.globalnames.org/>). The Commission's ZooBank Committee formulates policies for ZooBank. If you have a nomenclatural act you would like to register, or would like to become a data editor to allow you to enter multiple registrations, please contact Richard Pyle (deepreef@bishopmuseum.org).

Registration is advised for new names. It is likely to become mandatory for names in electronic-only publications if the amendment on e-only publication passes (e-only publication is not currently valid, see above). Your input on ZooBank is welcome.

11. Sources of information and advice

The full and authoritative text of the Code, FAQs and much more can be found on the Commission's website: <http://iczn.org>.

Acknowledgements

For discussions and helpful comments on the manuscript: Alessandro Minelli, Bruce Halliday, Daphne Fautin, David Patterson, Denis Brothers, Gary Rosenberg, Jan van Tol, Susan Lim, Mark J. Grygier, Maurice Kottelat, Miguel A. Alonso-Zarazaga, Pavel Štys, Philippe Bouchet and Thomas Pape.