

Guidelines for the Capture and Management of Digital Zoological Names Information

Francisco W. Welter-Schultes

Version 1.1



March 2013

Suggested citation:

Welter-Schultes, F.W. (2012). Guidelines for the capture and management of digital zoological names information. Version 1.1 released on March 2013. Copenhagen: Global Biodiversity Information Facility, 126 pp, ISBN: 87-92020-44-5, accessible online at http://www.gbif.org/orc/?doc_id=2784.

ISBN: 87-92020-44-5 (10 digits), 978-87-92020-44-4 (13 digits).

Persistent URI: http://www.gbif.org/orc/?doc_id=2784.

Language: English.

Copyright © F. W. Welter-Schultes & Global Biodiversity Information Facility, 2012.

Disclaimer: The information, ideas, and opinions presented in this publication are those of the author and do not represent those of GBIF.

License:

This document is licensed under Creative Commons Attribution 3.0.

Document Control:

Version	Description	Date of release	Author(s)
0.1	First complete draft.	January 2012	F. W. Welter-Schultes
0.2	Document re-structured to improve usability. Available for public review.	February 2012	F. W. Welter-Schultes & A. González-Talaván
1.0	First public version of the document.	June 2012	F. W. Welter-Schultes
1.1	Minor editions	March 2013	F. W. Welter-Schultes

Cover Credit: GBIF Secretariat, 2012. Image by Levi Szekeres (Romania), obtained by stock.xchng (<http://www.sxc.hu/photo/1389360>).



Table of Contents

How to use this book	1
----------------------------	---

SECTION I

1. Introduction	2
1.1. Identifiers and the role of Linnean names	2
1.1.1 Identifiers	2
1.1.2 Taxon concept models	3
1.1.3 How unique is a zoological name?	5
1.1.4 The problem of variant spellings of Linnean names	6
1.2 Biological background: What are zoological species, genera, families, higher groups?	6
1.3 Differences between zoology and botany	7
1.4 How zoological names are formed	8
1.4.1 Difference between nomenclature and taxonomy	8
1.4.2 Latin script and character encoding	9
1.4.3 Binominal and polynominal names	9
1.4.4 Original and current combination of species.....	10
1.4.5 Taxonomic ranks: hierarchy of names	12
1.4.6 Derivation of names	16
1.5 Some general notes about the ICZN Code and official zoological bodies	16
1.5.1 The nature of the ICZN Code.....	16
1.5.2 Limits of acceptance in the community	17
1.6 The spirit of zoological nomenclature, basic rules of the ICZN Code	18
2. Best practices and recommendations in the handling of taxonomic and nomenclatural data.....	20
2.1 How to cite the original spelling and the original combination.....	20
2.2 Stability and occasional change of genus-species names	22
2.3 Taxonomy or nomenclature: why do names change?.....	23
2.4 When should a name be changed? Best practice guide for changing names or not.....	24
2.5 Brief recommendations for establishing new names	25
3. Best practice guide for spellings of taxon name author strings	28

SECTION II

4. Verifying the correctness of a name: how to find and cite the original name	30
4.1 How to find published work	31
4.1.1 Technical preconditions: printed paper	31
4.1.2 Helpful resources to find original publications	32
4.2 Best practice guide to cite zoological literature	33
4.2.1 Differences between monographs, journal articles and articles in monographic works	34
4.2.2 Name of the author(s) of a publication	35
4.2.3 Year of publication	40
4.2.4 Title of the work	41
4.2.5 Journal titles	45
4.2.6 Page numbers, plate numbers	47
4.2.7 Locality of publication and publisher	49
5. Is the name available?	50
5.1 Published and unpublished work	50
5.2 Did the author apply binominal nomenclature?	52
5.2.1 Style of the work	52
5.2.2 Use of non-binominal names	53
5.3 "Used as valid" when proposed	54
5.3.1 Names cited in pure documentations of other sources	55
5.3.2 Alternate names for the same taxon	55
5.3.3 Unclear and conditional classifications	56
5.4 Was the name new when proposed?	56
5.4.1 Sensu names	57
5.4.2 Deliberate misidentifications	58
5.5 The frame within which a name can be spelled	58
5.6 Special requirements for availability	60
5.6.1 Requirements for genera	60
5.6.2 Requirements for species	60
6. Can the name be used?	64
6.1 Available names which cannot be used	64
6.1.1 Homonyms	64
6.1.2 Synonyms	66
6.1.3 Names rejected under Art. 23.9	67

6.1.4 Names suppressed by the Commission	67
6.2 Unavailable names which can be used	68
6.2.1 Art. 11.6: validated synonyms	68
7. Special chapter: new replacement names.....	70
8. How is the name correctly spelled?.....	74
8.1 The names of genus and species	74
8.1.1 Incorrect original spellings that must be corrected.....	74
8.1.2 Names that must not be corrected	79
8.1.3 Selection procedure between two equivalent original spellings	82
8.1.4 Treatment of subsequently modified spellings of names	82
8.1.5 Prevailing usage	84
8.1.6 Gender agreement.....	86
8.2 The name of the author	93
8.2.1 How to determine who is the author.....	94
8.2.2 Spelling of the author	99
8.3 The correct year in a name	108
9. Types, type designations, type locality	111
9.1 Type species of genera	111
9.1.1 How to determine the type species.	111
9.2 Types of species, subspecies and subordinate variants	116
9.3 Type locality	117
10. Current status and mechanisms for the online registration of names and nomenclatural acts	119
Acknowledgements	120
References	121

How to use this book

This book is conceived as an extensive guide that aims to help those working with zoological scientific names in digital environments to do it in a standard and uniform way. It compiles all the most frequent cases of conflict that the reader may find when digitizing names, and provides advice based on the Zoological Code of Nomenclature and experience gathered over the years by the AnimalBase team. All the cases are extensively documented with examples.

The structure of the book is as follows:

The **introduction** (chapter 1) provides background information for those who need to refresh some concepts about nomenclature and taxonomy applied to zoological names.

Chapters 2 and 3 are a summary of the best practices for handling nomenclatural data including authors' names, a major source of discrepancies. The rationale for many of these recommendations can be found in the following chapters.

Chapters 4 to 7 describe how to use (and properly record) the original citation of a name to find out if the name is available and can be used.

Chapter 8 helps to confirm which is the correct spelling of names, including when to correct names and in which terms. It complements and expands chapters 2 and 3.

Chapter 9 is targeted at those who work with type specimens.

Chapter 10 describes ZooBank, one of the current initiatives to register zoological names globally.

Most users will not need to read all chapters in detail. Those interested in using names as a backbone for digital systems managing other kinds of biodiversity information will most probably use chapters 1 to 3 to determine the correct spelling of the names they use. Those whose main focus is working with the taxonomic information itself, will probably find chapters 4 to 7 very useful when dealing with literature and the most problematic cases.

The whole book can be used as a **reference guide**: when you need to know how to deal with a specific case, try using the table of contents or the search feature of your reader (if using a digital version of this document) to find the information you need.

1. Introduction

This contribution is thought as a guide for those who seek advice on handling zoological names, who like to share with others biodiversity-related information on animal species using electronic data resources, and for those who are interested in more effective strategies for connecting the information.

Important aspects will include a guide to verifying the correctness of zoological names and the proposal of a best practice guide for uniform spellings, with particular focus on the names of the authors, currently perhaps the most serious problem.

In the AnimalBase team at Göttingen University we have been working for several years on digitizing early zoological literature and providing free access to it. We also established an interdisciplinary zoological database containing the original taxonomic names of species and genera published in the early works, for which we had to apply the same rules and standards in all animal groups.

Our approach and scope of the AnimalBase project explains that this manual is mainly focussed on species and genera, not on families and higher categories, and it also explains the trend that rules and special problems concerning modern names established after 1930 are more rarely mentioned in this manual.

This guide also intends to give some recommendations for publishing new names as well as advice for those taxonomists and users of zoological names who ask themselves whether or not and in which situation it is necessary or useful to change a commonly used name of a zoological species.

Many databases provide precious information on animals. Others try to connect information from various databases, either to harvest contents from them or to link to them. This creates a need to use standard identifiers for animals, particularly for species.

By way of massive use of internet resources, development of knowledge occurs across web interfaces of organisations and projects by recycling and building on the work of others. Data are shared to a much greater extent than prior to the adoption of internet technologies, where information was mainly derived from printed publications. A researcher needs to be able to compile data from various sources into a single analysis. Data suppliers need to tag their data with identifiers.

The information on a species is usually connected by means of the most successful identifier that was ever invented for the purpose of effective communication in bioscientific contexts: an internationally accepted binominal name established in the Linnean system.

This is a strictly historical system invented in the 1750s in Sweden, internationally accepted since the late 1780s. For a group or concept of animals (genus, species etc.) only one name must be used, and the same name must not be used for another such group of animals of the same rank.

The success of the Linnean names is mainly attributed to the fact that they can be pronounced, they are memorable, easily controlled for error and adaptable to progress in bioscientific research. Practically every bioscientific source uses Linnean names when referring to species.

Making life easier for those who try to connect biodiversity databases can be a step to facilitate biodiversity research. By saving some unnecessary costs this might contribute to help protect nature.

This is a training manual written for a broad public, so I tend to avoid insider terms used in the ICZN Code. Subspecies and subgenera are species and genera in the sense of this manual, if not otherwise stated.

1.1. Identifiers and the role of Linnean names

1.1.1 Identifiers

Biodiversity data are tagged by identifiers which serve as keys to information. Databases talk with each other by using identifiers.

There are various classes of identifiers used in these contexts. They can either be natural keys or surrogate keys. A natural key contains "intelligent" information, data-bearing fields, while a surrogate key is just a number and does not contain information about the object being identified.

In zoology, a Linnean name of a species consists basically of two components (genus-species), but due to the high number of 3-4 million names this is not sufficient to avoid error sources. Therefore, usually four components are used: genus-species-author-year (genera: three components, genus-author-year), a construction for which the term "**taxon name author string**" is used. Zoological names follow a slightly different system than botanical names.

These Linnean names are compound **natural keys**, usually given in the form: *Elephas maximus* Linnaeus, 1758 (genus-species-author-year).

They can be converted to combined long text strings (single-field natural keys), for example in the forms: `elephas_maximus_linnaeus_1758` or `elephas_maximus_linnaeus_1758_used`.

Such single-field or concatenated natural keys could be used for data interchange. Two databases who like to connect their information could create such keys on the basis of the Linnean names and work with them. A precondition would be that the Linnean names would be spelled absolutely identically in both databases and produce the same single-field natural key. In zoology, the major problem for this approach is the varying spelling of names in various sources, in particular the spelling of the author which usually provides the most significant obstacle.

It is also possible to use the compound natural key and create a query using the four components which should match in both databases. But also here, the varying spelling of zoological names is a major problem.

A third approach is to use a third identifier, for example, a surrogate key which both databases would need to know.

Examples for **surrogate keys** are IDs as used by many databases, often a number arbitrarily given to an object. Should the name change, the ID will remain the same.

Many databases use self-created identifiers in addition to the Linnean names, usually to facilitate navigation within a database system. Databases use surrogate keys as IDs for many different objects, such as original names, currently used names, literature references or journal titles. Some web interfaces of biodiversity databases show the IDs to the user, or even invite the user to use these IDs, for example for quick navigation within a database. If you know the ID, you will find the object more quickly. Numeric IDs often appear in browser lines, and you can easily find an object by inserting the ID.

ZooBank uses **UUIDs**, Universally Unique Identifiers. A UUID is a 128-bit number, usually written in the form 8-4-4-4-12 for a total of 32 digits (0-9 and A-F) and 4 hyphens, for example, `37AA3C1B-B498-406B-A51C-C3CF8C88A59F`. Anyone can create such a UUID; with a random generator following a given standard, the probability that you hit the same combination is $1/(3.4 \text{ E}+38)$, incredibly low.

The term **GUID** (Globally Unique Identifier) usually refers to Microsoft's implementation of the UUID standard.

LSIDs (Life Science Identifiers) were developed by IBM to locate pieces of information on the Internet. They have a different structure (something like a natural key), they have been used for a while and it seems they are slowly becoming outdated.

Some projects are currently trying to establish services for persistent identifiers which can be shared by two databases when trying to connect their information. The idea is to submit a Linnean name and to receive a globally used ID.

The Global Names Architecture **GNA** is trying to deliver a single set of globally unique identifiers to be used, but naturally this creates the same problem: If your Linnean names do not exactly match those provided by GNA, you need a tool to bring your names in accordance with that of the GNA. For this purpose a Global Names Index **GNI** was developed (www.globalnames.org). In this index all variants with and without authors, years and initials, **including incorrect spellings** and taxonomic concept constructions, can be found. In 2010 there were 18 million entries of scientific names (2011: 20 million). This is a useful resource, because if there is an error in a name, you can try to find the correct name or correct author and year.

The permanent, shared, unique persistent identifiers will then eventually emerge from a Global Names Usage Bank **GNUB**. This could potentially provide a global perspective for the future, at least for larger database projects. Any given database would need to cross-check their names with the GNUB database, extract their IDs for the Linnean names and then share them with other databases using the same IDs.

This model is perhaps less suitable for smaller databases. These might connect their data more directly by working with Linnean names. This is why it makes sense to better prepare Linnean animal names for their use in biodiversity informatics.

The baseline of all these approaches is that Linnean names play a crucial and important role in these processes, and that unique and identical spelling of a Linnean name in different databases is a crucial detail for enabling the world's biodiversity data to be cross-linked. Identical spellings are not indispensable, because there are tools to compensate for their shortcomings, but they would certainly facilitate the work.

1.1.2 Taxon concept models

The meaning of a name used in one source at a given time may differ from that of the same name used in another source at another time. Bioscientific research is progressing steadily, authors can have different views on the same group of animals, or names are applied incorrectly (misidentifications).

Time is an important factor under such conditions. Only a proportion of specific names is used in the same sense as 100 years ago. This varies substantially among disciplines. Names of birds and mammals tend to have conserved their meaning for longer times than hemipterous insects or acanthocephalan worms, simply because

birds and mammals are better known. In European non-marine molluscs, which is perhaps a more or less representative group between the extremes, we can integrate data from an estimated 70-80 % of the specific names established until 1900 from pre-1900 sources, and a much lower proportion has not modified its generic classification (9 % of 1380 species known before 1900 are still in the same genus as originally classified). Linnean names allow to communicate between centuries, but you have to know the limits.

The name/meaning divergence is regarded as a major impediment to the integration of biological information (Franz & Peet 2009). This is a general problem of Linnean names and can neither be solved here nor by using other identifiers.

I have a few more comments about recent proposals to overcome problems associated with the name/meaning divergence. Several approaches were proposed to improve tracking the quality behind the information connected to a Linnean name in a certain context. These approaches involved models of taxonomic concepts (Franz 2005, Kennedy et al. 2006, Franz et al. 2008, Franz & Peet 2009) by which the use of Linnean names should be more accurately delimited using more or less objectively defined standards. The proposed solutions involved adding metadata to the Linnean name to improve the quality of the biodiversity information behind it. Berendsohn (1995) proposed using the term *secundum* (*sec.*, = according to) to label different usages of a name, for example *Carya ovata* Gleason 1952 *sec.* Stone 1997 (plants: Juglandaceae), Stone 1997 being the author of a revision generally accepted as important, where the concept of this species was delimited. The idea behind this proposal was that ambiguities in the use of Linnean names would mainly result from multiple revisions of a taxonomic name. The term "*secundum*" was not new; in zoology it was already used in similar contexts in the early 1800s.

A major shortcoming of these taxonomic concept models is that they were elaborated in botanical environments using few well-studied model groups; they only **seem to be of limited value for zoological contexts**. Other than in botany, the use of zoological names seems to be much more diverse and not as well defined - if the cited models reflect current trends in botanical taxonomy at all. It is extremely **difficult to determine whether or not a zoological name was correctly applied** in a publication, and it is certainly not possible to define objective criteria for a reliable data quality assessment. In zoology, only in some cases are name/meaning divergences provoked by multiple revisions of a taxonomic name.

The authors of these theoretical models also failed to provide evidence that such a model would actually be applicable in practice as well as improve the situation for biodiversity data management. The model depends on the assumption that any author who used a name explicitly defined in which sense the name was used. For such a model it would also be necessary to define which publication should be regarded as a "major revision", qualifying for a "*secundum*" authorship. A revision of a genus would certainly be one, but where are the limits? If an author revised a genus and separated a subgenus containing two species without mentioning to which subgenus four additional species belong, can we add those species later as having been implicitly contained and thus revise the author's incompletely presented concept of the subgenus?

The major source of incongruent uses of zoological names is simply misidentifications. This occurs frequently, for example in molecular studies which deal with a decreasing ability of bioscientists to identify species correctly before studying them on a molecular basis. Taxonomists can sometimes recognise such misidentifications if a locality was given where the species is known not to live, or if voucher specimens were deposited somewhere. But even then, it is not possible to improve the data record, for example in GenBank, where molecular data deposited under a name of a misidentified species cannot subsequently be shifted to the (presumably) correct name of the species. The database provider will not allow metadata to be added afterwards. So although an author may have cited a certain source as the basis for the use of a name (an equivalent to Stone 1997 in the example given above), which could serve as an objective criterion, the species in question could have been misidentified anyway. The reliability behind a name must be evaluated for each use of each name individually.

One must know that a certain name was used in another sense prior to the 1970s than afterwards. One must know that a shift in the use of the name was not always initiated by a published source (an important difference from the theoretical model proposed by Franz 2005), and that even if so, subsequent authors were not always aware that in previous sources a modification of the meaning of the name was proposed. One must know how taxonomy works in practical zoological life.

Below are some examples regarding terrestrial molluscs which illustrate the main problems. In contrast to many marine species and fishes, terrestrial molluscs have no dominating central internet resource; they reflect developments in a diverse body of experts.

Examples:

Some researchers analysed the type specimens of 6 European endangered *Anisus* species (Gastropoda) and did not publish detailed results. Based on these analyses, Falkner et al. 2001 and Falkner et al. 2002 rejected on species checklists the traditional use of the six names and simply used the names in a different sense. In a much more detailed study of the group, Glöer 2002 came to different conclusions and only partially accepted these changes. The names as used by the Falkner et al. 2001 checklist were copied to the Fauna Europaea database file (www.faunaeur.org) in 2004, a very important internet resource used by many researchers. It is necessary to know this as well as the fact that the data behind these entries were not based on a sound and scientifically published study, and that the classification had been rejected in a much more detailed scientific study by Glöer in 2002. Glöer & Meier-Brook 2008 finally rejected Falkner et al.'s 2001 entire concept. Around 2010 www.faunaeur.org returned to the traditionally used names, but many internet sources had meanwhile copied the

information, classified taxa under the untenable concept and associated information on distributional ranges to names which were not corrected later.

The gastropod *Viviparus viviparus* does not live in Austria, a rare case of a true distributional gap of a common European freshwater mollusc. But many do not know this, and the relatively similar species *Viviparus contectus* is repeatedly misidentified and reported as *V. viviparus* from Austrian localities, as can be seen in GBIF range maps. It is almost impossible to trace the nature of the errors in the original sources - true misidentifications by the authors or copied data of previous publications. The only solution is to know that the Austrian records must be incorrect.

For more than 5 decades the genus *Oxychilus* was studied intensively by A. Riedel who published a summary of his work in 1998. In the same year, Giusti & Manganelli studied a few species and mentioned that the subgeneric classification of *Oxychilus* could be questioned. In their uncommented checklist of European species, Falkner et al. 2001 subdivided the genus and elevated three subgenera to generic rank. Giusti & Manganelli 2002 made clear that they did not intend to modify Riedel's 1998 classification. The data provided by Falkner et al. 2001 were copied to the Fauna Europea online database mentioned above, and since then have been used by many researchers. Today these names are used in the sense of an internet database, or a simple checklist, without being based on a taxonomic concept. No detailed scientific study has proposed a sound concept for a new classification after Riedel 1998.

In some zoological revisions, responsible authors who were aware of the problem that the use of a name before and after a revision will stand in contrast to each other, associated the new taxon concept simply with a previously forgotten old name. Sometimes this is an option to avoid ambiguous name/meaning divergences.

Example:

The names of several species of *Radix* (Gastropoda) had to change after a detailed study by Bargues et al. 2001 who found three species A, B and C. Prior to 2001, the name *ovata* was used for species A and B, *peregra* for species C. The authors found that the types of *ovata* and *peregra* both belonged to species A. Then they proposed to use the older and forgotten name *balthica* for species A, *lagotis* for B and *labiata* for C. Both names *ovata* and *peregra* would no longer be used after 2001; they were junior synonyms of *balthica*. This means that all old *peregra* records referred to *labiata*, the old *ovata* records referred partly to *balthica* and to *lagotis*, usually to *balthica*. Today, the use of *balthica* will automatically indicate identification according to the classification after 2001. New records of *peregra* and *ovata* after 2001 will automatically indicate usage of the old concept.

Google hits 2007-2009, Google Scholar 2011 (the figures for Google hits were only of limited reliability until 2009, but it was possible to verify the results from other computers. After 2010 they depended increasingly on the geographic location of the querying IP address and became totally unreliable. The figures for Google Scholar included citations and were still based on true hits in 2011):

07.2007: "radix-ovata" 650, "radix-peregra" 850, "radix-balthica" 1000, "radix-lagotis" 90, "radix-labiata" 350.

07.2007: "lymnaea-ovata" 620, "lymnaea-peregra" 18,500, "lymnaea-balthica" 15, "lymnaea-lagotis" 30, "lymnaea-labiata" 0.

09.2009: "radix-ovata" 6300, "radix-peregra" 3100, "radix-balthica" 1700, "radix-lagotis" 150, "radix-labiata" 500.

09.2009: "lymnaea-ovata" 800, "lymnaea-peregra" 5400, "lymnaea-balthica" 200, "lymnaea-lagotis" 230, "lymnaea-labiata" 0.

11.2011 ("since 1992"): "radix-ovata" 360, "radix-peregra" 502, "radix-balthica" 266, "radix-lagotis" 30, "radix-labiata" 95.

11.2011: "lymnaea-ovata" 150, "lymnaea-peregra" 1080, "lymnaea-balthica" 7, "lymnaea-lagotis" 10, "lymnaea-labiata" 0.

The name *balthica* is only slowly gaining importance in internet resources. Interestingly, many sources still use the genus *Lymnaea* which has not been used as the genus for these species by taxonomic experts for several decades.

1.1.3 How unique is a zoological name?

The rules on how zoological names are constructed are written in the International Code of Zoological Nomenclature (ICZN Code or often simply Code, www.iczn.org/iczn), a compound collection of regulations which in large parts are followed more or less strictly by the zoological community. Its main objective is to provide unique names for animals.

How much information is needed to provide a unique data set referring to a taxon?

Below I will explain the difference between the **original** and the **currently used genus-species combination**. The main point is that a species originally established as *Fringilla domestica* can be classified in another genus and change its genus-species combination to *Passer domesticus*.

If Linnean names are referred to as unique identifiers, this almost exclusively concerns names in their currently used combination. Usually the currently used name of a species is used to connect biodiversity-related information. But in some instances it is necessary to mobilise information not only connected to the currently used name, but also to the original name or to names of synonyms, which are cited in their original combinations.

The taxon name author string (genus-species-author-year) is only unique for current combinations. The zoological rules have effectively inhibited homonyms from being used in current genus-species combinations (ICZN Code Art. 52-60). Author and year are not needed to provide a unique identifier for currently used Linnean names; genus and species would be sufficient. Authorship and year are given for some other reasons which has to do with variant classifications and error control.

For **original names** the author and the year are very important and homonyms are frequent.

Examples:

Ansa Walker 1858 (Lepidoptera), not *Ansa* Walker 1868 (Hemiptera)

Balsa Walker 1860 (Lepidoptera), not *Balsa* Walker 1867 (Hemiptera)

Helix praetexta Pfeiffer 1848, not *Helix praetexta* Pfeiffer 1871 (Gastropoda)

Conus catenatus Sowerby 1850, not *Conus catenatus* Sowerby 1875 (Gastropoda)

Helix balcanica Kobelt 1876, not *Helix balcanica* Kobelt 1903 (Gastropoda)

Clausilia calcarea Boettger 1878, not *Clausilia calcarea* Boettger 1880 (Gastropoda)

Clausilia chia Boettger 1878, not *Clausilia chia* Boettger 1889 (Gastropoda)

For the original names, the four (genus: three) components alone would not provide a unique identifier, because some homonyms were established by the same author in the same year. Authors were not always aware of producing homonyms when they established a specific name at a specific rank and on another occasion the same name at a subspecific rank.

We also have some rare examples where the same author established the same name twice in the same year, for different animals. At least for genera it must have been well known that this was against all conventions.

Examples:

Amydona Walker 1855 (Lepidoptera: Limacodidae) (p. 1110), not *Amydona* Walker 1855 (Lepidoptera: Lasiocampidae) (p. 1413)
Betousa Walker 1865 (Lepidoptera: Thyridae) (p. 1111), not *Betousa* Walker 1865 (Lepidoptera: Noctuidae) (p. 1208)
Cicada variegata Fabricius 1775 (p. 684), not *Cicada variegata* Fabricius 1775 (p. 686) (both Auchenorrhyncha)
Noctua marginata Fabricius 1775 (p. 597), not *Noctua marginata* Fabricius 1775 (p. 610) (both Lepidoptera: Noctuidae)
Clausilia (Albinaria) oertzeni Boettger 1889 (p. 42), not *Clausilia (Albinaria) schuchi* var. *oertzeni* Boettger 1889 (p. 52) (both
 Gastropoda: Clausiliidae)

Thus, one more field of information would be needed to provide a unique identifier for an original name. The page of description would do it in most cases. In extremely rare cases not.

Examples:

Laphria limbata Macquart 1834 (p. 187 No. 29) from French Guyana, not *Laphria limbata* Macquart 1834 (p. 187 No. 31) from mainland France (Diptera)
Zonites verticillus var. *graeca* Kobelt 1876 (p. 48), not *Zonites albanicus* var. *graeca* Kobelt 1876 (p. 48) (Gastropoda)

1.1.4 The problem of variant spellings of Linnean names

As already mentioned above, Linnean names referring to the same species need to be spelled identically. Presence of variant spellings for the same name is undesired and a problem in zoology.

We have perfect guides provided by the ICZN Code for how to spell genus and species, **we have no official guide for the name of the author**, and we have relatively good guides for the year.

Names of authors in a taxonomic name are often spelled in various ways; this is a considerable source of problems.

Electronic systems are highly character-sensitive. If only one of the four components deviates in only one character, database providers will inevitably be confronted with an increase of costs for the usually manual or semiautomatic work necessary to connect data sets belonging to the same species. A computer program cannot automatically connect a name for a gastropod species *Helix aspersa* Müller 1774 in one database with another name *Helix aspersa* O. F. Müller 1774 in another database. It is at least equally difficult for a computer program to connect *Helix aspersa* with *Cantareus aspersus*.

It is desirable that all four components contain the same characters in the files of both databases. But in many cases it is impossible to tell taxonomists or database providers that they should all use the same genus for a species. The community is too diverse. Some like the name *Helix aspersa*, others *Cantareus aspersus*, again others *Cornu aspersum*, and still others *Cryptomphalus aspersus*. All four combinations are correct under certain circumstances; no consensus can be reached.

Users of electronic information on species can only recommend not to change generic names if not absolutely necessary in order to avoid names appearing as *Helix aspersa* in one database and as *Cantareus aspersus* in another database. Taxonomists tend to do this all the time in almost all animal groups, and there is no perspective to improve the situation for the names in their function as identifiers. But this increases the importance of the author in a Linnean name. The author is often necessary in order to understand the situation and to identify the two names with the same taxon.

Consistent spellings for zoological authors in taxon name author strings would certainly improve the situation. Proposing a best practice guide for authors is one of the most important issues in this manual.

1.2 Biological background: What are zoological species, genera, families, higher groups?

A **species** is usually acceptably well defined by biological criteria. In many animal groups a biological species comprises a group of animals able to produce fertile offspring under natural conditions, species should be reproductively isolated from other such groups. This does not work in all animals, it is difficult to apply this concept in animals without sexual reproduction, or when slightly different animals live on remote islands or in different regions. In some animal groups other species concepts are used, such as the phylogenetic species concept, which are lastly based on the same idea, the presence of separate lineages possessing with some probability intrinsic barriers to reproduction. The basic line is that a biological species is usually more or less objectively defined.

A **subspecies** is much less well defined, its definition differs substantially within and between animal groups and authors. Subspecies are generally not considered to be reproductively isolated from each other, and they should differ recognizably from each other in some way, usually morphologically (Mallet 2001). There are also concepts by which subspecies are only defined by their distributional ranges.

A **genus** is not biologically well defined, it is a subjective unit. It comprises a number of more or less similar species, and is preferably monophyletic and not too big. For many genera paraphyly is accepted, some might also be polyphyletic (especially in fossil animals). A generic name forms part of a specific name and has a much higher importance for communication than a family or other higher category name. If a genus is placed in another family, this has no influence on its name or those of its species. Placing a species in another genus will seriously affect its binominally combined name: *Helix aspersa* will become *Cantareus aspersus*.

Families and other **higher groups** or higher categories are usually assigned to groups of phylogenetically more or less closely related species, they can refer to monophyletic clades or to any other subjectively defined groups. This does not affect binominal names. The name of a species remains the same if its genus is classified in another family.

Biological classification is generally a mixture of scientific constraints (based on concepts of phyletic relationships) and subjective opinions (concerning the preferred sizes of groups). Groups of closely related animals are called clades (if monophyletic). The use of ranks sorted in hierarchical systems (subphylum, superorder, infraclass etc.) is probably about to become outdated and is often regarded as old-fashioned in scientific communication.

A name for a group that contains only one subgroup is redundant in a phylogenetical classification. A genus can be the sister group of a subclass.

Example:

The actinopterygian fish order Cypriniformes comprises 6 families with 2700 species, while the order Petromyzontiformes comprises only 1 family Petromyzontidae with 42 species. The name Petromyzontiformes is redundant and would not be used for a clade. In a phylogenetic tree Petromyzontidae could stand as a sister group next to Cypriniformes, ignoring the hierarchical ranks.

If relational databases work with strongly hierarchical systems, long lists of categories are often observed. Up to 35 hierarchic ranks are possible, and even more could be invented. In every animal group the number of actually used categories is different.

Fauna Europaea (www.faunaeur.org) uses the following 21 ranks, but not all ranks are used in all animal groups (in parentheses additional ranks recognised by PESI (Pan European Species-directories Infrastructure), but which are not always used at the level suggested by PESI):

kingdom - subkingdom - (division) - phylum - (subdivision) - subphylum - infraphylum - (superclass) - class - subclass - infraclass - superorder - order - suborder - infraorder - (section) - (subsection) - superfamily - family - subfamily - tribe - subtribe - genus - subgenus - (aggregate) - (collective species) - species - subspecies - (variety) - (subvariety) - (forma).

Often, the terms "variety" and "forma" were used synonymously with subspecies, "group" has often been used more or less synonymously to "subgenus", "section" for "subgenus" or "aggregate", other infrasubgeneric terms for aggregate or collective species.

In phylogenetic systems, the expressions "clade", "group" or "informal group" are often used, these are not hierarchically sorted. Animalia is a "kingdom" in the hierarchic system, and a "clade" in the phylogenetic system.

The same name can occur at different ranks in the hierarchy and can have a different meaning there.

Examples:

Reticulata is used as an order in Foraminifera, and as a clade in Ephemeroptera.

Acanthocephala is a well-known group of gnathiferan worms. *Acanthocephala* Laporte 1832 is a genus of American bugs (Hemiptera).

Trochoidea is a superfamily of large sea snails (Gastropoda), a name derived from the generic name *Trochus*. The same name *Trochoidea* Brown 1827 is a genus of European terrestrial snails.

Chitonoidea is a superfamily of chitons (Polyplacophora), a name derived from *Chiton*. *Chitonoidea* Svihla 1983 is a genus of Iranian beetles (Coleoptera).

Delphinoidea is a superfamily of toothed whales (Mammalia), a name derived from *Delphinus*. *Delphinoidea* Brown 1827 is a genus of tiny marine snails (Gastropoda).

Likewise generic names are *Acrania* Burr 1915 (Dermaptera), *Amphibia* Berthold 1827 (Pulmonata), *Aptera* Saussure 1864 (Orthoptera), *Ciliata* Couch 1832 (Actinopterygii), *Homoptera* Boisduval 1852 (Lepidoptera), *Mecoptera* Guenée 1837 (Lepidoptera), *Radiolaria* Provancher 1886 (Hymenoptera), *Trichoptera* Meigen 1803 (Diptera).

1.3 Differences between zoology and botany

Among the main differences between zoology and botany we observe the distinctly higher number of animal species and a much more highly diverse community of taxonomists, and as a result of these conditions the absence of narrowly defined standards for example for the names of authors.

The founder of botanical and zoological nomenclature, Carl Linnæus (since 1761 Carl von Linné), was primarily a botanist and promoted botanical studies earlier and more intensively than zoological studies. Plants are generally easier to catch and to identify than most animals, so the proportion of early described species in botany was substantially higher than in zoology.

- Linnean binominal nomenclature in botany started in 1753, zoology in 1757/1758.
- Botanical descriptions must contain a short diagnosis in Latin (since 2012 this can be in English), zoological descriptions have no restrictions to language or form.
- **Latin errors** in specific and generic names are usually corrected or standardized in botany (only one variant accepted for *chinensis/sinensis*, *kamtchatkensis/camtschatensis*...), in zoology Latin errors are not corrected (always the original spelling is used).
- Botany allows **hyphens between words** in names (*Capsella bursa-pastoris*), zoology does not allow such hyphens.
- Genus-species **tautonymy** is allowed in zoology (*Bison bison*), in botany not.
- Family names end -idae in zoology, in botany -aceae.
- Botany has a (TDWG-like) standardized lists of authors and their abbreviations (with strong recommendations to use these), zoology has nothing (and every taxonomist uses an individual standard).
- In botany the author of a new genus-species combination is recorded, in zoology not.
- Botanical taxonomy is much more regulated than in zoology.
- The term "valid" in botany is used as commonly in English (valid = correct publication of a name) while in zoology it has the meaning of a name being used as the correct name in an author's current classification.

Animal, plant and Fungi nomenclature are entirely independent from each other. The most evident shortcoming of this situation is that the same generic name can be used for animals and plants at the same time. For this kind of homonyms the expression "hemihomonyms" is sometimes used. Far more than 1000 such names are known. In the Moscow State University a database was created: <http://herba.msu.ru/shipunov/os/homonyms/index.php>

Examples:

The generic name *Dryas* L. 1753 represents a genus of magnoliophytan plants (family Rosaceae), and at the same time *Dryas* Hübner 1807 is also a lepidopteran insect genus (family Nymphalidae).

The genus *Tandonia* was established in animals (Gastropoda), in plants (Euphorbiaceae) and in Fungi (Ascomycetes).

Other examples for sometimes well known plant names with zoological equivalents are *Aotus* (Fabaceae and Mammalia), *Arenaria* (Caryophyllaceae and Aves), *Betula* (Betulaceae and Hymenoptera), *Chloris* (Cactaceae and Aves), *Dugesia* (Asteraceae and Plathelminthes), *Erica* (Ericaceae and Araneae), *Hystrix* (Poaceae and Mammalia), *Iris* (Asparagales and Orthoptera), *Liparis* (Orchidaceae and Actinopterygii), *Phalaenopsis* (Asparagales and Aves), *Pinus* (Pinaceae and Mollusca), *Prunella* (Lamiaceae and Aves), *Ricinus* (Fabaceae and Acari), *Taxus* (Taxaceae and Mammalia), *Typha* (Typhaceae and Porifera), *Ulva* (Ulvothyxales and Lepidoptera), *Viola* (Violaceae and Lepidoptera).

1.4 How zoological names are formed

This is a short general introduction into zoological nomenclature. For a more detailed approach see chapter 4.

1.4.1 Difference between nomenclature and taxonomy

To understand the formation of zoological names it is important to understand the basic difference between nomenclature and taxonomy.

Taxonomy is how taxa are correctly classified, in agreement with a biological system.

Nomenclature is how the names of these taxa are defined and correctly spelled.

This is a very basic and important difference.

If a researcher finds that a species consists of two reproductively isolated units - this is taxonomy. The researcher is free to classify the two units as two independent species, and it is not necessary to record this anywhere.

Placing a species in another genus, elevating a subspecies to the rank of a species, classifying a genus in a different family, subdividing a genus into various subgenera, placing genera into another family, lumping two species into one single species because they are not reproductively isolated - all this is taxonomy. These are just proposals for different classifications and no official acts. Such a proposal can be accepted or not.

No species in zoology has an officially recognised binominal name that must currently be used. The community can feel invited to accept results of recent taxonomic studies. This is taxonomy.

This is also important for the conservation of animals. Authors of Red Lists also have this freedom, and with it a responsibility. If someone lumps 10 endangered species into one without a sound scientific study in order to get them outside legal protection, a Red List author has the freedom and the responsibility to either accept this

proposal or not, and instead use a previously published different classification, and keep the 10 species in the Red List.

But the researcher is not free in the selection of the names. There are clearly defined rules which unit must receive which name under a certain taxonomic constellation. A taxonomist can feel free to regard two taxa as belonging to one species, but the name that must be used for the resulting species is fixed by the frame of nomenclatural rules. Eventually types must be selected, new names must be established, old forgotten names can be suppressed or homonymous names must be replaced - all this is nomenclature.

1.4.2 Latin script and character encoding

All zoological names must be in Latin script, which is defined as being restricted to the 26 characters used for example in the English alphabet. This does not apply to the names of the authors which can also be spelled in Russian, Chinese, Devanagari or other scripts. For international databases the use of Latin script for the authors is recommended.

Any database needs to define a character encoding for its textual contents. Databases containing taxonomic and nomenclatural data - all databases with names of species - should use the appropriate character set.

ASCII (American Standard Code for Information Interchange) is a 7-bit standard with 95 graphic characters (94 printables and a space), and 33 non-printing control characters. It was created in 1963 as a US code and was developed from telegraphic codes. On the World Wide Web this standard was most commonly used until 2007, when it was surpassed by UTF-8.

ISO 8859-1 was developed in 1985 and encodes 191 graphic characters in an 8-bit communication standard. It was intended to be used for some Western European languages, provides all characters for Spanish, Portuguese, Italian, German and Scandinavian languages, but important French, Finnish, Estonian and Hungarian characters were obviously forgotten. It was revised in 1999 as ISO-8859-15, when the French, Finnish and Estonian characters and the Euro sign were added. The revised version was never able to supplant ISO 8859-1 in 8-bit communication, but was used by Microsoft as a base for their successful Windows operating systems and programs.

Windows-1252 (sometimes incorrectly called ANSI, which stands for American National Standards Institute, but it has never been an ANSI standard) was developed in 1990 and is still (2011) the default 8-bit character encoding for versions of Microsoft Windows in English and some other Western European languages. Important characters of many other languages written in Latin script, such as Slavic, Romanian, Latin, Turkish, Hungarian and Baltic alphabets cannot be displayed in the Windows-1252 character encoding, much less Vietnamese. The Windows-1252 standard is not sufficient for spelling the names of zoological authors correctly.

UTF-8 (Universal Character Set Transformation Format 8-bit) is a multibyte character encoding for Unicode. Unicode was developed as a character standard in 1991 and covers not only Latin including all necessary diacritic marks and ligatures of all languages including Vietnamese, but also many other currently used scripts such as Russian, Arabic, Chinese and others. UTF-8 was developed in 1992 and is the most successful character encoding for Unicode characters. Today it plays a crucial role in the global Internet communication.

If species are cited with author and year, all characters of the Latin alphabet should be spelled correctly. This is why UTF-8 is indispensable for the name of the author. Databases cannot connect effectively if this is underestimated. Using UTF-8 is important and recommended for every database dealing with biodiversity data.

Examples:

ASCII:	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, B?d?r?u, F?russac, Linn?us, M?ller, Tomi?, Urba?ski, Y?ld?r?m.
ISO 8859-1:	a, ä, å, ç, è, é, ê, ë, ì, í, î, ï, ð, ó, ô, õ, ö, ø, ù, ð, ù, ž. B?d?r?u, Férussac, Linnæus, Müller, Tomi?, Urba?ski, Y?ld?r?m.
Windows-1252:	a, ä, å, ç, è, é, ê, ë, ì, í, î, ï, ð, ó, ô, õ, ö, ø, ù, ž. B?d?r?u, Férussac, Linnæus, Müller, Tomi?, Urba?ski, Y?ld?r?m.
UTF-8:	a, ä, å, ç, è, é, ê, ë, ì, í, î, ï, ð, ó, ô, õ, ö, ø, ù, ž. Bädärâu, Férussac, Linnæus, Müller, Tomić, Urbański, Yıldırım.

1.4.3 Binominal and polynominal names

In binominal nomenclature we have uninominal (1), binominal (2) and trinominal (3) names.

Uninominal names: genera, families and names of higher categories.

Binominal names (Art. 5.1): species in the combination *Genus species*, or *Genus (Subgenus) species*.

Trinominal names (Art. 5.2): subspecies as *Genus species subspecies*, or *Genus (Subgenus) species subspecies*.

Subgenera do not count in this game (Art. 6.2). Binominal, trinominal and names of genera and families are regulated by the ICZN Code, the names of higher categories are based on common acceptance and unwritten conventions.

Polynomial names are usually not considered as admissible for Linnean nomenclature. The term is not well defined, but usually understood as a non-Linnean name consisting of a genus followed by a specific name consisting of two or more words that are not referring to each other as a single entity. For deciding whether or not a name is polynomial it is usually necessary to understand a little Latin and to be able to extract the relationship between the words from the grammatical structure. If these words refer to a single entity, they are considered as binominal (Art. 11.9.5) and are united without a hyphen (Art. 32.5.2.2). The grammatical nature of binominality is often disputed, mainly in countries where English is spoken. The problem concerns mainly names mentioned in early zoological works.

Examples:

Aphis aquilegiae flava (a sternorrhynchan insect) is a polynomial name (the yellow *Aphis* of the aquilegia plant). *Aphis* is the genus, *aquilegiae* and *flava* are both components of the specific name, they are not directly referring to each other (and *Aphis aquilegiae* is not the name of a previously established species). The adjective *flava* (yellow) refers to *Aphis* and not to the other word in the specific name, *aquilegiae*.

Elater fusco flavipes (a coleopteran insect) is a binominal name (the brownish-yellow-footed *Elater*). The adjective *fuscus* was converted by a connection vowel to *fusco*, to indicate that it referred to *flavipes* and not to *Elater*. The two words *fusco* and *flavipes* form a single entity under Art. 11.9.5 and the words are united to *Elater fuscoflavipes* under Art. 32.5.2.2. A name *Elater fuscus flavipes* (the brown and yellow-footed *Elater*) would be polynomial and not admissible, since both words *fuscus* and *flavipes* refer to *Elater*.

Various taxonomists seem to believe that presence or absence of a hyphen between the words of the specific name should be regarded as a decisive criterion. This view neglects that the hyphen was not used in Classical Latin and that Fabricius, Thunberg and many other early zoologists did not use the hyphen in compound specific names.

Examples:

Conus stercus muscarum Linnæus, 1758 (Gastropoda), a name composed of two words forming a single entity under Art. 11.9.5, and not united by a hyphen, to be corrected to *Conus stercusmuscarum*.

Apis 4 cincta Fabricius, 1777 (Hymenoptera), a name composed of a numeral and an adjective forming a single entity under Art. 11.9.5, and not united by a hyphen, to be corrected to *Apis quadricincta*.

Scarabaeus novae Hollandiae Fabricius, 1775 (Coleoptera), a name composed of two words forming a single entity under Art. 11.9.5, and not united by a hyphen, to be corrected to *Scarabaeus novaehollandiae*.

1.4.4 Original and current combination of species

1.4.4.1 Original and current combinations, parentheses

A specific name must always be combined with a genus. The genus-species combination used when the specific name was established is the **original combination**.

Examples:

Fringilla domestica Linnæus 1758, *Felis tigris* Linnæus 1758, *Felis leo* Linnæus 1758, *Panthera tigris sumatrae* Pocock 1929.

A genus-species combination in agreement with a currently accepted classification in a published source is the **current combination**.

Examples:

Passer domesticus (Linnæus 1758), *Panthera tigris* (Linnæus 1758), *Panthera leo* (Linnæus 1758), *Panthera tigris sumatrae* Pocock 1929.

Theoretically each species has only one currently widely accepted genus-species combination. But many species suffer from disputes among taxonomists, and are - like *Helix aspersa/Cantareus aspersus* - combined with more than one genus in current literature.

If the species is classified in a **different genus** than in the original publication, author and year are wrapped in **parentheses**. If they are classified in the same genus, author and year are not wrapped in parentheses. If the genus was spelled incorrectly in the original description of the species, its correct spelling is responsible for determining the parentheses (Art. 51.3.1).

Examples:

Tyrannosaurus rex Osborn 1905, original combination was *Tyrannosaurus rex* Osborn 1905 (Sauropsida).

Lesteva (Lesteva) fontinalis Kiesenwetter 1850, original combination was *Lesteva fontinalis* Kiesenwetter 1850 (Coleoptera).

Helix aspersa Müller 1774, original combination was *Helix aspersa* Müller 1774 (Gastropoda).

Chondrina generosensis Nordsieck 1962, original combination was *Chondrina megacheilos generosensis* Nordsieck 1962 (Gastropoda).

Cornu aspersum (Müller 1774), original combination was *Helix aspersa* Müller 1774 (Gastropoda).

Cantareus aspersus (Müller 1774), original combination was *Helix aspersa* Müller 1774 (Gastropoda).

Passer domesticus (Linnæus 1758), original combination was *Fringilla domestica* Linnæus 1758 (Aves)

Panthera tigris (Linnæus 1758), original combination was *Felis tigris* Linnæus 1758 (Mammalia).

Panthera leo (Linnæus 1758), original combination was *Felis leo* Linnæus 1758 (Mammalia).

Polyphylla alba (Pallas 1773), original combination was *Scarabaeus albus* Pallas 1773 (Coleoptera).

Fenestella subantiqua D'Orbigny 1850, original combination was *Fenestrella subantiqua* D'Orbigny 1850 (Bryozoa), *Fenestella* was an incorrect subsequent spelling for *Fenestrella*.

Bithynia graeca Westerlund 1879 (Gastropoda), original combination was *Bythinia graeca* Westerlund 1879, *Bythinia* was an incorrect subsequent spelling for *Bithynia*.

If the species was established as a **subspecies** or variety ("var.") of another species, this does not affect the parentheses. Neither if a subspecies was transferred from one species to another species. The subgenus does not count either. Only the genus counts for the parentheses (Art. 51.3.2).

Examples:

Cochlostoma fontqueri Haas 1924 (Gastropoda), originally established as *Cochlostoma patulum fontqueri* Haas 1924.

Valvata sibirica Middendorff 1851 (Gastropoda), originally established as *Valvata cristata* var. *sibirica* Middendorff 1851.

Albinaria bigibbosula sibyllae Fauer 1993 (Gastropoda), originally established as *Albinaria hohorsti sibyllae* Fauer 1993.

Goniocidaris (Petalocidaris) florigera Agassiz 1879 (Echinoidea), originally established as *Goniocidaris (Goniocidaris) florigera* Agassiz 1879.

Zoological taxonomy is easier than in botany. The person who first classifies a species in a different genus is not obligatorily recorded. Some taxonomists of some animal groups have intended to record histories of genus-species combinations. In many groups this has not generally been done, except in some taxonomic revisions of genera or species.

The parentheses only indicate presence or absence of the original genus in a currently used name. They are helpful to better understand a name, but they have no really significant nomenclatural function. Parentheses are not needed if zoological names are used as identifiers.

In electronic environments parentheses are often ignored, especially in search queries of internet resources (for example in Google).

1.4.4.2 Comma between author and year

A **comma** can be set between author and year.

Examples:

Passer domesticus (Linnaeus, 1758), *Crotalus durissus* Linnaeus, 1758, *Macoma balthica* (Linnaeus, 1758).

The comma contains no additional information and **is not obligatory** (Code Recommendation 22A.2.1). Most official publications seem to use it, but there are different traditions in various disciplines. The comma has no nomenclatural function and is not needed if zoological names are used as identifiers.

Many years ago there have been conventions to use a comma if author and year formed part of a taxonomic name, and no comma if author and year were used as a citation of a literature reference. Today every journal uses their own conventions. Often a comma is obligatory between author and year in literature citations. In many journals it is not allowed to set a comma between author and year of a taxonomic name. It is not recommended to cite a literature reference directly behind a binominal name, and in such cases write *Helix aspersa* (see Smith 1988).

I personally do not like the comma, so I take advantage of my freedom as a scientist and do not use it in this work. It is convenient not to use the comma here, since this is a manual for zoological data resource integration and a comma may sometimes lead to misunderstandings. A comma is usually used to separate logical entities, also in computer environments. A taxon name author string genus-species-author-year is such a logical entity, and a comma would unnecessarily indicate a logical break between genus-species-author and year.

Not using the comma makes also clear that this is not an official outlet of the ICZN.

1.4.4.3 Gender agreement

If specific names are Latin adjectives, the ending might change when the species is combined with a genus that has a different gender.

Examples:

Fringilla domestica will change to *Passer domesticus*, *Gryllus migratorius* will change to *Locusta migratoria*, *Scarabaeus albus* will change to *Polyphylla alba*, *Submacrosiphum nigrum* will change to *Nasonovia compositellae nigra*, *Agriolimax barceus* will change to *Deroceras barceum*.

This is also done if the original author did not give the correct ending.

Examples:

Unio mancus Lamarck 1819 (Bivalvia), original combination was *Unio manca* Lamarck 1819.

Nettenchelys pygmaea Smith & Böhlke 1981 (Actinopterygii), original combination was *Nettenchelys pygmaeus* Smith & Böhlke 1981.

Deroceras rhodense Forcart 1972 (Gastropoda), original combination was *Deroceras rhodensis* Forcart 1972.

Applying gender agreement correctly is not trivial. Skilled zoologists with fairly good knowledge of Latin are able to decline up to 97 % of the Latin specific names correctly. This will be explained much more in detail in chapter 8 on gender agreement (see [section 8.1.6](#)).

Gender agreement is **not consistently applied in lepidopteran names**.

1.4.5 Taxonomic ranks: hierarchy of names

In the 1750s Linnæus established the idea to classify biological names in a hierarchical system, based on a typological concept of classification mixed with early concepts of phylogenetic relationships (in the 1750s bats were not regarded as birds any more, whales and dolphins not as fishes). Species which looked similar were lumped together in hierarchical arrangements of groups. This produced categorical levels such as phylum, class, order, family and genus, and subdivisions of these ranks.

Today taxonomy works with a classification mainly based on phylogenetic relationships. A group in this sense is understood as a phylogenetic lineage, or a clade, supposed to have had a common ancestor. Thinking in categorical levels is slowly being substituted by concepts working with phylogenetical lines and nodes. This system does not produce levels and has no need for hierarchical positions.

Example:

Classifications of the earliest known groups of **recent vertebrates**:

1750s: **Classes** Mammalia, Aves, Amphibia, Pisces.

1800s: **Classes** Mammalia, Aves, Reptilia, Amphibia, Pisces.

1900s: **Classes** Mammalia, Aves, Reptilia, Amphibia, Pisces.

Present: **Classes** Mammalia, Sauropsida, Amphibia, Cephalaspidomorpha, Chondrichthyes, Actinopterygii.

Present: **Clades** Mammalia, Sauropsida, Amphibia, Petromyzontidae, Chondrichthyes, Actinopterygii.

1.4.5.1 Higher groups

Although Art. 1.2.2 claims the contrary, higher groups (higher categories) at ranks above the superfamily level are practically **not regulated by the ICZN Code**. The only effective statements in the Code concern the spellings. The names of the ranks are not specified.

Higher group names are **capitalised** (they begin with an upper-case letter, Art. 28, 32.5.2.5), do **not contain diacritic marks** (Art. 27) and are **not spelled in italics**. Occasionally author and year are cited for higher groups. These do not follow any written rules.

The following ranks are more or less commonly used (not all in all disciplines), they are neither mentioned nor stipulated by the ICZN Code:

kingdom - subkingdom - phylum - subphylum - infraphylum - superclass - class - subclass - infraclass - superorder - order - suborder - infraorder.

In modern sources based on phylogenetic systematics, the terms "clade", "group" or "informal group" are used, they are repeatedly used at various levels.

There are no generally accepted rules restricting how a higher group name should be formed. It is usually not possible to see the rank level in such a name. Most names end with -a, some with -es, some otherwise

Examples:

Vertebrata, Mammalia, Insecta, Coleoptera, Ephemeroptera, Brachiopoda.

Plathelminthes, Chondrichthyes, Scorpiones, Aves, Primates.

Actinopterygii, Nemertini, Acari, Dipnoi, Teleostei, Araneae, Avialae, Neognathae.

In some groups (birds, fishes) the order rank has names ending consistently with -iformes. This is based on unwritten conventions in these disciplines.

Examples:

Anseriformes, Columbiformes, Passeriformes, Anguilliformes, Gadiformes, Perciformes.

There is no rule that prohibits the use of the same higher-group name repeatedly in different disciplines, but zoologists have generally tended to avoid homonymies.

Example:

Pulmonata is usually used for a very prominent group in Gastropoda, but the name is also (rarely) used for a group in Arachnida.

Reticulata is used as an order in Foraminifera, and as a higher group of undefined rank in Ephemeroptera.

If arranged in hierarchic systems, the names for the higher group can be classified at different levels by different authors.

Examples (Google hits, 08.2009):

Metazoa: kingdom (41,000), subkingdom (48,000).

Foraminifera: class (8800), order (8100).

Pterygota: subclass (15,500), infraclass (43,500)

It is not always possible to transfer a phylogenetic classification into the traditional ranking system without distorting the accepted ranks. Sometimes some subdivisions based on nodes in phylogenetic lineages must remain without being assigned to a named hierarchic rank.

Examples of some selected phylogenetic lineages, following the general arrangement 1kingdom - 2subkingdom - 3phylum - 4subphylum - 5infraphylum - 6superclass - 7class - 8subclass - 9infraclass - 10superorder - 11order (numbers are added here to facilitate navigation, in parentheses Google hits, 08.2009):

1kingdom **Animalia** (500,000) - 2subkingdom **Bilateria** (123,000) - Eubilateria - Gastroneuralia - Spiralia - Eupiralia - Articulata - 3phylum **Arthropoda** (700,000) - Euarthropoda
 Euarthropoda - 4subphylum **Mandibulata** (60,000) - Tracheata - Labiata - 7class **Insecta** (330,000) - Ectognatha - 8subclass **Dicondylia** (43,000) - 9infraclass **Pterygota** (43,500) - Neoptera - Eumetabola - 10superorder **Holometabola** (500) - 11order **Coleoptera** (160,000)
 Euarthropoda - Arachnata - 4subphylum **Chelicerata** (36,000) - Euchelicerata - Metastomata - 7class **Arachnida** (120,000).
 2subkingdom **Bilateria** (123,000) - Eubilateria - Gastroneuralia - Radialia - Deuterostomia - 3phylum **Chordata** (800,000) - 4subphylum **Vertebrata** (250,000) - Myopterygii - 5infraphylum **Gnathostomata** (120,000) - Neognathostomata - Sarcopterygii - Choanata - 6superclass **Tetrapoda** (34,000) - Amniota - Synapsida - 7class **Mammalia** (210,000).

In a modern classification the higher groups are simply referred to as clade or group.

Example (Bouchet & Rocroi 2005, classification of gastropod families):

Gastropoda - n+1clade Heterobranchia - n+2informal group Opisthobranchia - n+3clade Nudipleura - n+4clade Nudibranchia - n+5clade Dexiarchia - n+6clade Cladobranchia - n+7clade Dendronotida

1.4.5.2 Families

The ICZN Code uses the expression "family-group names", this is an insider term and comprises five ranks with their characteristic (and obligate) endings (Art. 29.2):

superfamily (-oidea, the ending -acea is outdated), family (-idae), subfamily (-inae), tribe (-ini), subtribe (-ina).

They are not spelled in italics and begin with an upper-case letter. Not all are used in all animal groups.

The ICZN Code provides rules for author and year which are - surprisingly for those who do not know this - more complicate than those for genera or species. Authorships and years of families are rarely cited.

Many taxonomists believe that family names are selected by common acceptance and internal conventions, like the order names in fishes and birds, while others are convinced that priority and authors of higher ranks are strictly ruled by the ICZN Code.

Assigning a family rank to a group of more or less closely related species is always subjective and depends on conventions and common acceptance. Selecting a name for such a group - family, superfamily, order or subphylum - is usually a question of conventions and common acceptance as well.

The **base of a family name is always a generic name**, the type genus, not necessarily used today. Its name is visible in the family name, which is formed by adding the ending -idae. It is usually not important where this was actually done for the first time, except if two family names compete with each other and priority rules will come into effect.

Homonyms occur relatively rarely in families (only if generic names are identical or very similar and adding an ending -idae produces identical results) - and discovering such a homonymy usually produces the same problems as if there were no rules, conflicts between entirely independent and unconnected groups of taxonomists working in different animal groups. Very often the Commission must be asked to take a decision.

Examples:

Bulimina (Foraminifera) and **Buliminus** (Gastropoda) give both Buliminidae, and both families were used since the 1880s. When the homonymy was discovered 110 years later in the 1990s, the Commission needed to be asked for a solution and the younger (gastropod) taxon had to receive a new family name Buliminusidae (Opinion 2018).

Claria (Rotifera) and **Clarias** (Actinopterygii) give both Clariidae, but only the fish name was used since 1845. Shortly after Clariidae had been proposed in Rotifera in 1990, the homonymy was discovered and the Commission had to decide that the Rotiferan family needed to be amended to Clariidae (Opinion 2032).

Family names are important. The proportional rate of cases solved officially by the Commission is substantially higher for family names than for genera and species, relative to the total number of names in these ranks. Of the currently used family names (about 14,000), 6 % (= 850) have been subject to decisions by the Commission, the corresponding proportion in species ranged near 0.2 %.

Detailed data:

Specific names: total 3.5 million (= 90 % of all names), 4400 on Official List (= 51 % of the rulings, 0.1 % of all specific names)

Generic names: 340,000 (= 8.7 % of all names), 3300 on Official List (= 39 % of the rulings, 1.0 % of all generic names)

Family names: 55,000 (= 1.4 % of all names), 850 on Official List (= 10 % of the rulings, 1.5 % of all family names)

Sources for dates: specific names: roughly estimated; generic names: www.ubio.org/NZ, 09-2009; family names: estimated by taking the proportions of gastropod family names (Bouchet & Rocroi 2005) in relation to specific names (2396 family names, of which 611 = 25 % are currently used, number of specific names established estimated to 150,000).

Family names have been used since the early 1900s as a powerful tool of communication, for example in titles of journal articles to give a quick idea of the studied animal group, so that not only insiders who knew the genus could understand what the article was about. This tool depends on widely known family names and is weakened when family names for genera are repeatedly changed in association with new results of phylogenetical studies. With the increasing trend to modify the meanings of well-known family names, the importance of those names is decreasing. The same effect is achieved if families contain less genera and if at the end every genus has its own family.

Family names can be cited without authors and years, like the names of the other higher ranks which are not ruled by the ICZN Code. The complicated rules for family names are not explained in detail in this manual.

1.4.5.3 Genera

The ICZN Code uses the expression "genus-group names", this is an insider term and comprises three ranks: genus, subgenus, infrasubgeneric name.

They are **spelled in italics** and are **capitalised**. They have author(s) and year, which are not spelled in italics.

Infrasubgeneric names are names below the subgeneric level, this rank is not used today and was in the past known as section, division, aggregate or Formenkreis. The Code uses the term "division" and rules that such names are treated as if they were established as subgenera (Art. 10.4). To avoid misunderstandings and confusion "division" is not used here.

A subgenus is usually wrapped in () parentheses and cited in a form *Genus (Subgenus)*, but this is only a convention. The author refers only to the last genus-group name in a genus-subgenus listing.

Examples:

Scaphopodan genus *Sagamicadulus* Sakurai & Shimazu 1963.

Coleopteran genus *Polyphylla* Harris 1842,

subgenus *Polyphylla (Xerasiobia)* Medvedev 1951 (or "*Xerasiobia* Medvedev 1951, currently classified in the genus *Polyphylla*")

Bivalvian genus *Pseudodon* Gould 1844,

subgenus *Pseudodon (Pseudanodonta)* Bourguignat 1877.

For an infrasubgeneric name a second set of parentheses (()) can be used. This is not ruled by the Code, but sometimes necessary.

Examples:

Gastropodan genus *Pomatias* Studer 1789,

subgenus *Pomatias (Auritus)* Westerlund 1883,

infrasubgeneric name *Pomatias (Auritus (Patuliana))* Caziot 1908.

Gastropodan genus *Ferussacia* Risso 1826,

subgenus *Ferussacia (Euferussacia)* Bourguignat 1864,

infrasubgeneric name *Ferussacia (Euferussacia (Hohenwartiana))* Bourguignat 1864.

If the name of the author was not given in the original work and was derived from secondary sources, the author is usually wrapped in [] square brackets. If the author is unknown, the term "Anonymous" (usually in the English orthography, the Code recommends "Anon." but this is rarely seen) is used instead of an author. The ICZN Code demands to acknowledge anonymous authorship in both cases (Art. 50.1), most taxonomists follow Recommendation 51D and cite the true author in square brackets. For some generic names several versions are in use.

Examples:

Mammalian genus *Loxodonta* Anonymous 1827.

Actinopterygian genus *Monotaxis* Anonymous 1830 or *Monotaxis* [Bennett] 1830 or *Monotaxis* Anonymous [Bennett] 1830

Heteropteran genus *Corixa* [Geoffroy] 1762.

Bivalvian genus *Placuna* [Lightfoot] 1786.

Bivalvian genus *Chlamys* [Röding] 1798.

1.4.5.4 Species

The ICZN Code uses the expression "species-group names", this is an insider term and comprises three ranks: species, subspecies, infrasubspecific name.

In several disciplines nomenclatural equivalents of subspecies were occasionally called variants (var.) or forms (forma) until the early 1900s. Infrasubspecific names are names below the subspecific level, previously called natio, aberration or morph, or simply added as another name behind the subspecies. This rank is not used today and such names are only exceptionally accepted (Art. 45.5, 45.6).

All these names are spelled in *italics* and begin with a lower-case letter. They have author(s) and year, these are not spelled in italics and can be wrapped in parentheses.

A **species** must always be cited in combination with a genus. This is the heart of binominal nomenclature.

Author and year area added voluntarily.

Examples:

Dinosaur species *Tyrannosaurus rex* Osborn 1905 (or simply *Tyrannosaurus rex*).

Mammalian species *Panthera tigris* (Linnaeus 1758) (or simply *Panthera tigris*).

Gastropodan species *Helix mazzullii* De Cristofori & Jan 1832 (or simply *Helix mazzullii*).

In written texts it is allowed and usual to abbreviate the genus (*T. rex*, *P. tigris*). The name should at least **once be mentioned** in its complete form (Recommendation 51A).

A **subspecies** must always be cited in combination with its generic and specific name. The name of the author attached to a subspecies refers to the subspecies, not to the species (and is added voluntarily). Every species that contains several subspecies **has at least the nominate subspecies** (the name of the species is simply repeated at the third position, with the same author and year), and in addition one or more others, usually younger ones.

Examples:

Mammalian subspecies *Panthera tigris tigris* (Linnaeus 1758), *Panthera tigris sumatrae* Pocock 1929.

Gastropodan subspecies *Albinaria hippolyti hippolyti* (Boettger 1878), *Albinaria hippolyti aphrodite* (Boettger 1883).

A species or subspecies can also be cited with its subgeneric name.

Examples:

Polyphylla (Xerasiobia) alba (Pallas 1773) (species, Coleoptera).

Nasonovia (Nasonovia) compositellae nigra (Hille Ris Lambers 1931) (subspecies, Sternorrhyncha).

Lesteva (Lesteva) fontinalis fontinalis Kiesenwetter 1850 (subspecies, Coleoptera).

If the name of the author was not given in the original work and was derived from secondary sources, the author is usually wrapped in [] square brackets. If the author is unknown, the term "Anonymous" (or "Anon.") is used instead of an author. The ICZN Code demands to acknowledge anonymous authorship in both cases (Art. 50.1), most taxonomists follow Recommendation 51D and cite the true author in square brackets. For some specific names several versions are in use.

Examples:

Gastropodan species *Architectonica radiata* [Röding] 1798.

Lepidopteran species *Zerynthia polyxena* [(Denis & Schiffermüller) 1775].

Avian species *Lanius carolinensis* Anonymous 1772.

Actinopterygian species *Arothron stellatus* Anonymous 1798

Actinopterygian species *Ophisurus apicalis* Anonymous [Bennett] 1830 or *Ophisurus apicalis* [Bennett] 1830

The terms var. (= varietas, variety), f. (forma) and likewise expressions are not used any more today. In any case these terms are not formatted in italics.

Examples:

Dreissena bourguignati var. *blanci* Westerlund 1890, currently used as *Dreissena blanci* Westerlund 1890 (Bivalvia).

Chondrus pupa var. *grandis* Mousson 1859, currently used as *Mastus grandis* (Mousson 1859) (Gastropoda).

These terms were not consistently used in all zoological disciplines, and had no well delimited interdisciplinary definition as they had in botany. The terms natio, aberratio or morpha usually indicated infrasubspecific names (Art. 45.6.2). A forma was often regarded as inferior to a variety, referring to an infrasubspecific name, but not in all disciplines. This depended also from the style of a work. If a forma was used in a trinomial combination genus-species-forma, then it is commonly regarded as having been established as a subspecies (Art. 10.2, 45.6.4).

Examples:

Pupa (Orcula) gularis forma *restituta* Westerlund 1887, currently used as *Orcula restituta* (Westerlund 1887) (Gastropoda).

Buliminus (Napæus) cefalonicus forma *concolor* Westerlund 1887, currently used as *Ena concolor* (Westerlund 1887) (Gastropoda).

1.4.5.5 Subordinate variants

Subordinate variants are presented either by Latin or Greek letters (a-b-c, α - β - γ) or numbers (1-2-3) or names. The letters and numbers are not names in the sense of the Code, but they have some weak separate taxonomic identity since their types do not belong to the main species (Art. 72.4.1). Usually they are not cited with authors and years, but a bibliographical reference is usually given to explain exactly what it meant. The subordinate variants were individually arranged in each work. The same subordinate variant letter (var. β) could be used by various authors in subsequent works for different taxa, so the Greek or Latin letters do not follow priority rules. Sometimes the author gave synonymous names for the subordinate variants.

Examples:

Gastropod subordinate variants

Helix neglecta α , *Helix neglecta* β as published by Draparnaud 1805

Helix lenticula α as published by Férussac 1821

Achatina algira var. β synonym *Polyphemus dilatatus* as published by Philippi 1836

Helix draparnaldi a. *gallica*, *Helix draparnaldi* b. *italica* as published by Beck 1837

Pupa minutissima var. A synonym *Pupa laeviuscula* as published by Küster 1850

Greek letters or numerals can also be spelled out and used as regular specific names. If so, they are not subordinate variants, but new names.

Examples:

Phalaena gamma Linnæus 1758 (Lepidoptera), currently *Autographa gamma* (Linnæus 1758).

Noctua lamda Fabricius 1787 (Lepidoptera).

Helix alpha Pfeiffer 1853, *Helix beta* Pfeiffer 1853, *Helix gamma* Pfeiffer 1853, *Helix epsilon* Pfeiffer 1853, *Helix zeta* Pfeiffer 1853, *Helix omega* Pfeiffer 1853 (Gastropoda).

Carinigera septima Brandt 1962, *Carinigera octava* Brandt 1962 (Gastropoda).

1.4.6 Derivation of names

Scientific names in zoology are not necessarily Latin names, they may come from any language or can even be fantasy names (Art. 11.3). Many names are based on Latin and Greek, but this is just a tradition. The only requirement is that they must be pronounceable in some language, and it must be possible to treat them as Latin words. Acronyms that cannot be pronounced (cbadfg) are not allowed (Example in Art. 11.3, however no explanation is given why exactly cbadfg is no word in the sense of the Code, this has also led to disputes if ansp, anspi or nmnh or nmnh are admissible as names in the sense of this Article).

1.5 Some general notes about the ICZN Code and official zoological bodies

1.5.1 The nature of the ICZN Code

The ICZN Code is the result of a historical development. Early drafts existed since the 1840s in several countries, but had not been commonly accepted by all taxonomists until 1895 when international rules were established. Currently effective (2011) is the 4th edition of the Code (since 01 Jan 2000).

The ICZN Code rules only **nomenclature, not taxonomy**. Zoologists are free to classify animals, the ICZN Code gives no rules for classification, the rules regulate only which names should be used (see chapter 1.4.1).

The ICZN Code is **not a legal document**. It is not unambiguously considered as a binding law in the sense of a mandatory set of rules and regulations, it is based on common acceptance. Zoologists feel themselves invited to apply the Code voluntarily, to avoid the chaos which would result in the absence of rules. But if they do not consider some of the Code's detailed rules as useful they simply do not apply them - this is no problem if the community accepts the consequences. Names can be used that are not acceptable under the ICZN Code.

Example:

Crocodylus niloticus Laurenti 1768 (Crocodylia) is widely used for the Nile crocodile, a scientific name that could not be used for it under the ICZN Code since it would refer to an American crocodile species. This name is used only by common acceptance.

Some rules in the Code are disputed, not all are known, understood, accepted and applied by all taxonomists in all disciplines. Zoology is a very wide field and every single taxonomist is needed to contribute to the knowledge of the community. Contributions of taxonomists who do not accept certain rules are not necessarily rejected for this reason alone.

The nature of the ICZN Code is a **retrospective law** (Art. 86.3). Every nomenclatural act in the past is exclusively evaluated under the present edition of the Code, and not under a previous edition. A name or nomenclatural act (type selection or whatever) which had been established in 1963 under the then effective edition, is not evaluated under that edition, but under the 4th edition. A name established in France in the 1890s is not evaluated under the rules then commonly accepted in France, but exclusively under the 4th edition.

The ICZN Code is **not a case law**, with legal cases establishing precedent to decide subsequent cases with similar issues or facts (Art. 80.5). The ICZN Commission - an unpaid body of 28 persons not older than 75 years encharged to set aside rules of the Code in singular cases - can suppress names or make unavailable names available in Opinions, but every case is singular and other cases cannot be judged using preceding cases as a guideline.

The ICZN Code can be, like most legal works, **difficult to understand** by zoologists who are not used to reading legal texts. Like in most other legal works, many regulations allow several interpretations. The Code is used as a guide by zoologists who seek advice how to interpret or spell a name correctly, but it has not been designed as such. Occasionally it is necessary to know common practice in zoology for understanding provisions in the Code, or in other words, it is necessary to know backgrounds why certain articles have been included. As usual in laws, these reasons and backgrounds are not adequately documented (see also the notes in the *Jackmahoneya* example as a case of abuse in this situation).

A particular feature is the confusing use of **internal terms** which are not in accordance with their common usage neither in dictionaries nor in botany ("species-group name" does not refer to a name for a group of species, "valid" does not mean that anything is valid as commonly understood, "to conserve" does not mean that something is conserved as commonly understood - the last expression was introduced as a new internal term in 2000 to replace the term "to validate", once perfectly intelligible but in contrast to the internal use of the term "valid"). But also commonly understood terms may have vague, undefined or more or less well defined special meanings in the Code, such as "published work", "author" or "word".

The ICZN Code gives high importance to **Latin and Greek**, which were commonly understood languages in scientific communities in the early 1800s, but not anymore today. Problems arise from taxonomists not being linguists, and from the fact that dictionaries do not help in many problems with Latin grammar. Members of the community have asked to remove from the ICZN Code the need to consult Latin and Greek dictionaries and to abolish gender agreement, but no changes have been made to the Code till date.

The official texts of the ICZN Code are written **in English and French**, both texts are considered to be equal in force, meaning and authority (Art. 86.2). If the meaning of the English text is ambiguous, the French text is regarded as decisive, and otherwise. This is an important tool to interpret the ICZN Code, and can be very helpful, because linguistically both versions do not cover each other entirely.

Examples:

In Art. 30.1.4.2 the English version gives a restriction that is not contained in the French version, probably unintended since it gives no sense. A genus of common gender will be feminine if originally combined with a feminine adjectival specific name in the English version, in the French version with a feminine adjective. The idea behind the passage reflects that the author must have treated the name as feminine, so if the genus was combined with a feminine adjective in a Latin text, the name should be feminine under the French version.

In Art. 32.5.2.6 the French version differs substantially from the English version and looks like a bad translation of a person who did not understand the context. In the English version is expressed that numerals must be written in full as Latin words, while in the French version numerical adjectives and adverbs must be translated into Latin.

In Art. 32.5.1.1 the English and French versions complement each other. The English versions talks of a circulated slip to be inserted in a work, the French version of a slip inserted in a work. The slightly stricter French version makes clear that the slip can have been printed later, but that it must have been inserted by the publisher or printer to the work, after the print and before presenting the work to the public. Sending out a slip later and asking the subscribers or booksellers to insert the slip to the work would not match the French version.

Art. 87 rules that also all other officially authorised translations of the ICZN Code shall be equal in force, meaning and authority. This implies that the Commission might undertake an impractical task that may not be in accordance with what is reasonable. Any translation implies always a weak change in the meaning. We can assume that the French Code contains the weakest change because French is probably the second mostly understood language by skilled zoologists. But it will be an unreasonable request to all 28 Commissioners to be able to judge the correctness of a Bengali translation of the 120 pages of the Code.

1.5.2 Acceptance in the community

Like in every legal work, the compilation of the ICZN Code is the result of political processes, with proposals and compromises, and only few taxonomists are incorporated in or have influence on the procedure of composing the regulations. In fact, in the past only a minority has ever had access to the small group of persons who have modified the ICZN Code (the ICZN Committees, usually 7 persons). The last Committees have lacked a democratic legitimation. Since 1972 there have neither been regular zoological congress meetings to deal with nomenclatural problems, nor opinion polls, public surveys, queries or public votings offered for zoological taxonomists. The Commission takes its power from a general biological congress (IUBS, International Union of Biological Sciences) (Art. 77.2), attended by very few zoologists.

In the recent past the members of the official ICZN organs, in particular the Committees, have not sought wide acceptance by the community in some issues. It may even be possible that personal opinions have affected articles incorporated to the ICZN Code.

Example:

In 1993 Ride established *Jackmahoneya* (Mammalia, dedicated to Jack Mahoney) and specified its name as masculine. This was literally allowed due to a gap in the 3rd edition of the Code, but contrasted commonly accepted basic rules of Latin grammar (such a noun composed of a stem and an ending *-a* must have feminine gender). In 1999 Ride was chairman of the Committee for the 4th edition and this case was inserted as an example in an extended new version of Art. 30.2 for "masculine because its author specified it" (authors who did the same with names based on Greek words were not allowed to do this).

Some regulations reflect a vision of the future rather than actual practice. The *List of Available Names in Zoology* concept was inserted in 2000 (Art. 79). More than 10 years later zoologists began to start discussing the purpose of such lists: either, to provide a documented record of the previously established names, or to get rid of names that were not used or caused problems as senior homonyms.

Other rules were incorporated probably without adequate technical advice. Art. 8.6 was inserted in 2000 and based on the assumption that electronic media such as CD-ROMs and DVDs would remain readable for the next 400 years, like printed books.

Some rules even contradict the spirit of zoological nomenclature. Art. 3.1 in the version from 2000 defines the names established in Clerck's work "Svenska Spindlar" to date from 1758 although the indicated and true date was 1757 - contradicting the very basic rule that a name must always carry the true date of publication.

The Committee didn't address new technical developments in the 1980s by which textual documents could be published in small quantities by using home printers - the present ICZN Code (Art. 8.5) still regards two identical outprints obtained from a home printer as a fully accepted publication in which a new name can be established.

As a consequence of such shortcomings a large part of the taxonomic community seems to accept only parts of the ICZN Code, usually those parts which reflect something which may be called the spirit of zoological nomenclature. Clerck's names are widely cited with the 1757 date, single sheets issued from home printers are not commonly accepted as published work. It is necessary to know then which parts are commonly accepted, and which parts not.

In other ambiguous rules in the ICZN Code, regulations which seem to have been incorporated as results of compromises, we observe different traditions of interpretations in different disciplines.

Example:

If a name *smithi* was dedicated to a woman, the ICZN Code (Art. 31.1) states that the name must be *smithae*, but gives no regulation what to do if the name was actually spelled *smithi*. Some disciplines tend to correct such names in frames established by themselves (the dinosaur name *Seismosaurus halli* has been emended to *hallorum*), others follow Art. 32.5 and do not correct such mistakes (Brandon-Jones et al. 2007, Dubois 2007).

The situation became more difficult when the ICZN Code incorporated in 2000 the concept of "prevailing usage", a largely undefined term intended to promote stable usage of names, which makes nomenclature less well defined, and has resulted in many lengthy disputes on correct spellings of rarely mentioned names. It is predictable that various disciplines are going to develop different traditions in the interpretation of the meaning of this term. The Rules of Zoological Nomenclature have once been established in 1905 to overcome the problematic situation that every zoological discipline follows their own rules. Today the trend may possibly go back to a situation before 1905, since many zoologists consider spellings of names as most "stable" if every zoological discipline maintains their own unwritten conventions.

The ICZN Commission faces a challenge to keep a strong position and good reputation. The main problem concerns communication. Not all members necessarily feel obliged to communicate with the community they represent. Some do it and participate in discussions in international mailing lists, they answer questions, give advice and try to help. But some Commissioners fail to answer their e-mails in a timely fashion. There are rules to exclude Commissioners after several months from the body if they do not even communicate with the Commission itself (Constitution Art. 3.3.3).

One of the major points of criticism is that the Commission is not democratically legitimated, and that its composition is biased towards experienced and well-known persons who know Latin very well, persons who know the Code very well and who speak English fluently.

In contrast, many members of the taxonomic community are young, do not know Latin very well, need a useful and helpful nomenclatural guide and have difficulties in reading the ICZN Code, they communicate in other languages than English, are amateurs with limited financial resources and are not paid for their taxonomic work.

To close this critical paragraph on the official ICZN organs, which I consider necessary to understand the background situation, I should repeat that the basic parts of the ICZN Code are commonly accepted by the taxonomic community, and that most Opinions published by the ICZN Commission are almost unanimously accepted.

1.6 The spirit of zoological nomenclature, basic rules of the ICZN Code

- **Publication:** Everything must be published (except information on type specimens and true dates of publication).
 - o No name published before **1758** enters zoological nomenclature (except those of Clerck 1757).
- **Binominality:** Names for species consist of two words (*Genus species*), subspecies have three, all others one word.
- **Coordination:** subspecies are nomenclaturally treated like species, subgenera like genera, subfamilies etc. like families.
- **Priority:** If two names refer to the same animal, the oldest name has precedence.
- **Stability:** If a very old name was never used, it may be ignored or suppressed.
- **Spelling:** Names are spelled in Latin script.
 - o The correct spelling of a name must be taken **from the original publication**.
 - o Afterwards a name can usually not be corrected, only the ending of an adjective can change.
- **First Reviser:** If two alternative names or spellings were published simultaneously, a First Reviser decides on priority.
- **Description:** Any new name must have a description, regardless in which language or script.
 - o The content and accuracy of a description is not regulated.
 - o Any new name must have been treated as a correct name for a taxon in the author's classification.
- **Typification:** The identity of a name is not based on the description but on types.
 - o Types are preferably fixed in the original publication.
- **Homonymy:** Different animals must not have the same name.
 - o An available name that cannot be used can be substituted by a new replacement name.
- **Authority:** The author in a name is the person who wrote the description.
- **Date:** The year in a name is the true date of publication.
- **Accuracy:** For more recent publications, stricter nomenclatural standards apply.

- **Legality:** The Code is widely and voluntarily accepted by the community, it is not a binding law.
 - o The ICZN Commission can set aside rules in singular cases, these are not regarded as cases of precedent.
- **Taxonomy excluded:** The ICZN Code regulates only nomenclature, not taxonomy.
 - o The author who combines a species with another genus is not recorded in the taxonomic name.
 - o A species does not have an official taxonomic status, all classifications are only regarded as proposals.

2. Best practices and recommendations in the handling of taxonomic and nomenclatural data

2.1 How to cite the original spelling and the original combination

The Code does not give examples for a correct or recommended citation of original combinations. This guide is based on common usage and on practical considerations.

An original name can be cited for different purposes. This has influence on the mode of citation. In some cases only the original combination is relevant, in others both the original spelling and combination.

General unwritten rules for citing names

If available scientific names of genera and species were originally spelled in normal type, they are usually cited in *italics*. Bold type is ignored in citations, as well as typeface and font size.

Nomina nuda and otherwise unavailable scientific names are not always cited in *italics*. Normal type is often used to indicate that a scientific name is unavailable.

If names were originally spelled in CAPITALS they are cited in lower-case letters according to the currently accepted rules and standards for scientific names (generic names are capitalised, species are cited in lower-case letters). Occasionally this can be tricky. If a name was originally spelled ELEPHAS SMITHI and it is well-known that when using lower-case letters the author generally capitalised specific names dedicated to persons, it may be questionable to cite the name as *Elephas smithi*, and acceptable to cite it as *Elephas Smithi*.

If names were originally spelled in SMALL CAPITALS they are cited as if they were written in normal type, CAPITALISED WORDS are cited as Capitalised words.

Some unusual letters used in old types are not considered in citations of scientific names.

The **long s** (ſ) used before 1820 is not regarded as an independent letter, scientific names which contained this letter are always cited as if they were originally written with a standard s (= terminal, round or short s).

Stylistic ligatures for ct, ff, fi, fl, ffi, st, tz and others (including combinations involving the long s) are cited as if the letters were printed separately. The ligatures æ and œ are cited in this form as ligatures, not separately as ae and oe.

The **German ß** (originally a ligature of a long s and a short s, having the value of ss, still used in Germany and today the only lower-case letter in Latin script without equivalent upper-case letter) is regarded as an independent letter and is cited as such. It looks like the Greek letter beta, but this is just a coincidence.

Hyphens are not cited if they were used to connect words over line breaks.

Original spelling

Letters with diacritic marks are cited in the original form (á, à, â, ä etc.), but if a small e was printed above a, o or u to indicate an umlaut in very early texts (superscript e), the letter is cited as ä, ö or ü. The ligatures æ and œ are cited as such.

If a specific name was originally capitalised, this is usually repeated in the citation, like in *Elephas Smithi*. This is normally not confusing. If a subgenus is cited, then usually in parentheses (parentheses in italics) in the present-day conventions, as in *Elephas (Smithiana) Smithi*. It gets more confusing if genera and subgenera were originally spelled in lower-case letters (not capitalised) and are cited in this form, like in *elephas smithiana smithi*, or if species were originally presented in a style that involved the use of parentheses, such as *Elephas (smithi)*. In such a situation it is certainly convenient to use present-day conventions, or, if it is necessary to cite the original style, to explain the circumstances verbally to avoid misunderstandings.

Example:

[Denis & Schiffermüller] 1775 combined the lepidopteran names of the genus *Phalaena* with the subgenera (*Bombyx*, *Noctua*, *Geometra* etc.). On p. 102 a new name was presented as G. Coarctaria with ct ligature. The original spelling was *Phalaena (Geometra) Coarctaria*.

If the species was combined with a genus for which the correct spelling was not used, we have a conflict for which no rules seem to exist. Many authors spell the name of the genus as if it had been spelled correctly in the original source. Sometimes it is necessary to cite the spelling of the genus as in the original source.

Examples:

Cypraea mappa Linnæus, 1758, original spelling is usually cited as *Cypraea Mappa*, but can also be cited as *Cypræa Mappa*.

Lymnaea auricularius var. *ampla* Hartmann, 1821 was originally established as *Limneus auricularius* var. *ampla*. *Limneus* was a misspelling for *Lymnaea*.

Original combination

The original combination is usually the combination of a generic name and a specific name (*Genus species*), or *Genus species subspecies*, or *Genus species* var. *variety*. For citing this combination the corrected original spelling is usually used, for the genus and the species.

Examples:

Elephas maximus Linnæus 1758.
Cypraea mappa Linnæus 1758.
Chondrina farinesii granatensis Alonso 1974.

The genus does not need to have been directly combined with the specific name, but it must have been unambiguously clear from the context which genus was meant. It must be possible to derive the generic name from the original work, there must be no need to consult secondary works to obtain the probable name of the genus. If the genus was not directly combined with the species in the original source, but it was mentioned somewhere else (as usually done in early works, for example by Linnæus or Fabricius), the original combination is not cited with the genus in [] square brackets.

Examples:

Musca cibaria Linnæus 1758 (Diptera), established on p. 599 as *cibaria*. The name of the genus *Musca* was mentioned on p. 589.
Papilio phaenareta Schaller 1785 (Lepidoptera), established as *Phaenareta*. It was clear from the context that only the genus *Papilio* can have been meant, this name was mentioned in a Latin text passage.
Hyalinia diducta Westerlund 1886 (Gastropoda), established on p. 49 as *H. diducta*. The name of the subgenus *Polita* was mentioned on p. 40 and p. 29, the name of the genus *Hyalinia* on p. 28. The complete original combination is *Hyalinia (Polita) diducta*.

If the **genus was spelled incorrectly** in the work in which the new species was established (incorrect original spelling, incorrect subsequent spelling or unjustified emendation), the original combination is applied as if the genus was spelled correctly (Art. 51.3.1).

This is important for the use of parentheses (author year) in a current genus-species combination. For genera being distinct, a one-letter difference can be sufficient. Unexperienced users would get confused if they see that a species was established in a different genus.

Examples:

Squalus maximus Gunnerus 1765 (Chondrichthyes), originally spelled *Sqvalus maximus*, the generic name is *Squalus* Linnæus 1758.
Cardium casertanum Poli, 1791 (Bivalvia), originally spelled *Cardivm casertanvm*, the generic name is *Cardium* Linnæus, 1758.
Lymnaea albolimbatus Küster 1856 (Gastropoda), originally spelled *Limnaeus albolimbatus*, the generic name is *Lymnaea* Lamarck 1799.
Bithynia walderdorffii Frauenfeld 1865 (Gastropoda), originally spelled *Bythinia Walderdorffii*, current name *Bithynia walderdorffii* Frauenfeld 1865 without parentheses, the generic name is *Bithynia* Leach 1818.

Also if the genus was only given tentatively and with some doubt expressed, the original combination stands (Art. 11.9.3.4).

Examples:

Paramastus goettingi Forcart 1961 (Gastropoda), originally established as *Paramastus? goettingi*.
Dysidea papillosa Johnston 1842 (Porifera), originally established as *Dysidea? papillosa*.
Hiltrudia globulosa Subai 2009 (Gastropoda), originally established as *Hiltrudia (?) globulosa*.

The subgenus is rarely cited in original combinations, it is often overlooked and nowhere needed for nomenclature except for error control purposes.

If the name was originally **combined with a subgenus**, the original combination is not cited as *Subgenus species*, even if the specific name was forced to agree in gender with the subgenus and not with the gender, but *Genus species* or *Genus (Subgenus) species*. The style of the work must be analysed to understand the author's classification. The genus is not by definition the name with which the specific names were directly combined in the original source, because this could also have been the subgenus.

Examples:

[**Denis & Schiffermüller**] 1775 combined the lepidopteran names of the genus *Phalaena* with the subgenera (*Bombyx*, *Noctua*, *Geometra* etc.). On p. 102 a new name was presented as G. Coarctaria with ct ligature. The original combination was *Phalaena coarctaria* or *Phalaena (Geometra) coarctaria*.
Pupa (Torquilla) homala Westerlund 1892.
Helix (Patula) rupestris chorismenostoma Westerlund & Blanc 1879.

Expressions like var. and forma are often included in original combinations, these terms are not spelled in italics.

Examples:

Pupa quinquedentata var. *juliana* Issel 1866.
Pupa megacheilos var. *tenuimarginata* Des Moulins 1835.
Pupa (Vertigo) arctica var. *extima* Westerlund 1877.
Pupa (Oracula) gularis forma restituta Westerlund 1887.
Acme lineata mut. *villae* Stabile 1859.

Tautonymous names with identical genus and species are allowed and welcome in zoology.

Examples:

Bison bison (Linnaeus 1758) (Mammalia), *Bufo bufo* (Linnaeus 1758) (Amphibia), *Cygnus cygnus* (Linnaeus 1758) (Aves), *Salamandra salamandra* (Linnaeus 1758) (Amphibia), *Anguilla anguilla* (Linnaeus 1758) (Actinopterygii), *Caleta caleta* (Hewitson 1876) (Lepidoptera), *Semilimax semilimax* (Férussac 1802) (Gastropoda).

Names that were first established as synonyms and later made available under Art. 11.6.1 should be cited with their complete original classification. Art. 11.6.1 does not identify which one should be the original genus responsible for the parentheses in specific names. This is just a proposal.

Examples:

Vertigo **synonym** *Abida* Turton 1831.
Lymnaea **synonym** *Stagnicola* Jeffreys 1830.
Pupa minutissima var. A **synonym** *Pupa laeviuscula* Küster 1850.
Pupa megacheilos var. d *pusilla* **synonym** *Pupa bigorriensis* Des Moulins, 1835.
Achatina algira var. B **synonym** *Polyphemus dilatatus* Philippi 1836.

If the gender of a specific name was not in agreement with the genus, the original genus-species combination should be cited with the **incorrect original ending of the adjective**. An incorrect ending could have various reasons and was not necessarily incorrect in the original source, or regarded as incorrect at the time or in the future.

The Code rules that Latin adjectival names "must agree in gender with the generic name with which it is at any time combined" (Art. 31.2, 34.2). This has no impact on the citation of an original source (where Art. 31.2 may have been violated), an exact citation of the original source should cite the incorrect ending.

It is possible that someone in the future will need the incorrect ending. The gender agreement rules are much more disputed than for example the corrections of the diacritics down to the 26 Latin letters or the corrected misspelled genera in original genus-species combinations.

Examples:

Deroceras rhodensis Forcart 1972 (Gastropoda), *Deroceras* is neuter, the adjective was incorrectly declined (because the author did not know how to decline correctly a Latin adjective) and should have been *rhodense*. The name is currently used as *Deroceras rhodense* Forcart 1972.
Unio manca Lamarck 1819 (Bivalvia), *Unio* is masculine and not feminine, the adjective was incorrectly declined (because the author thought *Unio* was feminine) and should have been *mancus*. The name is currently used as *Unio mancus* Lamarck 1819.
Nettenchelys pygmaeus Smith & Böhlke 1981 (Actinopterygii), should have been *pygmaea* Smith & Böhlke 1981, the adjective was probably incorrectly declined, I don't know why (and I don't need to know that). The name is currently used as *Nettenchelys pygmaea* Smith & Böhlke 1981.
Lymnaeus pereger var. *labiatus* Rossmässler 1835 (Gastropoda), the genus was originally spelled *Limnaeus* (masculine) by Rossmässler 1835, so *labiatus* (masculine) was correctly declined, but the original genus must be corrected to *Lymnaea* (feminine). The name is currently used as *Radix labiata* (Rossmässler 1835).
Pomatias tessellatus var. *achaica* Boettger 1885 (Gastropoda), should have been *achaicus*, Boettger forced the name of the variant to agree in gender with the term "varietas" (feminine). Currently used as *Cochlostoma achaicum* (Boettger, 1885).
Papilio torquatus var. *flavida* Oberthür 1879 (Lepidoptera), Oberthür regarded *Papilio* as masculine (most probably incorrectly, most current authors seem to agree that *Papilio* should be feminine), but forced the name of the variant to agree in gender with the term "varietas" (feminine). Originally the subspecific name should have been given as *flavidus*.
Glischrus (Helix) diaphana Studer 1820 (Gastropoda), the specific name *diaphana* (feminine declination) agreed originally in gender with the subgenus *Helix* (feminine) and not with the genus *Glischrus* (masculine). The name is currently used as *Vitrea diaphana* (Studer 1820).
Lymnaeus (Gulnaria) ampla Hartmann 1841 (Gastropoda), the specific name *ampla* (feminine declination) agreed originally in gender with the subgenus *Gulnaria* (feminine) and not with the genus which was incorrectly given as *Lymnaeus* (masculine). The name is currently used as *Radix ampla* (Hartmann 1841).

2.2 Stability and occasional change of genus-species names

In the ICZN Code the stability of names has high priority and several measures are provided to maintain stable usage of names. But this concerns only nomenclatural changes of names.

Taxonomic changes of genus-species names occur much more frequently, under the responsibility of taxonomists - and also of users who quickly (sometimes too quickly) accept and use new changes published by taxonomists. For taxonomically induced changes only best practice guides can help. The ICZN Code has only little influence on taxonomy.

It is widely agreed that stability of names concerns only the genus-species names, not the authors and years of a taxon name author string. If only the author and the year must be modified, it is usually should not a problem to change it. It will create problems, but if the previously attributed authorship is incorrect, it will have to be changed anyway and everywhere. Disputes are rare on authors and dates if the original sources are available.

The most important recommendation for a taxonomist is: do not quickly change a genus-species name unless this is not absolutely necessary. Communication is based on stability of names. Always keep in mind that as a taxonomist you have the responsibility to provide a unique name for an animal to be used by the whole society. Taxonomists are not the only users of taxonomic names. You are providing a service for others.

But users are at least equally responsible. A taxonomist can never change an officially used genus-species name, because there are no officially used names in zoology. A taxonomist can only propose to use a name. Users and responsible database providers are not obliged to adopt every proposal and to use every changed name. A responsible composer of a Red Data List is not obliged to follow a recent author who proposed on extremely weak evidence a new classification for an endangered species, in the objective to allow killing their last populations after taking them outside of any legal protection by lumping them with a widespread species. The entire community is lastly responsible for the stability of names, and for the protection of nature.

In some cases a change of a commonly used name cannot be avoided.

2.3 Taxonomy or nomenclature: why do names change?

For a computer program or a database a change of the genus is at least as critical as a change of the species. A database provider cannot know whether *Helix aspersa* is the same as *Cantareus aspersus* or not. Author and year will help, but they give no guarantee. Insects with the name *fasciata* were established in many genera, often by the same authors in the same years and for closely related animals.

For a taxonomist this is much less a problem. Taxonomists know the names of closely related genera and are perfectly able to communicate using various generic names and endings, they do not even feel the change. Taxonomists are much more bothered by minor changes in the spelling of a name.

In 1999 taxonomists succeeded in setting the ICZN Code Committee under pressure to establish rules that incorrect names should not be changed if they are in "prevailing usage" (a very vaguely defined and disputed term), in response to a newly created "Principle of Stability". But "stability" in this sense did not mean that the name *Drosophila melanogaster* should remain stable and not be changed to the much different name *Sophophora melanogaster*. It meant that a name *Trypanosoma brucei* should remain stable and not be changed to a very faintly different name *Trypanosoma brucei*.

For a taxonomist the difference between *Helix aspersa* and *Helix aspersia* is much more significant than the difference between *Helix aspersa* and *Cantareus aspersus*.

Most changes of genus-species names with which the public is confronted, concern the genus component, more rarely the species component. Changes of the genus component in a genus-species name are usually taxonomy induced. Changes of the species component are sometimes nomenclaturally induced, and sometimes taxonomically for various reasons.

Taxonomic changes at generic level occur much more frequently, and generally hit much more frequently used and well-known names. *Drosophila melanogaster* is the best example, which some taxonomists recently proposed to change to *Sophophora melanogaster*. Cases like these usually provoke surprised reactions and little understanding in the broad scientific public. In the public opinion avoiding such disasters would be a task for the ICZN Commission, but the Commission has no measure to save *Drosophila melanogaster* by telling taxonomists not to split up this genus, since this is in the realm of taxonomy, not nomenclature.

In the Linnean system a genus is a part of the name of the species, and at the same time a hierarchical rank in the classification based on our current knowledge on phylogenetic relationships between animals. Due to the steady advancement of scientific knowledge the classifications are occasionally modified, and with them the genus-species combinations. This is a general shortcoming of binominal nomenclature, and its heavy impact on the stability of names can only be avoided if either the genera are tolerated not to be forced to represent monophyletic units (a solution most taxonomists do not like), or if genera comprise very large groups with many species (as done in many groups prior to 1900) so that new knowledge on phylogenetic relationships will not affect the genus-species combinations, or if every single species is placed in its own genus (as practically done in dinosaurs which are almost only known by their generic names). In zoology there is no national or international institution that would regulate such strategies.

Nomenclatural changes rarely hit well-known names. *Trypanosoma brucei* was an exceptional case. The Commission protected the widely used incorrect spelling *brucei* against the correct *brucei* in Opinion 1484.

This means that a strict application of the Principle of Stability in the ICZN Code will only contribute to avoid relatively few changes (if the involved cases are not disputed). The life of database providers will not be substantially improved. Database providers have to deal with many more misspellings.

Examples (proportions refer to 2200 names of European non-marine mollusc species, names were changed somewhen in the past decades, variant spellings occupied a significant proportion of hits in Google search, usually more than 20 Google (2009) hits for a variant spelling or name, or a proportion larger than 5 %):

Change of **species only (nomenclature) (name was misspelled) (0.4 %)**: *tandonia-lagostoma* // *tandonia-lagostana*, *vitrea-densigrata* // *vitrea-densigrata*, *lozekia-transsylvanica* // *lozekia-transsilvanica*, *pupilla-sterri* // *pupilla-sterrii*

Change of **species only (nomenclature) (incorrect gender agreement) (1.0 %)**: *deroceras-rhodensis* // *deroceras-rhodense*

Change of **species only (taxonomy) (1.5 %)**: *ferrissia-wautieri* // *ferrissia-fragilis*

Change of **genus only (nomenclature) (0.6 %)**: *dreissensia-polymorpha* // *dreissena-polymorpha*, *trichia-erjavecii* // *trochulus-erjavecii*

Change of **genus only (taxonomy) (13 %)**: *oxychilus-cyprius* // *schistophallus-cyprius*, *helicigona-setosa* // *liburnica-setosa*, *zebrina-cosensis* // *rhabdoena-cosensis*, *isabellaria-chelidromia* // *carinigera-chelidromia* // *albinaria-chelidromia*

Change of **genus and species (nomenclature)** (0.7 %): *trichia-hispida* // *trochulus-hispidus*

Change of **genus and species (taxonomy)** (0.5 %): *helix-aspersa* // *cornu-aspersum* // *canteraus-aspersus* // *cryptomphalus-aspersus*,
oxychilus-hydatinus // *mediterranea-hydatina*, *oxychilus-glaber* // *morlina-glabra*

2210 names of European non-marine mollusc species may represent an average group of animals, they are less well-known than fishes or birds, and better than sponges or nematodes. They are unusual in that 77 % of the genera are feminine (average in zoology 58 %), so a change in the genus-species combination will more rarely provoke a change in the ending of the specific name than in other animal groups.

Of these 2210 species, 18 % suffered from recent changes of their names. In most cases (13.5 %) changes in the genus-species classification were reponsible (in many cases unsubstantiated, weakly justified and not confirmed in more recent studies). New insights in species identities - the only reason why a name would need to change in any case - were reponsible for only 1.5 %.

Misspellings of names concerned 0.7 % of the analysed names in this animal group. This was the class of changes for which the ICZN Code was substantially modified in 1999 under the label "stability of names". Had the new rules been affective since 50 years the proportion would probably be almost the same.

Incorrect gender agreement - usually provoked by disputes among taxonomists about which was the correct ending or the correct gender of the genus - was a more serious problem and affected 1 % of the names so much that both versions were represented in websites. The major stumbling block was neuter gender. Solving this problem would be possible for the ICZN, but they have neither shown awareness of the problem nor intended to propose ideas or provide measures to improve this situation.

The results of this analysis, if applicable as a model for other animals, suggest that nomenclaturally induced changes of names affect only a small minority of cases (and most are related to gender agreement), while a much more problematic threat for the stability of names is careless behaviour of taxonomists who often propose much too quickly new generic classifications, and users and database providers who blindly follow these proposals.

2.4 When should a name be changed? Best practice guide for changing names or not

The ICZN Code (Appendix B) gives only very vague recommendations concerning the stability of names, and underlines that the Code is not responsible for taxonomic changes of names. The goal, stability of names, cannot be reached if the fact is ignored that most changes are due to reclassifications of taxa.

The need to change a name decreases gradually depending on the situation.

It is absolutely necessary to change a genus-species name if:

- bioscientific research provided evidence that two species must be lumped,
- bioscientific research provided evidence that one species must be separated into two,

There is no alternative to remove the younger name and use the older name for the species.

Example:

Walther et al. 2006 suggested that the gastropod species known in Europe as *Ferrissia wautieri* (Mirolli 1960) and *Ferrissia clessiniana* (Jickeli 1882) was conspecific with the North American species *Ferrissia fragilis* (Tryon 1863). The study was sound and it can be expected that researchers will accept the conclusions. There is no alternative to accept using the older name also for the European species. Entries in databases and checklists should be changed.

It is almost absolutely necessary to change a genus-species name if:

- study of type specimens provided evidence that a species must have a different name,
- literature research found a senior homonym that has been used after 1899,
- literature research yielded a different type species for a genus.

It is not absolutely necessary but in most cases convenient and wise to change a genus-species name if:

- the name was spelled differently in the original source,
- an older name is discovered that has been used after 1899.

If the spelling of a name must be corrected for nomenclatural reasons, it is usually the best choice to correct it. If it is not an extremely widely used name such as *Trypanosoma brucei* (for which the Commission can be asked for an official decision), an incorrect spelling has probably no future, the correct spelling is almost always superior.

Example:

In a routine check of original literature in the early 2000s, a researcher and database provider found that the well-known gastropodan name *Neostyriaca strobeli* (Strobel, 1850) was originally established by Strobel 1850 as *Clausilia strobela*, who did not spell the name *strobeli*. Following the ICZN Code the name should be *strobela* and not *strobeli*. It was a rarely mentioned species (only 70 Google hits for "neostyriaca-strobela" in 2009, indicating rare use), *strobela* was never used before. The researcher decided not to maintain the incorrect subsequent spelling and to use the name *Neostyriaca strobela* in the online database (www.faunaeur.org).

This was a responsible decision. Very few years later the Google hits for the previously never used spelling "neostyriaca-strobel" (100 hits in 2009) surpassed those of the traditional spelling "neostyriaca-strobeli". An incorrect spelling for a name that is not widely used is quickly replaced, if the correct name appears in an important online database.

It is not necessary but often convenient to change a genus-species name if:

- bioscientific research suggested that a subspecies should better be classified as a species,
- an older synonym was discovered that has not been used after 1899,
- the name has been used with an incorrect ending, which differed from the original spelling.

If an older name for a relatively well-known **genus** is discovered, do not immediately replace the widely known genus. Wait several years, try to find solutions to maintain usage of the old name, try to ask other experts of your discipline for their opinion.

If an older name for a relatively well-known **subgenus** is discovered, it is usually the best choice to replace the subgenus. The idea of stability of names refers mainly to genera and species, not to subgenera and subspecies.

If an older name for a relatively well-known **species** is discovered, be careful to replace the well-known name, and try to verify how well-known this species really is.

- Try to find out whether the older name was used as a name for a taxon (species, subspecies) after 1899.
- If yes, wait some years, try to contact and ask others, talk about the problem, also with your competitors, and finally replace the younger name. In most cases it is better to replace the younger name.
- If no, try to find 25 publications where the younger name was mentioned, and try to meet the conditions of Art. 23.9.

Suppress names under ICZN Code Art. 23.9 following strictly the procedure. Cite accurately and completely, do not forget to mention the Article 23.9 and the full names, and give 26 publications of the past 50 years, one in excess of 25, so that one error will not give reason to regard your act as invalid. Do not write "please look in the reference list published by Smith 1990 to find the required publications". Do not write "for finding the required publications please consult the Zoological Record". Cite all 26 papers in the list of references.

Example:

In accordance with Art. 23.9 *Turbo fuscus* Montagu 1803 shall be used for a name of a taxon, *Turbo fuscus* Müller 1776 has not been used in such a sense since 1899, *Turbo fuscus* Montagu 1803 was used as a "valid" name in the following 26 papers: Sevo 1974: 8, Devriese 1976, Kerney 1976: 75, Zilch 1976: 126, Fretter & G. 1978: 121, Seidl 1978: 96, Kerney & Cameron 1979: 54, Kerney et al. 1980, Kerney et al. 1983: 69, Ross 1984, Holyoak & S. 1985: 69, De Wilde et al. 1986, Prieto et al. 1987: 261, Van Goethem 1988, Boeters et al. 1989: 43, Korn 1990, Wiese 1991: 34, Vogt et al. 1994: 50, Kerney 1999: 43, Falkner et al. 2001, Roper 2003: 28, Moorkens & K. 2004, Anderson 2005, Kobialka et al. 2006, Jungbluth & K. 2008.

And then, of course, cite all the papers in the list of references.

This is a real case but not a valid nomenclatural act, because this manual is not a paper-based publication, and as such not published work in the sense of zoological nomenclature (Art. 9.7).

It is not necessary to change a genus-species name immediately if:

- bioscientific research suggested to elevate a subgenus in the rank of a genus,
- bioscientific research suggested to downgrade a genus to the rank of a subgenus,
- bioscientific research suggested that a species should better be classified in a different genus,
- bioscientific research suggested that two species should probably be lumped,
- bioscientific research suggested that one species should probably be separated into two,
- it seems probable that the original name was formed incorrectly, but this may be disputed,
- the ending of the original name was incorrectly spelled and has never been corrected,
- a change is exclusively based on unpublished results of a study.

2.5 Brief recommendations for establishing new names

A new name must be established in a paper-based **publication** in numerous identical copies issued simultaneously (a minimum of 50 copies has been discussed as appropriate, or 25 copies deposited in public libraries. Less than 20 copies obtained only little support in such discussions).

Online publications do not count!

If you publish in a journal, make sure that paper copies are printed and available, for example by checking online public library resources.

The ICZN Commission is currently (since 2008) trying to amend the Code to allow electronic publications. In the drafts this referred only to periodicals which were registered in public archival systems. The result of the discussions is still open.

It is obligatory to introduce the new name as **expressly new**. Use a standard term in the form of spec. nov., n. sp., nov. gen.

If you do not know exactly the Code's exceptions for skipping these provisions, you must also give a **description**, compare the new taxon with others and designate a **name-bearing type** (in species a holotype, and it is necessary to state where this type is deposited). Usually an **illustration** is recommended for new species.

Publish your description in a **language** that is broadly understood. But don't publish in a foreign language in which you cannot firmly express your ideas. Do not force yourself to write in English if you do not speak it properly.

If you publish in a not widely understood language, give an extended summary in a better known language. In this extended summary, try to translate the diagnoses of the new taxa, and do not only write "the species is described in detail with its well visible characters".

Take care that your new name is **not preoccupied**.

For genera: consult at least Nomenclator Zoologicus: www.ubio.org/NZ, but also Google and others, and botanical sources. Do not publish a new generic name that is used in botany or other kingdoms.

For species: consult many sources in your field, www.globalnames.org and others, do not rely on one single source or aggregator.

If you establish a new name it is recommended to be careful and prefer a **peer-reviewed journal**. But do not rely on the belief that reviewers will be able to detect serious nomenclatural mistakes. Even if your article is reviewed by 4 skilled scientists and an experienced editorial team, this does not imply that any of those may find your most basic mistakes.

Example:

Lambert et al. 2010 established a new genus of a fossil sperm whale in the *Nature* magazine and called it *Leviathan*. None of the magazine's reviewers and editors verified if the name was not preoccupied. In Nomenclator Zoologicus they would immediately have seen that the same name had been used in 1841 for a mammal. The authors had to publish a corrigendum in the same journal, where they established a new replacement name *Livyatan*.

A name must be a **word**. It can be a fantasy word, the key is pronouciation. *cbdafg* is no word, do not ask why and do not try to test the tolerance.

Use only the 26 basic letters of the Latin alphabet, not diacritic marks, hyphens or other signs.

For species, if you do not like your name to be eventually changed later according to **gender agreement**: add a statement "**to be used as a noun in apposition**".

Otherwise take care to apply the rules of Latin gender agreement correctly.

State the **etymology** of your new name, particularly if it is a genus. If you do not know it, write "arbitrary combination of letters".

Give the **gender** of a new genus. **Avoid establishing genera with neuter gender**. Most taxonomists do not know how to decline the adjectives correctly in neuter gender.

Do not dedicate names to disputed politicians, particularly not if they were engaged in suppressing minorities, do not create names that can give offense on any grounds.

Do not establish the same specific name a second time in another genus of the same family. In botany this is not allowed, in zoology this cannot be recommended. It leads to readers not understanding what is meant.

Examples:

Isabellaria riedeli Brandt 1961, *Macedonica riedeli* Urbanski 1978, *Phrygica riedeli* Nordsieck 1994 (all Gastropoda: Clausiliidae).
Alopi nordsiecki Grossu & Tesio 1973, *Albinaria nordsiecki* Zilch 1977, *Macedonica nordsiecki* Fauer 1985, *Charpentieria nordsiecki* Fauer 1991, *Sciocochlea nordsiecki* Subai 1993, *Balea nordsiecki* Dedov & Neubert 2002, *Carinigera nordsiecki* Gittenberger & Uit de Weerd 2004 (all Gastropoda: Clausiliidae).
Malaprespia albanica Radoman 1973, *Albaniana albanica* Radoman 1973, *Orientalina albanica* (Radoman 1973) (all Gastropoda: Hydrobiidae).

Do not establish a name that is likely to be confounded with a very similar name in the same or closely related genus, or with a previous misspelling of such a name.

Examples:

Vitrea riedeli Damjanov & Pintér 1969, *Vitrea riedeliana* Paget 1976 (Gastropoda).
Albinaria adrianae Gittenberger 1979, *Albinaria adriani* (Gittenberger 1987), *Albinaria ariadne* Schilthuizen & Gittenberger 1991 (Gastropoda).

Do not establish names that are not easily memorable and that are likely to be misspelled.

Examples:

Speleodentorcula Gittenberger 1985 (Gastropoda).
Virpazaria aspectulabeatidis Reischütz, Reischütz & Subai 2009 (Gastropoda).

Xerocrassa rhithymna Hausdorf & Sauer 2009 (Gastropoda).
Szczurekia Gonzales-Sponga 1992 (Opiliones).

If you feel you need to establish a new genus for a group of species which are currently classified in another genus, then select a name with the same gender as the previous genus. It is not necessary that also the ending of the specific names must change.

It is good practice **not to attach more than 3 co-authors** for a new taxonomic name, if not absolutely necessary. This however, is disputed, and there are taxonomists who see no problem in attaching 10 or more co-authors to a single new species name, if they all contributed to the description. For data integration purposes this is probably not a good idea.

Consider that if you attach many co-authors to a new name, you create workload for others. Your name as a co-author will remain connected to something further generations would probably not appreciate very much, since you leave them alone with the work to cite all these co-authors every time they mention that name in a scientific study (it is best practice to **cite the complete authorship and year at least once** in a work).

If the authorship for the new name shall differ from that of the paper, pay attention. If at least one of the co-authors of the name is not among those of the work, you must give a statement who was responsible for the **description** of that taxon. Simply attaching names of persons to the new taxonomic name is not necessarily sufficient. Only if these were co-authors of the paper. If not, then do not simply write "only the following persons shall be co-authors of this new name" or "the name of the new taxon shall be restricted to the following co-authors". The statement must read "only the following persons have contributed to the **description** of the new name" or "Person X contributed to the **description** and shall be co-author of the new name".

Example:

In an article published by Gittenberger in 1983 was established a new gastropod species *Hypnophila malagana*. Gittenberger explained that the name should be cited with the authorship of Gittenberger & Menkhorst because the description had been prepared by both authors. Because the responsibility for the description was clarified, the name is attributed to Gittenberger & Menkhorst.

Avoid using the two following potentially misleading taxonomic terms in nomenclatural contexts:

redescription: a term often used for species, to indicate that the original description was insufficient, incorrect or too short. This term is meaningless in nomenclature because it has no effect on the availability or identity of a name. This is why it is not mentioned in the Code's Glossary.

A name usually needs a description, but this is just a formal requirement, the identity of taxa is based on types. For a species with ugly original description it is often useful to publish a better description. This is a regular taxonomic study and scientists will thankfully acknowledge your work, but it has no influence on the nomenclatural background. A "redescription" cannot define a species or specify or restrict its definition and identity.

Example:

I herewith give a statement that Asian elephants (*Elephas maximus*) are friendly big animals with small ears and grey skin. This is a redescription, a more or less perfect description of the important characters of the animal in my own words. It has the same nomenclatural implication as if I gave here a perfect standard description with all taxonomically important bones.

new combination (n. comb.): this term is often employed to demonstrate that a species is classified in a genus in which it had never been classified before. This term suggests the present of an official act, but in reality it is meaningless in nomenclature. Any author can produce any combination, this is taxonomy and nowhere recorded, nothing official comes into effect, and consequently there is nothing "new" to be created.

Example:

I can classify humans as elephants and use a name *Elephas sapiens* as valid right here. Subsequent authors will regard my classification as useless and nonsense. No one records that I was the first in having established this combination. It is also possible that others have done this earlier. If someone in 100 years likes to publish the same combination, for a completely different reason, nobody will remember that I had once done this here. This is only an example to illustrate the idea. This manual is not a paper-based publication, and as such not published work in the sense of zoological nomenclature (Art. 9.7), but it is a taxonomic statement and not a nomenclatural act.

Both terms sound as if they represented official nomenclatural acts, which is not true.

And finally a last recommendation: Avoid publishing a statement that you are **intending to write an application for the Commission** to suppress a name, if you have not already done this several times and know how much work it is.

3. Best practice guide for spellings of taxon name author strings

This short summary chapter summarizes the main information given in the following chapters on correct spellings in taxon name author strings. References to more extensive explanations in this text are provided in each section for your convenience.

Author and year are important to disambiguate homonyms and near homonym names, and to detect possible mistakes. In species they are extremely important to understand the identity of a species if it is placed in an uncommon or new genus. For original names they do not provide unique identifiers, the page of description would be needed as a 5th piece of information.

The ICZN Code gives almost mandatory rules and recommendations how to spell zoological names. A best practice guide is mainly needed for the name of the author in species-author and genus-author combinations.

Genus name (see also [section 8.1](#)):

Follows almost entirely the rules provided by the ICZN Code, as explained in [chapter 8](#). Only 26 Latin characters are allowed.

The genus is usually spelled in italics, where this is possible.

Species name (see also [section 8.1](#)):

Follows almost entirely the rules provided by the ICZN Code, as explained in [chapter 8](#). Only 26 Latin characters and exceptionally a hyphen (for the *c-album* case) are allowed.

The species is usually spelled in italics, where this is possible.

Author (see also [section 8.2](#)):

Only the identity of the author is ruled by the ICZN Code, but not the spelling.

The author is not spelled in italics.

The ICZN Code's rulings concerning the author's identity should be largely respected, as outlined in chapter 4.

There is no commonly accepted standard for spellings of authors. Currently there are various different standards or approaches used in various zoological disciplines, by various taxonomists and database providers.

Two full taxon name author strings for the same taxon can contain different sets of characters - usually because the spelling of the author deviates. There is no standardised list of unique spellings for zoological authors, and the use of initials (of first names) is frequent and inconsistent. The zoological community is probably too diverse, the disciplines work too much independently from each other, and no financial resources have been made available to create such lists.

Much can be improved if taxonomists and databases follow a best practice guide and spell the names of authors consistently using two guiding principles:

Initials (see also [section 8.2.2.3](#)):

- **Never use initials** of first names in a taxon name author string. Cite only the surname(s).
- If you have names equipped with initials, consider removing them. If you think initials are absolutely necessary and have a great future in zoology, create an additional field for the initials, so that you can remove initials from the names for data mobilising purposes.

Spelling of author (see also [section 8.2.2](#)):

- Use UTF-8 character encoding, and spell the author with all **diacritic marks** and ligatures as in the original work.
- Use Latin script for the author if possible.
- Separate the last co-author by &, the other co-authors by comma.
- If you have verified the **original spelling** of the author, use the original spelling and add a green flag that you have confirmed it.
- If you insist in using a **preferred spelling** for each author or for some authors in your database, then create two fields: one for your preferred name, and one for the original spelling.
- If you do not have the original spelling, use an unconfirmed (preferred) spelling and add a red flag that you have not confirmed the original spelling.
- If you have a small database or collection of data, try to obtain consistently the original spelling.
- Avoid uncommon formats in the citation of the author, for example by adding in parentheses the name of another author who provided a manuscript name, a true description or who placed a species in the currently used genus, as occasionally done in nematode taxonomy.

Year (see also [section 8.3](#)):

- Follows almost entirely the rules provided by the ICZN Code, the leading idea is that the true year of publication is cited in every name, as explained in chapter 4. Only one single year must be given, it must range between 1757 and present. A **range of years (1868-1869) is not admitted**, neither are constructions such as "1771 in 1776".
- The year is not spelled in italics.
- The year should **not be set in [] square brackets** if not or incorrectly given in the publication itself. The year is always exactly determined by the Code's provisions and does not depend on the original source. Also secondary and unpublished information has to be considered.
- Currently there is only one exception: Clerck's spiders can be combined with 1757 (true date) or 1758 (Art. 3.1, effective since 2000 and since then disputed). Recent important publications in arachnology have used the 1757 date, which should be preferred. The 1758 date created confusion and 1757 has always been accepted.
- Avoid using uncommon formats for the date which deviate from the usual form (four numeral digits).

Parentheses:

Regular parentheses () surrounding author and year are used in currently used specific names if the species was originally established in a different genus than the one in which it is currently classified.

For data mobilising purposes the parentheses are usually not very important. They are not known to disturb processes.

Comma:

The comma between author and year is a convention that can be respected, but it is not a must. It does not add any information to the taxon name author string.

If a comma is used, then use it consistently in all names. Presence or absence of a comma is usually no problem for data mobilising, but inconsistent usage could be a potential source of problems.

Additional information:

Unavailable names should be marked as such, if they are cited with author and year.

Family names and higher groups:

Names of families and higher groups are usually clear and based on common acceptance. It is usually not necessary to add author and year for their use in electronic environments.

The following endings should be used for family-group names:

superfamily (-oidea)

family (-idae)

subfamily (-inae)

tribe (-ini)

subtribe (-ina)

Occasionally the ending -acea was used for superfamilies in some animal groups, for example in mollusc collection data. This ending can be replaced by -oidea for data mobilising purposes.

The names of the higher groups are not ruled by the ICZN Code, no author and year should be added to these names. They are based on common acceptance. Authors and years are not important because they are not subject to priority rules.

All these names are not spelled in italics.

4. Verifying the correctness of a name: how to find and cite the original name

To verify which one is the correct spelling of a name of a species, it is always necessary to consult the **original publication**. There are no reliable other sources. Zoology has no official database or nomenclator where correct names are recorded. This applies also to those animal groups for which commonly used online databases exist.

Every researcher in every animal group must always consult the original source for the correct spelling and for the identity of a name of a species or genus.

Verifying 250 year-old names is getting easier than it used to be in the past. A steadily increasing number of early publications is being digitised and their contents become available electronically in free access internet resources.

So we need to find the publication where the name was originally established. This is usually only one single publication.

Any other later publication where the name was mentioned and perhaps much better described, redescribed, figured, corrected, misinterpreted or rejected, is irrelevant for nomenclature. Only the original first source needs to be consulted.

This chapter ends in a long section how literature should be cited, to make sure that others will find it more quickly and will not have to do all the research again. It is very important to communicate constantly the original sources to keep them in memory, since there exist no central databases who connect all names with all their original publications. Experience has shown that bad and insufficient citations of zoological literature sources not only created much workload for subsequent researchers, but also that in extreme cases the knowledge about the original source can entirely get lost.

The name of the **author** and the **year** in the taxon name author string usually provide a helpful key. In most cases the author is the person who wrote the book or the journal article, and the year is the year when the book or journal was published. This year is usually the year indicated on the title page of the book. In European non-marine molluscs 87 % of the names fall in this group.

Examples:

Mammalian name *Felis tigris* **Linnaeus 1758** was established in **Linnaeus 1758** (*Systema naturæ* Vol. 1, 10th edition): page 41.

Gastropodan name *Clausilia (Albinaria) aphrodite* **Boettger 1883** was established by **Boettger 1883** (*Proceedings of the Zoological Society of London* 1883): page 329.

Aranean name *Araneus angulatus* **Clerck 1757** was established in **Clerck 1757** (*Svenska spindlar*): page 22.

But not always, and there is usually no indication if not. In many cases the **year** in the taxonomic name differs from the bibliographically relevant year on the title page of the original publication (12 % in European non-marine molluscs). The problem with the true date is that it is not necessarily indicated in the original source and you must know which (hopefully published) secondary source has researched the currently accepted true date.

Examples:

Lepidopteran name *Papilio polyxena* [Denis & Schiffermüller] **1775** was established in [Denis & Schiffermüller] **1776** (*Systematisches Verzeichniß*): page 162. On the title page of this work was printed 1776, but we know from secondary sources that the whole work appeared in 1775.

Gastropodan name *Pupa bergomensis* Küster **1850** was established in Küster **1852** (*Systematisches Conchylien-Cabinet* 1 (14)): page 114. The title page indicated 1852, but we know from secondary sources that pages 97-128 were published in 1850.

Gastropodan name *Helix balmei* Potiez & Michaud **1835** was established in Potiez & Michaud **1838**: page 120. The title page indicated 1838, but we know from secondary sources that the text was published in 1835. It is necessary to know that Paulucci published a short note in 1879.

Gastropodan name *Onchidium celticum* Cuvier **1816** was established in Cuvier **1817**: page 411. The title page indicated 1817, but we know from secondary sources that the text was published before 02 Dec 1816. It is necessary to know that Roux published a short note in 1976.

Gastropodan name *Clausilia idaea* Pfeiffer **1850** was established in Pfeiffer **1849** (*Proceedings of the Zoological Society of London* 17): page 140. On the title page of the journal volume was printed 1849, but it is clear from the contents that the article was published in 1850.

Aranean name *Araneus angulatus* Clerck **1758** was established in Clerck **1757** (*Svenska spindlar*): page 22. This is the same name as above, but some authors just use 1758 because ICZN Code Art. 3.1 demands this since 2000, others use 1757 because this was the true date of publication.

Gastropodan name *Pomatias nouleti* Dupuy **1851** was established in Dupuy **1847-1852** (*Histoire naturelle des mollusques*): page 510. The title page indicated 1847-1852, as such it is known in bibliographies, but in small font on the title page was indicated that pages 459-594 were published in 1851.

Gastropodan name *Ohrigocea* Hadžišće **1959** was established by Hadžišće **1956** in a Macedonian journal. The title page of the journal volume indicated 1856, but Radoman 1962 explained in a footnote that the claimed date was faked and that the true date was 1959.

In some cases the name of the **author** in the taxon name author string differs from the author to whom the work is attributed (proportion in European non-marine molluscs 3 %). This is slightly less problematic than the date because the name of the "true" author must be stated in the original source.

Examples:

Neuropteran name *Formicaleo nostras* **Geoffroy** 1785 was established in **Fourcroy** 1785 (Entomologia Parisiensis): page 360. On the title page of this work was printed Fourcroy as the author, but in the introduction Fourcroy explained in complicate Latin that the descriptions were written by Geoffroy. In 30 % of the sources, Fourcroy is cited as the author (Google hits, 02.2010).

Gastropodan name *Bithynia graeca* **Westerlund** 1879 was established in **Westerlund & Blanc** 1879 (Aperçu sur la faune): page 137. On the title page of this book were printed both co-authors, but the authors indicated under the descriptive text of *Bithynia graeca* that only Westerlund and not Blanc was responsible for this specific description.

In some cases both the name of the **author** and the **year** in the specific name differ from the title page of the original publication. These cases are rare (in European non-marine molluscs only 1.5 %).

Examples:

Gastropodan name *Planorbis strauchianus* **Clessin** 1884 was established in **Küster, Dunker & Clessin** 1886 (Systematisches Conchylien-Cabinet 1 (17 [a])): page 204. On the title page of this volume was printed Küster, Dunker & Clessin as the co-authors and the year 1886, but it was explained on p. 63 that this part of the work was only by Clessin, and we know from secondary sources that pages 111-222 were published in 1884.

Gastropodan name *Bulinus cretensis* **Pfeiffer** 1846 was established in **Philippi** 1847: p. 124. Philippi attributed the description to Pfeiffer, and pp. 1-152 of Philippi's book appeared in 1846, as indicated in the original work.

This means we must usually look for a work published in this year by this author. If this fails, we must look slightly more tolerantly.

If we have no idea where the name was originally published, we can look for a book under the name of the author in library catalogues, or screen journals of the mentioned year looking for an article written by the author. Not having any idea where something was published is always an obstacle, also for the specialist. Nomenclators such as Sherborn's *Inde Animalium* or Neave's *Nomenclator Zoologicus* may help, but the experience is that if one nomenclator fails, the others will usually not be very helpful either.

To find a publication it is necessary to know what constitutes published work in the sense of zoological nomenclature.

4.1 How to find published work

Almost every bit of information relevant in zoological nomenclature must be published.

One rare exception is when it comes to finding types for species in old collections. In this situation also unpublished information is important. In some cases general knowledge about authors and years of certain works must also be consulted from unpublished sources, for example the true authors of old dissertations.

Under the term "published work" in the sense of zoological nomenclature we mainly understand (monographic) books and (journal) articles. We will either look for a book or for a journal. There are some exceptions, but this guide covers most cases.

The term "published work" in the ICZN Code is based on a very special definition (Art. 8, 9) that not only takes into account that the work must be available for the public, but also that it was issued to be kept in long-term archival systems (libraries). Otherwise the Code defines a work as "unpublished". The detailed differences are explained in the chapter "Published and unpublished work" more below (see [section 5.1](#)).

4.1.1 Technical preconditions: printed paper

Long-term archiving of published information on paper largely depends on three components: number of printed issues, paper quality and ink quality.

Letterpress printing was invented around 1234 in Korea (but not widely used until 1444 when the Korean *hanyul* alphabet was established) and around 1454 independently in Mainz, Germany, certainly with much more success. The main invention was not the press as such. This had been invented around 1040 in China where wooden movable types were used. The main invention was the movable type-printing from reusable and stable metallic letters set together in a frame, which involved a few inventions at once. This produced a much more efficient workflow process and enabled to print many identical copies of a work within a short time. Still it is much work so that books have always been expensive.

In combination this resulted in that books have been regarded for centuries as something precious and people have taken care to preserve them.

If we try to understand why we are able to use the Linnean nomenclatural system today, the crucial point is exactly here. It is only because all the original information necessary to apply the system has been preserved.

These two preconditions - presence of many originally printed identical copies of a work and relatively high values of old books - were responsible for the fact that practically all published zoological information since the

1550s has been preserved in original copies and is available. This method was so successful that in various zoological disciplines not a single publication has been lost.

Paper quality used in letterpress printing was initially very high and durable, and decreased substantially in the 1800s when larger quantities of paper were repeatedly recycled. This was exaggerated in the socialist era in eastern Europe when such a low paper quality was used that the books desintegrated after few decades and needed to be restored at high costs. There is no industrial calibration scale for paper quality. Quality depends mainly on the length of the fibres.

Ink quality has usually been high and durable, except in the dot-matrix printing machines where an ink-soaked cloth ribbon is struck against the paper like in a typewriter. Ink quality (lightfastness, ink fading is mainly provoked by ultraviolet radiation) is calibrated by the **Blue Wool Scale**, where in a scale ranging from 0 to 8 low numbers (0-4) correspond to bad ink qualities, and values above 5-6 to acceptable qualities for long-term archiving of printed material. Good offset printing machines use inks with ratings 6-7, laser printers are in the range of 5-6, their printing quality can hardly be distinguished from offset prints.

Letterpress was used since the 1500s until the 1970s when it was replaced by **offset printing**, which had been invented in 1903 in the United States. One of the characteristics of this method is that smaller quantity printing is impractical, which creates a need to print high numbers of issues. For zoological nomenclature this is an advantage, as it forces the publishers to print high numbers of issues. The numbers of printed books exploded in the 1900s. Still these books were printed in high numbers, and some of them always made their way into the magazines of public libraries where they were preserved. It was not necessary to regulate this in more detail than by a very general rule that the published information must be printed (Art. 8.1.3).

After the 1970s **dot-matrix printers** and ink-jet printers in combination with personal computers became popular, they were replaced by **laser printers** using higher ink quality in the 1990s. This allowed to print publications in extremely low numbers, which had not been possible before. It means that one of the most important preconditions for long-term conservation of zoological information, a high number of printed copies, is not any more a natural part of the printing process. The ICZN Code has not been adapted to this new situation.

4.1.2 Helpful resources to find original publications

Any published work is subject to access restrictions caused by international conventions and national laws on intellectual property rights (IPR, copyright). This is a complex field and theory and practice differ substantially. In many countries a published work is considered as free (public domain) if the author died more than 70 years ago. National laws and practice deviates from this general rule. In most European countries digitising published work legally gets extremely difficult if published after 1900. In the United States a law was passed that works published until 1923 is considered to be in the public domain (1923 is a fixed year and might not be changed in the coming decades). Australia and China allow this until 1955, but only for work published in their own countries. US libraries digitise also European works until 1923, many providers including BHL show these works also in European countries.

Free online access gets very difficult if works were published after 1923. These must be consulted in libraries which have a traditional right to provide free access to subscribed printed books.

Access to works published after 1995 is currently easier than prior to the 1990s because electronic files are currently held by many private persons, usually scientists who have lastly obtained the files from the authors. This, of course, is a temporary situation based on illegal copying of files in a broad community, and it remains to be seen if in 20 or 30 years access to works published in the early 2000s is as easy as it is today.

Helpful free internet resources to find the publication in which a name was originally established:

Nomenclator Zoologicus (Neave 1939-1940 and updated, practically all generic names until recently, with abbreviated literature citations of their original descriptions):
www.ubio.org/NZ

Index Animalium (Sherborn 1902-1922, 440,000 specific and generic names until 1850, with abbreviated literature citations of their original descriptions):
www.sil.si.edu/digitalcollections/indexanimalium/TaxonomicNames

Biodiversity Heritage Library BHL (the Taxon Finder tool allows to find names mentioned in digitized works, but it is rare that the original description of a name is among the results):
www.biodiversitylibrary.org

AnimalBase (50,000 names with direct links to digitized original descriptions):
www.animalbase.org

There are no general databases covering specific names established between 1851 and today. These names are usually the most difficult to find. Many were mentioned in the **Zoological Record** (since 1864), which is not a public resource (www.organismnames.com, currently owned by Thomson Reuters), with limited access to information, and with very incomplete records in the early years.

A general rule is that most species were described in journal articles from 1850-1860 onwards. Another general rule is that in most animal groups the years 1850-1920 was the most productive era in species descriptions, in these years taxonomists were more productive in terms of species descriptions than at present.

In many animal groups good online resources are available with accurate information on the original publication.

Internet resources to find digitised published work:

Biodiversity Heritage Library BHL (all biodiversity related literature, mainly for literature published until 1923):

www.biodiversitylibrary.org

archive.org (any kind of digitized literature and other media, biodiversity related literature is taken from BHL, Google and own resources. In the search function "text" should be selected)

www.archive.org

Google Books (digitized literature of any kind, for the digitized material Google owns the copyright with all rights reserved. This is usually helpful to find more recently published material, but often it is not free);

Google Scholar (links to scientific literature online anywhere):

<http://scholar.google.com>, <http://books.google.com>

Gallica (mostly French literature, digitised by the Bibliothèque Nationale de France):

<http://gallica.bnf.fr>

AnimalBase (early zoological literature, early established names linked to their digitised original publications, mainly before 1800):

www.animalbase.org

GRI B (Global References Index to Biodiversity, compound catalogue of public libraries holding digitized literature, free access):

<http://grib.gbv.de>

Internet resources to find titles of monographs and journals in library catalogues:

Karlsruher Virtueller Katalog (a selection of the globally most important library catalogues, search function covers authors, years, titles of journals and monographs - the search engine screens all library catalogues and gives detailed results. Very useful service):

www.ubka.uni-karlsruhe.de/kvk.html

Libweb global collection of library catalogues (links to many many local library catalogues, search function covers names of libraries. You would then need to search your book in the search function of the library catalogue you selected. This is usually not very helpful because you have no search for titles function that covers several library catalogues at once):

<http://lists.webjunction.org/libweb>

4.2 Best practice guide to cite zoological literature

It is important to record a publication in which important information was found. Finding the original description of a name is not easy. Finding the site of a valid subsequent type designation is even more difficult. It makes sense to record these research results in databases so accurately that others can take advantage of these efforts. For this purpose the literature should be cited with all necessary data to facilitate finding the source.

Accurate and complete citation of literature references is also a mirror of accurate taxonomic work and a reliable database.

The leading recommendations are

- Cite the literature so **accurately** that others (including non-scientific librarians) can quickly find it.
- Avoid including any possible obstacles to finding the work. **Avoid using insider terms.**
- **Don't abbreviate journal titles.** Always cite the full journal title.
- **Don't translate titles**, neither of works nor of journals. Always cite in the original language.
- Attribute the work strictly to the author who was given as author on the title page.
- **Use UTF-8 character encoding** in your database.
- If the source is digitised, provide stable URLs and DOIs.

Most journals have useful and well elaborated standard instructions how to cite literature. Many of the recommendations given below can be found in the instructions of high-quality journals. This is the usual (and very successful) standard to cite zoological literature.

There are three main types of publications: monographs, articles in monographic works, and journal articles. All publications should fit more or less in one of these categories.

4.2.1 Differences between monographs, journal articles and articles in monographic works

A **monograph** is a single book, usually published at a single date. The entire book is usually written by an author (or by co-authors). Series of books with separate volume numbers (multivolume works) are usually regarded as individual monographs each.

A **journal** (or serial, periodical) is a periodically issued set of publications, usually with several contributions (articles) by several authors, and with volume numbers. Volume counts can have up to three hierarchies (series, volume, heft/fascicle/part). Multivolume works can also be classified as serials, especially if each book has its own volume number.

Articles in monographic works are published in monographs edited by an editor (or co-editors). The book with its articles is arranged like a journal, but it is only a single book.

The ICZN Code (Art. 50) mixes up the terms author, editor and publisher. They should be used in the common way used in scientific contexts.

An **author** is the person responsible for having written the scientific content of a published text. Image authors, copperplate engravers and photographers are not authors in this sense.

An **editor** is the person responsible for compiling the material written by one or several authors and preparing the arrangement of the scientific content for publication. An editor can also act as an author, if the editor is responsible for text passages not referred to one of the other authors. Monographs have usually no editors, except in some posthumously published works.

A **publisher** is the person or legal entity responsible for converting the prepared manuscript into a printable work, for bringing it to the printer, for paying the bill, and for distributing the printed copies.

Examples:

Monographs:

Linnaeus, C. 1758. *Systema naturæ per regna tria naturæ, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Tomus I. Editio decima, reformata. - pp. [1-4], 1-824. Holmiæ. (Salvius).

: Linnaeus was the **author**, Salvius in Stockholm (Sweden) the **publisher**.

Hitchcock, E. 1858. *Ichnology of New England: a report on the sandstone of the Connecticut Valley, especially its footmarks, made to the Government of the Commonwealth of Massachusetts*. - pp. 1-220. Boston. (White).

: Hitchcock was the **author**, White in Boston (USA) the **publisher**.

Graff, L. von 1882. *Atlas von zwanzig Tafeln zur Monographie der Turbellarien. I. Rhabdocoelida*. - pp. [1], [1-20], Taf. I-XX [= 1-20]. Leipzig. (Engelmann).

: Graff was the **author**, Engelmann in Leipzig (Germany) was the **publisher**.

Gould, J. 1848. *The birds of Australia*. In seven volumes. Vol. V. - pp. [1-3], [1-92], pl. [1-92]. London.

: Gould was the **author**, and also the **publisher**, because the title page said "published by the author".

Merian, M. S. 1730. *De europische insecten, naauwkeurig onderzocht, na t'leven geschildert, en in print gebraakt door Maria Sibilla Merian. In't frans beschreven door J. Marret, en door een voornaam liefhebber in't nederduits vertaalt*. - pp. [1-2], 1-84, pl. I-CLXXXIV [= 1-184]. Amsterdam. (Bernard).

: Merian was the **author**, although she had died 13 years before, Bernard in Amsterdam (The Netherlands) was the **publisher**. Marret was a translator and not an author. In her earlier works Merian herself was also the publisher, but not in this posthume edition.

Forskål, P. [Forsskål] 1775. *Descriptiones animalium avium, amphibiorum, piscium, insectorum, vermium; quæ in itinere orientali observavit Petrus Forskål. Post mortem auctoris edidit Carsten Niebuhr. Adjuncta est materia medica Kahirina atque tabula maris rubri geographica*. - pp. 1-20, I-XXXIV [= 1-34], 1-164, 1 map. Hauniæ. (Möller).

: Forskål was the **author**, although he had died 12 years before, Niebuhr was the **editor**, Möller in Copenhagen (Denmark) was the **publisher**. The correct name of the person was probably Forsskål, but the title page indicated Forskål. From secondary sources we know that the textual content was largely written and compiled by a 4th person (Fabricius), but the name of this person was not indicated in the work itself. Fabricius may be called "true author".

Journal articles:

Holthuis, L. B. 1987. The scientific name of the sperm whale. - *Marine Mammal Science* 3: 87-90.

: Holthuis was the **author**, the editor or editorial board of the journal *Marine Mammal Science* was the **editor**, Blackwell in Oxford (England) was the **publisher**.

Fabricius, O. 1794. *Bidrag til Snylte-Ormenes Historie*. - *Skrivter af Naturhistorie-Selskabet* 3 (2): 1-45, Tab. I-IV [= 1-4]. Kiøbenhavn.

: Fabricius was the **author**, the editor or editorial board of the journal *Skrivter af Naturhistorie-Selskabet* was the **editor**, Naturhistorie Selskabet in Copenhagen (Denmark) was the **publisher**.

Férussac, J. B. L. d'Audebard de 1802. *Ueber eine neue Thierart, welche die Gattungen *Limax* und *Helix* mit einander vereinigt, *Helix Semilimax**. - *Der Naturforscher* 29: 236-241, Tab. I Fig. A-D. Halle.

: Férussac was the **author**, Schreber was the **editor** of the journal *Der Naturforscher*, Gebauer in Halle (Germany) was the **publisher**.

Articles in monographic works:

Gittenberger, E. 1984. Vicariantists and dispersalists among the Chondrininae (Gastropoda, Pulmonata). - pp. 56-69, in: Solem, A. & Van Bruggen, A. C.: *World wide snails. Biogeographical studies on non-marine Mollusca*. Leiden. (Brill/Backhuys).

: Gittenberger was the **author**, Solem and Van Bruggen were the **editors**, Brill/Backhuys in Leiden (The Netherlands) was the **publisher**.

Quelch, J. J. 1886. Report on the reef-corals collected by H.M.S. Challenger during the years 1873-76. - pp. 1-203, Pl. I-XII [= 1-12], in:

Thomson, C. W. & Murray, J.: *Report of the scientific results of the voyage of H.M.S. Challenger during the years 1873-76 under the*

command of Captain George S. Nares and Captain Frank Tourle Thomson. *Zoology* - Vol. XVI [= 16]. London, Edinburgh, Dublin.
: Quelch was the **author**, Thomson and Murray were the **editors**, the **publisher** might have been a society or public institution.

Sometimes it is difficult which type of publication should be selected. Also libraries have these problems. Some publications appeared as monographs but carried a volume number of a serial publication. So some catalogues classify them as journals/serials, some as monographs. This means that some works can either be cited as journal articles or as articles in monographic works.

Examples:

Kabat, A. R. & Hershler, R. 1993. The prosobranch snail family Hydrobiidae (Gastropoda: Rissooidea): Review of classification and supraspecific taxa. - pp. 1-94. Washington.

: This monograph can also be cited as a journal article:

Kabat, A. R. & Hershler, R. 1993. The prosobranch snail family Hydrobiidae (Gastropoda: Rissooidea): Review of classification and supraspecific taxa. - *Smithsonian Contributions to Zoology* 547: 1-94. Washington.

Clessin, S. 1896. Die Familie Dentaliidae. - *Systematisches Conchylien-Cabinet von Martini und Chemnitz* 6 (5): 1-48, Taf. 1-11. Nürnberg.

: This journal article can also be cited as an article in a monographic work:

Clessin, S. 1896. Die Familie Dentaliidae. - pp. 1-48, Taf. 1-11 in: Martini, F. H. W. & Chemnitz, J. H.: *Systematisches Conchylien-Cabinet*, Band 6 Theil 5. Nürnberg.

Journals of which only one volume appeared are usually treated as journals, if the obvious initial intention was to publish more volumes.

Examples:

Anonymous 1759. *Das Faulthier, Ignavus*. - *Dresdnisches Magazin* 1 (4): 250-252. Dresden. Only 1 volume appeared.

Jacquin, J. F. de 1787. *Lacerta vivipara*, observatio. - *Nova Acta Helvetica physico-mathematico-anatomico-botanico-medica* 1: 33-34, Tab. I [= 1]. Basiliæ. Only 1 volume appeared.

4.2.2 Name of the author(s) of a publication

In contrast to newspaper or yellow press articles, zoological publications have almost always been equipped with the name of an author. The author is very important in scientific contexts, it is usually the term under which a work is sorted alphabetically. In most cases it is also the link between the name of the taxon and the original work in which it was established. Only in some cases (3 % in European non-marine mollusc names) the author of the work and that of the describer are different persons. In very rare cases zoological works were published anonymously or under pseudonyms.

The authors of published works are usually cited with their initials, while the authors of taxonomic names should not be cited with initials. It is not usual to spell out the first names in lists of zoological publications.

This chapter explains how to record the spelling of the name of the author in a publication. In the chapter about the correct spelling of the author in a species will be explained more in detail which spelling should be used for a zoological name, and about the backgrounds for the importance of a uniform spelling.

Spelling of the author of a publication

Surname(s) are followed by initials of first names. Do not spell out first names, cite only the initials. Not everybody knows what first name and family name in Hua Chang Li or Zoltán Miklós is.

Cite all co-authors.

Examples:

Hardy, D. E. & Kohn, M. A. 1964. Dolichopodidae. - *Insects of Hawaii* 11: 1-256.

Osten Sacken, C. R., Williston, S. W., Aldrich, J. M., Wheeler, W. M. & Melander, A. L. 1886-1901. *Biologia Centrali-Americana*. Insecta. Diptera. Vol. I. - pp. i-viii [= 1-8], 1-378, Tab. 1-6. London. (Quaritch).

Cite the surname of the author exactly as spelled in the original source, with diacritic marks and ligatures, convert to the nominative case, and change v to u in the author's name (not in the title) when a name was spelled in classical Latin script.

Always cite the name in the nominative case, if it is given otherwise (genitive or others) on the title page.

Examples:

Linnaeus, C. 1758. *Systema naturæ per regna tria naturæ, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Tomus I. Editio decima, reformata. - pp. [1-4], 1-824. Holmiæ. (Salvius).

: Name was originally given in the genitive as **Linnæi**.

Fabricius, J. C. 1775. *Systema entomologiae, sistens insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus, observationibus*. - pp. [1-31], 1-832. Flensburgi, Lipsiæ. (Kort).

: Name was originally given in the genitive as **Fabricii**.

It is sometimes necessary to consult secondary sources to extract the true name behind a Latin genitive. And attention, not all names ending in -i are genitives. A name Pauli on a title page can be the genitive of Paul, Paulus, or it can be a proper name Pauli.

Examples:

Laurenti, J. N. 1768. *Specimen medicum, exhibens synopsis reptilium emendatam cum experimentis circa venena et antidota reptilium Austriacorum*. - pp. [1-2], 1-214, [1], Tab. I-V [= 1-5]. Viennæ. (Trattner).

: Laurenti is a name in the nominative case, not the genitive of Laurent or Laurentus.

Use UTF-8 character encoding and spell all characters with diacritic marks exactly as in the original source.

Examples:

Hadžišće, S. 1955. Prilog poznavanju Gastropoda Prespanskog i Ohridskog Jezera. - Glasnik Biološke Sekcije [Periodicum Biologorum], Hrvatsko Prirodoslovno Društvo (II/B) 7: 174-177. Zagreb.

Hausdorf, B., **Gümüş**, B. A. & **Yıldırım**, M. Z. 2004. Two new *Metafruticicola* species from the Taurus mountains in Turkey. - Archiv für Molluskenkunde 133 (1/2): 167-171.

Spell names as they were given on the title page of the work. Zoology has **no standardized list for spellings of authors**. If authors were spelled incorrectly and this error is not recognisable for a person who does not know the name, do not correct them (an error Miller would be recognisable and should be corrected).

Examples:

La Cépède, B. G. E. de 1788. Histoire naturelle des quadrupèdes ovipares et des serpens. Tome premier. - pp. 1-17, [1], 1-651, Pl. I-XLI [= 1-41]. Paris. (Académie Royale des Sciences).

La Cépède, B. G. E. de 1798. Histoire naturelle des poissons. Tome premier. - pp. [1-2], j-cxlvij [= 1-147], 1-532, Pl. 1-25, 1 table. Paris. (Plassan).

Lacépède, B. G. E. de 1799. Mémoire sur une nouvelle table méthodique de la classe des oiseaux. - Mémoires de l'Institut National des Sciences et des Arts. Sciences Mathématiques et Physiques 3: 454-468, 503-519. Paris.

Tournouër, R. 1876. Étude sur les fossiles tertiaires de l'île de Cos recueillis par M. Gorceix en 1873. - Annales Scientifiques de l'École Normale Supérieure (2) 5: 445-475, pl. 3-4. Paris.

Tournouer, R. 1875. Diagnose d'une coquille fossile des terrains tertiaires [sic!] supérieurs d'eau douce de l'île de Cos. - Journal de Conchyliologie 23: 167. Paris.

Tournouër, R. 1879. Conchyliorum fluviatiliu fossilium, quæ in stratis tertiariis superioribus Rumania Dr Gregorio Stefanesco collegit, novæ species. - Journal de Conchyliologie 27: 261-264.

Linnæus, C. 1758. Systema naturæ per regna tria naturæ, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Tomus I. Editio decima, reformata. - pp. [1-4], 1-824. Holmiæ. (Salvius).

Linné, C. von 1763. Centuria insectorum rariorum quam præside D:o Doct. Carolo von Linné, publico examini submittit Boas Johansson. - pp. [1-6], 1-32. Upsaliæ. (Dissertatio).

Linné, C. a 1767. Systema naturæ, Tom. I. Pars II. Editio duodecima reformata. - pp. 533-1327, [1-37]. Holmiæ. (Salvius).

Brunnich, M. T. 1768. Ichthyologia Massiliensis sistens piscium descriptiones eorumque apud incolas nomina. Accedunt spolia maris Adriatici. - pp. 16 + 110 pp.. Hafniae & Lipsiae. (Roth & Proft).

Brünnich, M. T. 1781. Beskrivelse over Trilobiten, en Dyreslægt og dens Arter, med en nye Arts Aftegning. - Nye Samling af det Kongelige Danske Videnskabers Selskabs Skrifter 1: 384-395, pl. [1]. Kiøbenhavn.

If you know a name was spelled incorrectly but this is only recognisable to the insider, you can cite the name as in the original source and add the correct name in [] square brackets. In some library catalogues or online literature resources the work can only be found under the cited name, in others only under the corrected name.

Example:

Forskål, P. [**Forsskål**] 1775. Descriptiones animalium avium, amphibiorum, piscium, insectorum, vermium; quæ in itinere orientali observavit Petrus Forskål. Post mortem auctoris edidit Carsten Niebuhr. Adjuncta est materia medica Kahirina atque tabula maris rubri geographica. - pp. 1-20, I-XXXIV [= 1-34], 1-164, 1 map. Hauniæ. (Möller).

The name used by the person himself was Forsskål and Forsskahl, the title page indicated Forskål.

Read carefully the title page to know who the author is, and never cite a work under an incorrect authorship. In cases of doubt, consult a library catalogue. If a work is attributed to an incorrect author, and if this is repeatedly done in subsequent sources, the work may in extreme cases finally get lost.

Example:

Garsault, F. A. P. de [1764]. Les figures des plantes et animaux d'usage en medecine, décrits dans la Matière Medicale de Mr. Geoffroy medecin, dessinés d'après nature par Mr. de Gasault, gravés par Mrs. Defehrt, Prevost, Duflos, Martinet &c. Niquet scrip. [5]. - pp. [1-4], index [1-20], Pl. 644-729. Paris.

: Since the 1840s this work had been cited by zoologists under the authorship of the zoologist E. L. Geoffroy (the name "Mr. Geoffroy" on Garsault's title page did not refer to this person, but zoologists did not know this). Garsault did not publish anything else in zoology, but Geoffroy was a well-known name. Since zoologists cited the work after the 1840s only under Geoffroy's authorship, they finally did not find it again in botanical and library catalogues in which the work has always been listed under Garsault's authorship. It took zoologists more than 150 years (until 2004) to rediscover the original work.

If an author published under a pseudonym, cite the pseudonym. Zoologists occasionally published under pseudonyms to avoid problems in their job. You can (but do not need to, and I would not recommend it) add the true name in [] brackets. Adding a name can provoke the misunderstanding that this name would be relevant for something, for example for combining new names with this author.

Do not cite the true name alone, less so in journal articles. A librarian or zoological colleague will not know the true name and will not find the work.

Example:

Fra Piero [= **Arbanasich**, P.] 1897. Nota sui limacidi in Sardegna a proposito di una nuova specie di Vitrina. - Annuario Club Alpino Sardo 4: 65-75, Tav. 1. Cagliari.

Repeat surnames of co-authors with identical surnames. Not repeating the surname of the second author may provoke misunderstandings and create extra work.

Examples:

Adams, H. & **Adams**, A. 1858. The genera of recent Mollusca; arranged according to their organization. In three volumes. - Vol. II. - pp. [1-3], 1-661. London. (Van Voorst).

: Do not cite Adams, H. & A.

Villa, A. & Villa, G. B. 1841. Dispositio systematica conchyliarum terrestrium et fluviatilium quae adservantur in collectione fratrum Ant. et Jo. Bapt. Villa conspectu abnormitatum novarumque specierum descriptionibus adjectis. - pp. 1-62, [1-2]. Mediolani. (Borroni & Scotti).
: Do not cite Villa, A. & G. B.

If an author from a country with non-Latin script published under a Latin transcription, use this transcription and do not correct it to another transcription mode. We may assume that librarians cited the names of those authors under the names printed on the title pages, and that they can only be found under these spellings.

Example:

Yen, T.-C. 1939. Die chinesischen Land- und Süßwasser-Gastropoden des Natur-Museums Senckenberg. - Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft 444: 1-234, Taf. 1-16.
: This was not today's official Pinyin transcription mode for Chinese.

Schileyko, A. A. 1977. The system of the group *Trichia* s. lat. (Pulmonata: Helicoidea: Hygromiidae). - *Malacologia* 17 (1): 1-56.
: This Russian author used an unusual German transcription mode, usual transcription would have been Shilejko.

If the author's name was given in a **non-Latin script**, it is possible to use the transcription mode used by the author in the publication, for example in an abstract spelled in a language using the Latin script. It is also possible and sometimes perhaps more convenient to use a widely understood international transcription mode.

Where appropriate, use two Latin characters for initials of first names which represent only one character in the original script.

Examples:

Shilejko, A. A. 1971. Srabitel'noanatomicheskoe issledovanie nektovykh Ariantinae (Pulmonata, Helicidae). - *Zoologicheskij Zhurnal* 50 (7): 990-1001.

: This paper was in Russian. In publications in Latin script languages the name of this author was transcribed as Schileyko.

Starobogatov, Ya. I. 1985. Rodovoj sostav semejstva Viviparidae (Gastropoda Pectinibranchia Vivipariformes). - *Trudy Zoologicheskogo Instituta Akademija Nauk SSSR* 135: 26-32. Leningrad.

: "ya" is only one character in Russian script.

If the author's name was originally spelled in a Latin script (which involves knowledge from secondary sources) and in a publication was transcribed into a non-Latin script, it is recommended to use the original Latin-script spelling. These are rare cases and occurred almost only when Western authors published in Russian journals.

Example:

Lindholm, W. A. 1924. K nomenklature nektovykh kaspjiskikh gastropod. - *Russkij Hidrobiologicheskij Zhurnal* 3: 32-34. Saratov.
: Title in Russian script, Lindholm was not Russian. The transcription of Lindholm's name back to Latin would be **Lindgol'm**.

If an author's name which was spelled in a non-Latin script, was originally derived from a language using Latin script, perhaps some generations ago, the name is transcribed using the international transcription mode.

Example:

Likharev, I. M. & Rammel'mejer, E. S. 1952. Nazemnye mollyuski fauny SSSR. - *Opredeliteli po Faune SSSR, Izdavaemye Zoologicheskim Institutom Akademii Nauk SSSR* 43: 1-512. Moskva, Leningrad.

: This work was in Russian. Rammel'mejer has originally been a German name, in German it would have been written Rammelmeier or Rammelmeyer, Rammelmaier, Rammelmayr, various versions would be possible.

Names of authors should be cited as completely as necessary.

Iberian (Spanish etc.) names should be cited in the way they were mentioned on the title page. This makes it easier for librarians who are not familiar with Spanish names, to find a requested work.

Examples:

Ortiz de Zárate Rocandio, A. & Ortiz de Zárate López, A. 1961. Moluscos terrestres recogidos en la provincia de Huelva. - *Boletín de la Real Sociedad Española de Historia Natural (Biología)* 59: 169-190. Madrid.

Oviedo y Valdés, G. H. de 1535. La historia general de las Indias. - pp. 1-193. Sevilla. (Cromberger).

Da Silva e Castro, J. 1885. Unionidæ nouveaux du Portugal. - *Bulletins de la Société Malacologique de France* 2: 277-294. Paris.

García San Nicolás, E. 1957. Estudios sobre la biología, la anatomía y la sistemática del género *Iberus* Montfort, 1810. - *Boletín de la Sociedad Española de Historia Natural (Biología)* 55: 199-390.

Mendes da Costa, E. 1776. Elements of conchology: or, an introduction to the knowledge of shells. With seven plates, containing figures of every genus of shells. - pp. i-viii [= 1-8], iii-vi [= 3-6], 1-318, [1-2], Pl. I-VII [= 1-7]. London. (White).

Most zoologists cite this author as Da Costa, but in library catalogues the author is recorded under his correct name.

Aguilar-Amat, J. B. de 1935. Observaciones malacológicas, 26. Datos para la malacofauna del Valle de Andorra. - *Andorra Agrícola* 3 (29): 8-9.

Arrébola Burgos, J. R. 1998. On two Andalusian *Oestophora* species: *Oestophora ortizi* De Winter & Ripken, 1991 and *Oestophora granesae* spec. nov. (Gastropoda: Pulmonata). - *Journal of Conchology* 36 (4): 35-41. London.

Arrébola, J. R. & García, F. J. 1999. Redescrición de *Helix martigena* Férussac 1832 como reterneciente al género *Trichia* Hartmann 1840 (Gastropoda: Pulmonata: Hygromiidae). - *Iberus* 17 (1): 21-30.

Azpeitia Moros, F. 1928. Uebersicht der von der Iberischen Halbinsel genannten Arten der Gattung *Caecilioides* Férussac. - *Archiv für Molluskenkunde* 60 (1): 1-20.

Bofill, A. 1886. Contributions à la faune malacologique de la Catalogne. - *Bulletins de la Société Malacologique de France* 3: 151-164. Paris.

Bofill i Poch, A. & Aguilar-Amat, J. B. de 1924. Malacologia de les Illes Pitiuses. - *Treballs del Museu de Ciències Naturals de Barcelona* 10 (3): 1-71, Lám. LII [= 1-2].

Bofill y Poch, A. 1897. Sobre una nueva forma malacológica de la provincia de Gerona (*Nenia subarcuata*). - *Boletín de la Real Academia de Ciencias y Artes de Barcelona* (3) 1 (18): 364-368.

"**Van**" and "**von**". In German names "von" is not part of the surname, this is a **title of nobility** and belongs to the set of first names. In Austria the "von" title was erased from names of Austrian citizens in 1919. Germans and Austrians who kept their "von" title when migrating to English countries are cited with the "Von" belonging to their surname.

In Dutch the "**Van**" is **not a title of nobility**. Belgian names are always cited with "Van" belonging to the surname. In names of persons from the Netherlands this has recently changed. In alphabetically sorted lists Dutch names have often been cited with "van" in the first names section like in German. Today it has become usual to cite Dutch names like Belgian names with the "Van" belonging to the last name, and sort such names alphabetically under V.

Other German (or former Austrian) titles of nobility such as Graf, Gräfin, Fürst or Ritter also belong to the first names. Some names are more complex, and it is difficult to cite them correctly without consulting a library resource.

Examples:

Van Belle, R. A. 1983. The systematic classification of the chitons (Mollusca: Polyplacophora). - Informations de la Société Belge de Malacologie 11: 1-178.
: Belgian author.

Van Goethem, J. L. 1988. Nouvelle liste commentée des mollusques récents non-marins de Belgique. - Documents de Travail - Studiedocumenten 53: 1-69. Bruxelles.
: Belgian author.

Scheven, T. G. von 1777. Beyträge zur Naturgeschichte der Insekten. Erstes Stück. - Der Naturforscher 10: 88-101, Tab. II [= 2]. Halle.

Vest, W. von 1867. Ueber den Schliessapparat der Clausilien. - Verhandlungen und Mittheilungen des Siebenbürgischen Vereins für Naturwissenschaften in Hermannstadt 18 (1, 7, 8): 5-18, 161-174, 188-196.

Martens, E. von 1864. Fossile Süßwasser-Conchylien aus Sibirien. - Zeitschrift der Deutschen Geologischen Gesellschaft 16: 345-351. Berlin.

Frauenfeld, G. Ritter von 1867. Zoologische Miscellen. XII. - Verhandlungen der kaiserlich-königlichen Zoologisch-Botanischen Gesellschaft in Wien 17: 775-784.

Aartsen, J. J. van 1977. Revision of the East Atlantic and Mediterranean Caecidae. - Basteria 41 (1/4): 7-19. Leiden.
: Dutch author.

Bentham Jutting, W. S. S. van 1957. Zoological results of a collecting journey to Yugoslavia, 1954. 3. Süßwassermollusken mit Ausnahme der Sphaeriidae. - Beaufortia 5 (60): 171-177. Amsterdam.
: Dutch author.

"**De**" and likewise particles. The particle "De" usually belongs to the surname in Italian, Belgian and some other nations' names, where it is spelled in capitals, but usually not in French names, where "de" is usually a title of nobility, it is spelled in lower-case and forms part of the first names (like the German "von").

There are many exceptions, but the general rule is that if the "de" is derived from a title of nobility, it is not cited with the surname. In the French name "De Gaulle" the "de" is not a title of nobility, so it is attached to the surname. If a French surname begins with a vowel the title d' is cited with the surname and spelled lower-case (also in a list of publications, and also if the citation begins with this lower-case letter d). Italian titles of nobility (like Marchese, Marchesa) are usually not cited as part of the name.

Examples:

De Betta, E. 1852. Malacologia terrestre e fluviatile della Valle di Non nel Tirolo italiano. Parte I. Molluschi terrestri. - pp. 1-144, 1 pl. Verona.

De Geer, C. 1775. Mémoires pour servir à l'histoire des insectes. Tome cinquième. - pp. I-VII [= 1-7], [1], 1-448, Pl. 1-16. Stockholm. (Hesselberg).

De Winter, A. J. 1985. A new *Deroceras* species from north-western Spain (Gastropoda Pulmonata: Agriolimacidae). - Zoologische Mededelingen 59 (7): 69-77. Leiden.

Uit de Weerd, D. R. 2004. Molecular phylogenetic history of eastern Mediterranean Aloiinae, a group of morphologically indeterminate land snails. - pp. [1-6], 3-119. Leiden.

De Oliveira, A. 2007. *Macrogaster portensis* (Luso da Silva, 1872) (Pulmonata, Clausiliidae): notícia de uma população actual no Noroeste de Portugal. - Iberus 25 (2): 145-147.

Delle Chiaie, S. 1828. Memorie sulla storia e notomia degli animali senza vertebre del Regno di Napoli. Volume III. - pp. [1-6], I-XX [= 1-20], 1-232. Napoli. (Società Tipografica).

Monterosato, T. A. di 1878. Enumerazione e sinonimia delle conchiglie mediterranee. - Giornale di Scienze Naturale ed Economiche 13: 61-115. Palermo. - (Originally given as T. A. di Marchese di Monterosato).

Des Moulins, C. 1830. Description d'une nouvelle espèce vivante de *Pupa*, du Périgord. - Actes de la Société Linnéenne de Bordeaux 4: 158-163, pl. [1].

Asso, I. de 1801. Introduccion á la ichtyologia oriental de España. - Anales de Ciencias Naturales 4 (10): 28-52. Madrid.

Blainville, H. de 1816. Sur plusieurs espèces d'animaux mammifères, de l'ordre des ruminans. - Bulletin des Sciences, par la Société Philomatique de Paris 8: 73-82.

Villers, C. de [= French author] 1789. Caroli Linnaei entomologia, faunæ Suevicæ descriptionibus aucta; DD. Scopoli, Geoffroy, De Geer, Fabricii, Schrank &c. speciebus vel in systemate non enumeratis, vel nuperrime detectis, vel speciebus Galliae Australis locupletata, generum specierumque rariorum iconibus ornata. Tomus secundus. - pp. j-xvj [= 1-16], 1-656. Lugduni. (Piestre & Delamollière).

d'Orbigny, A. 1847. Voyage dans l'Amérique méridionale (le Brésil, la République Orientale de l'Uruguay, la République Argentine, la Patagonie, la République du Chili, la République de Bolivie, la République du Pérou), exécuté pendant les années 1826, 1827, 1828, 1829, 1830, 1831, 1832 et 1833. Tome cinquième. 1.re partie: reptiles. - pp. 1-12, Pl. I-XV [= 1-15]. Paris, Strasbourg. (Bertrand, Levraut).

In some complex names it is difficult to decide which components are first names and which surnames. Library catalogues or Wikipedia may help.

Examples:

- Megerle von Mühlfeld, J. C.** 1816. Beschreibung einiger neuen [sic] Conchylien. - Der Gesellschaft Naturforschender Freunde zu Berlin Magazin für die neuesten Entdeckungen in der gesammten Naturkunde 8 (1): 3-11, Tab. I-II [= 1-2].
: Megerle was part of the surname of this noble person.
- Schrank, F. von Paula** 1803. Fauna Boica. Durchgedachte Geschichte der in Baiern einheimischen und zahmen Thiere. Dritten und letzten Bandes erste Abtheilung. - pp. I-VIII [= 1-8], 1-272. Landshut. (Krüll).
: Surname usually cited as Schrank, also in botany, but could also be cited as Paula Schrank, F. von.
- Stätius Müller, P. L.** 1776. Des Ritters Carl von Linné Königlich Schwedischen Leibarztes &c. &c. vollständigen Natursystems Supplements- und Register-Band über alle sechs Theile oder Classen des Thierreichs. Mit einer ausführlichen Erklärung. Nebst drey Kupfertafeln. - pp. [1-15], 1-384, [1-40], 1-536, Tab. I-III [= 1-3]. Nürnberg. (Raspe).
: Stätius was the surname of the Dutch ancestors of the author, so it was not a first name.
- Targioni Tozzetti, A.** 1873. Vertebrati e molluschi osservati o raccolti in una escursione pel Casentoni. - Atti della Società Italiana di Scienze Naturali 15 (4) ["1872"] : 309-372, Tav. 6. Milano.
- Férussac, J. B. L. d'Audebard de** 1802. Ueber eine neue Thierart, welche die Gattungen *Limax* und *Helix* mit einander vereinigt, *Helix Semilimax*. - Der Naturforscher 29: 236-241, Tab. I Fig. A-D. Halle.
- Férussac, A. E. J. P. J. F. d'Audebard de** 1814. Mémoires géologiques sur les terrains formés sous l'eau douce par les débris fossiles des mollusques vivant sur la terre ou dans l'eau non salée. - pp. 1-76. Paris. (Poulet).
- Blainville, H. M. Ducrotay de** 1825. Manuel de malacologie et de conchyliologie. - pp. I-VIII [= 1-8], 1-664, [1-4], Pl. I-LXXXVII [= 1-87], Tables [1-2]. Paris. (Levrault).

If the author's name is not given in the book itself and must be derived from secondary literature, this is usually indicated by [] square brackets.

Examples:

- [Denis, M. & Schiffermüller, I.]** 1776. Systematisches Verzeichniß der Schmetterlinge der Wienergegend herausgegeben von einigen Lehrern am k. k. Theresianum. - pp. [1-2], 1-322, [1], Tab. 1a-1b. Wien. (Bernardi).
- [Geoffroy, E. L.]** 1762. Histoire abrégée des insectes qui se trouvent aux environs de Paris; dans laquelle ces animaux sont rangés suivant un ordre méthodique. Tome premier. - pp. [1-2], j-xlvij [= 1-28], 1-523, Pl. I-X [= 1-10]. Paris. (Durand).
- [Vieweg, C. F.]** 1789. Tabellarisches Verzeichniß der in der Churmark Brandenburg einheimischen Schmetterlinge. Erstes Heft. Mit einer ausgemahlten Kupfertafel. - pp. I-VIII [= 1-8], 1-70, pl. [1]. Berlin.
- [Röding, P. F.]** [1798]. Museum Boltenianum sive catalogus cimeliorum e tribus regnis naturæ quæ olim collegerat Joa. Fried Bolten, M. D. p. d. per XL. annos proto physicus Hamburgensis. Pars secunda continens conchylia sive testacea univalvia, bivalvia & multivalvia. - pp. [1-3], [1-8], 1-199. Hamburgi. (Trapp).
: Principally an anonymous work, in library records Röding's name does not appear. The author was not Bolten, as incorrectly given in some library catalogues. Röding's name and the date September 1798 were printed on p. VIII after the introduction, which suggests that Röding was also the author of the main work.

If no author was given on the title page, the name of the author should be cited as "Anonymous".

Examples:

- Anonymous** 1847. Atti verbali della sezione di zoologia, anatomia comparata e fisiologia. - Atti della ottava Riunione degli Scienziati Italiani 8: 429-531, Tav. I.II [= 1-2]. Genova.
- Anonymous** 1759. Das Faulthier, *Ignavus*. - Dresdnisches Magazin 1 (4): 250-252. Dresden.

First names

First names are much less important than surnames. Errors or inconsistencies have little influence.

Cite only the initials of the first names, convert I. to J. and V. to U. if classical Latin was used. Spell out particles like "von" if they were abbreviated (as "v."). Some names have components that are spelled out but belong to the first names.

In early literature it is convenient to cite all known first names of an author completely and to use a standard composition of first names, although these may not be given on the title page.

In early French works it was uncommon to cite initials of first names, they usually wrote "M." (monsieur, = Mr.) or after the French Revolution until 1804 "Citoyen" (= citizen).

Examples:

- Schrank, F. von Paula** 1781. Enumeratio insectorum Avstræ indigenorum. Cum figuris. - pp. [1-24], 1-548, [1-4], Tab. I-IV [= 1-4]. Avgvstæ Vindelicorum. (Klett & Franck).
: Name on title page was spelled originally as "Francisci de Pavla Schrank".
- Fabricius, J. C.** 1775. Systema entomologiae, sistens insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus, observationibus. - pp. [1-31], 1-832. Flensbvrge, Lipsiæ. (Kort).
: Name on title page was spelled originally as "Io. Christ. Fabricii".
- Férussac, A. E. J. P. J. F. d'Audebard de** 1814. Mémoires géologiques sur les terrains formés sous l'eau douce par les débris fossiles des mollusques vivant sur la terre ou dans l'eau non salée. - pp. 1-76. Paris. (Poulet).
- Cuvier, G.** 1792. Mémoire sur les cloportes terrestres. - Journal d'Histoire Naturelle 2: 18-31, Pl. 26. Paris.
: Name on title page was spelled originally as "M. Cuvier".
- Cuvier, G.** 1796. Mémoire sur un nouveau genre de mollusque. - Magasin Encyclopédique, ou Journal des Sciences, des Lettres et des Arts 10: 416-417. Paris.
: Name of the author on first page was presented as "le citoyen Cuvier".

Initials of first names can be united by hyphens if done so in the original publication.

Example:

- Boissy, S.-A. de** 1835. Hélice. *Helix*. Linnée. H. cotonneuse. *H. lanuginosa*. De Boissy. - Magasin de Zoologie 5: text pp. [1-2], Classe 5 Pl. 69. Paris.

Sometimes no first name is known, and cannot be cited. Modern libraries have usually researched the first names of the authors of monographic works, but not for every author of a journal article. Librarians will however not need those.

Examples:

Villeneuve, von 1763. Anmerkungen, betreffend einen Fisch, welchen man für den Zitterfisch hält. - Hamburgisches Magazin 26 (6): 545-552. Hamburg, Leipzig.

Am Stein 1789. Description du lievre de montagne ou lievre versicolor. - L'Esprit des Journaux 12 (Déc. 1789): 355-359. Paris.

Sevastianoff 1802. Description de l'*Acarauna longirostris*, nouveau genre de poisson, appartenant à l'ordre des torachiques, et qui se trouve dans le Musée de notre Academie des Sciences. - Nova Acta Academiae Scientiarum Imperialis Petropolitanae 13: 357-366, Tab. XI [= 11].

Fra Piero 1897. Nota sui limacidi in Sardegna a proposito di una nuova specie di *Vitrina*. - Annuario Club Alpino Sardo 4: 65-75, Tav. 1. Cagliari.

: Pseudonym for P. Arbanasich, a name not mentioned in the original work.

[Sanders] 1793. Beschreibung der Seesonne, einer Art Seesterne, mit 21 Strahlen. - Der Naturforscher 27: 1-6, Tab. I-II [= 1-2]. Halle.

: Name "Professor Sanders" was mentioned in the previous article.

If the initials are incorrectly given on the title page (as can be derived from external sources), it might be convenient to cite them as given in the original and add the correct initials in square [] brackets (we must assume that librarians did not always know the correct name and listed the person under the exact name of the title).

Example:

Fischer, J. L. [= J. B.] 1778. Versuch einer Naturgeschichte von Livland. - pp. 1-16, [1-8], 1-374, [1-16]. Leipzig. (Breitkopf).

4.2.3 Year of publication

The year should be copied from the title page of the monograph, or from that of the journal volume. It is useful to cite the year under which the publication is likely to be found in library catalogues. If we know from secondary sources that the work was published at a different date, do not cite only this date.

In some cases, a time span was given on the title.

Examples:

Clerck, C. **1757**. Svenska Spindlar uti sina hufvud-slägter indelte samt under några och sextio särskildte arter beskrefne och med illuminerade figurer uplyste. - Aranei Svecici, descriptionibus et figuris æneis illustrati, ad genera subalterna redacti, speciebus ultra LX determinati. - pp. [1-8], 1-154, pl. 1-6. Stockholmia. (Salvii).

: The ICZN Code says 1758, but 1757 was printed on the title page.

Bruguière, J. G. **1792**. Encyclopédie méthodique. Histoire naturelle des vers. Tome premier. [ABE-CON]. - pp. [1-3], j-xviii [= 1-18], 1-757. Paris. (Pancoucke).

: We know from secondary sources that substantial parts were published in 1789 and the rest in 1792, but on the title page was printed 1792.

Benoit, L. 1875. Illustrazione sistematica critica iconografica de'testacei estramarini della Sicilia ulteriore e delle isole circostanti. - pp. I-XVI [= 1-16], 1-248, Tav. I-IX, XI-XII [= 1-9, 11-12]. Napoli. (Nobile).

: We know from secondary sources that the textual parts were published in 4 fascicles between 1857 and 1862, but the title page carried the date 1875, when the last plate was issued.

Bérenquier, P. **1884-1885**. Essai sur la faune malacologique du Var. - Bulletin de la Société d'Etudes Scientifiques et Archéologiques de la Ville de Draguignan 15: 1-118.

Bourguignat, J. R. **1863-1868**. Mollusques nouveaux, litigieux ou peu connus. Première centurie (Mars 1863 à Décembre 1868). - pp. [1-2], 1-324, Pl. 1-4, V-XLV [= 5-45]. Paris. (Savy).

If the year given on the title page of the journal volume was not the true year of publication, zoological sources often cite the article as if it was officially published in the "true" year. But the bibliographic year of publication, under which the journal volume is found in library catalogues, should at least be given in [] square brackets. This is important to facilitate literature research for the next person.

Examples:

Pfeiffer, L. **1850**. Nachträge zu L. Pfeiffer Monographia Heliceorum. - Zeitschrift für Malakozoologie 6 (6) ["1849"]: 81-95. Cassel.

Pfeiffer, L. **1850**. Descriptions of thirty new species of *Tornatellina*, *Cylindrella*, and *Clausilia*, from the collection of H. Cuming, Esq. - Proceedings of the Zoological Society of London 17 ["1849"]: 134-141.

Boettger, O. **1889**. Verzeichnis der von Herrn E. von Oertzen aus Griechenland und aus Kleinasien mitgebrachten Vertreter der LandschneckenGattung *Clausilia* Drp. - Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft 16 (1) ["1890"]: 31-68, Taf. [2].

If the year is not given in the book itself and must be derived from secondary sources, this should be indicated by square brackets []. If both author and year are not indicated in the original source, both are wrapped in square brackets [] independently.

Examples:

Bronn, H. G. [**1831**]. Ergebnisse meiner naturhistorisch-ökonomischen Reisen. Zweyter Theil. Skizzen und Ausarbeitungen über Italien. Nach einem zweyten Besuche im Jahre 1827 entworfen. Mit vier Steindrucktafeln. - pp. I-XVIII [= 1-18], 1-686. Heidelberg, Leipzig. (Groos).

Gmelin, J. F. [**1790**]. Caroli a Linné, systema naturae. Tom. I. Pars V. - pp. 2225-3020. [Lipsiae].

Goedartio, J. [**1667**]. Metamorphoseos et historiae naturalis pars secunda, de insectis. - pp. [1-32], 1-259, pl. [1-45] (Fig. 1-55). Medioburgi. (Fierensium).

[Voet, J. E.] [1766]. [Catalogus systematicus coleopterorum. - Catalogue systematique des coleoptères.]. - pp. 1-72 (lat.), 1-72 (fra.), 1-72 (ned.), Tab. I-XL [= 1-40]. La Haye. (Backhuys).

: Neither the author nor the year was given on the title page.

4.2.4 Title of the work

The title should usually be **cited in its full length** and in its **original language**. Terms for "volume" should also be cited as in the original (**Tomus, Tome, Volume, Vol., Band...**) to avoid misunderstandings.

Examples:

Linnaeus, C. 1758. **Systema naturæ per regna tria naturæ, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Tomus I. Editio decima, reformata.** - pp. [1-4], 1-824. Holmiæ. (Salvius).

Linné, C. a 1767. **Systema naturæ, Tom. I. Pars II. Editio duodecima reformata.** - pp. 533-1327, [1-37]. Holmiæ. (Salvius).

Férussac, A. E. J. P. J. F d'Audebard de & Deshayes, G.-P. 1819-1851. **Histoire naturelle générale et particulière des mollusques terrestres et fluviatiles, tant des espèces que l'on trouve aujourd'hui vivantes, que des dépouilles fossiles de celles qui n'existent plus; classés d'après les caractères essentiels que présentent ces animaux et leurs coquilles.** - pp. Tome 1: 8 + 184 pp.; Tome 2 (1): 402 pp.; 2 (2): 260 + 22 + 16 pp.; Atlas 1: 70 pl.; Atlas 2: 166 + 5 pl. Paris. (J.-B. Baillière).

Fuhn, I. E. & Gherasim, V. F. 1995. **Fauna României. Arachnida. Volumul V, Fascicula 5. Familia Salticidae.** - pp. 1-301. Bucureşti.

Gmelin, J. F. [1790]. **Caroli a Linné, systema naturæ. Tom. I. Pars V.** - pp. 2225-3020. [Lipsiæ].

Never translate titles. If originally spelled in a non-Latin script it is convenient to use a widely understood international transcription that does not use special characters (diacritic marks), but never cite only a translation, even if a summary or an abstract in another language was given and the title was translated in the original source. Always remember that you cite the title only for the purpose that subsequent researchers can find them. Librarians need to know the title as given on the title page of a work, they will not look on a different page where this title was translated into a different language. A librarian in Poland needs to know the title which has to be copied, and not an English translation of it. Librarians in Russia are able to read a Russian title in Latin script, but many do not understand English. Also in online resources articles can often be found by their original titles, but much less frequently by translations of their original titles (and such a search will be even less successful if a title was translated independently by various subsequent authors and not copied from the original source).

Examples:

Babor, J. & Košťál, J. 1893. **Příspěvky ku pozni poměru pohlavních u některých limacidů.** - Věstník Královské Společnosti Nauk,

Třída mathematicko-přírodovědecká - Sitzungsberichte der Königl.-Böhmischen Gesellschaft der Wissenschaften, mathematisch-naturwissenschaftliche Classe 51 ["1894"] : 1-7. Prag.

: Title in Czech, written in Latin script.

Frivaldszky, I. 1835. **Közlések a' Balkány' vidékén tett természettudományi utazásról.** - A' Magyar Tudós Társaság' Évkönyvei 2: 235-276, T. I-VII [= 1-7]. Budan.

: Title in Hungarian, written in Latin script.

Bole, J. 1961. **Nove hidrobide (Gastropoda) iz podzemeljskih voda zahodnega Balkana.** - Bioloski Vestnik 9: 59-69. Ljubljana.

: Title in Slovenian, written in Latin script.

Greze, V. N. 1944. **Kolichestvennaya draga dlya ucheta donnoy fauni.** - Zoologicheskij Zhurnal 23 (2-3): 102-104.

: Title in Russian, transcribed from Russian Cyrillic script.

Bajdashnikov, A. A. 1990. **Obzor mollyuskov rodu *Mentissa* (Gastropoda, Pulmonata).** - Zoologicheskij Zhurnal 69 (1): 21-31. Moskva.

: Title in Russian, transcribed from Russian Cyrillic script.

Damjanov, S. G. & Likharev, I. M. 1975. **Fauna na Bălgarija. 4. Sukhozemni okhljuvi (Gastropoda terrestria).** - pp. 1-425, [1]. Sofija. (Bălgarska Akademija na Naukite).

: Title in Bulgarian, transcribed from Bulgarian Cyrillic script.

If the title was not given on the title page in a series, but on the title page of another volume of the series, you can cite it in [] square brackets. Often the year is also given in square brackets, but usually not the author (because the name of the author was given on the first volume).

Plate volumes are often cited in this form. The corresponding title pages were usually bound with the text volumes. This depends often on the individual mode of binding in a library (plates could also be bound together with the texts in one single volume).

In some multivolume works the second volume carried only an auxiliary title page, to which should be added the title given on the first volume.

Examples:

Fabricius, J. C. [1792]. [Entomologia systematica emendata et aucta. Secundum classes, ordines, genera, species adjectis synonymis, locis, observationibus, descriptionibus.] Tom. I. Pars II. - pp. 1-538. Hafniae. (Proft).

: Second volume with auxiliary title page.

[Fichtel, L. von & Moll, J. P. C. von] [1803]. [Testacea microscopica aliaque minuta ex generibus Argonauta et Nautilus ad naturam delineata et descripta.] [Tafeln]. - Tab. 1-24. Wien. (Camesina).

: Plate volume.

[Merrem, B.] [1790-1821]. [Beytraege zur Naturgeschichte. Tafeln]. - Taf. (1) I-XII [= 1-12], (2) I-XII [= 1-12], (3) I-XII [= 1-13]. Leipzig, Essen.

: Plate volume referring to two text volumes.

[Pallas, P. S.] [1778]. [Novae species quadrupedum e glirivm ordine cum illustrationibus variis complurium ex hoc ordine animalivm. Tabulae]. - Tab. I-XXVII [= 1-27]. Erlangae. (Walther).

: Plate volume.

- [Shaw, G. & Nodder, F. P.] [1796-1797]. [Vivarium naturæ, sive rerum naturalium, variæ et vividæ icones, ad ipsam naturam. Depictæ et descriptæ. - The naturalist's miscellany: or coloured figures of natural objects; drawn and described immediately from nature. Volume 8]. - pp. (No. 85-96), Pl. 255-300. London.
: Volume 8 without title page, only volume 1 had a title page.
- Gmelin, J. F. [1790]. Caroli a Linné, systema naturæ. Tom. I. Pars IV. - pp. 1517-2224. Lipsiæ. (Beer).
Volume 4 with auxiliary title page, not citing the full title of the first volume, but intelligible. The name of the author was only given on the first volume.

Bilingual works in which the text was published in two languages should be cited with their **titles in both languages**.

Examples:

- Clerck, C. 1757. **Svenska Spindlar** uti sina hufvud-slägter indelte samt under några och sextio särskildte arter beskrefne och med illuminerade figurer uplyste. - **Aranei Svecici**, descriptionibus et figuris æneis illustrati, ad genera subalterna redacti, speciebus ultra LX determinati. - pp. [1-8], 1-154, pl. 1-6. Stockholmiae. (L. Salvii).
: Omitted: , secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis
- Brown, P. 1776. **Nouvelles illustrations de zoologie**, contenant cinquante planches nlnuminées d'oiseaux curieux, et qui non etés jamais descrits, et quelques de quadrupedes, de reptiles et d'insectes, avec de courtes descriptions systematiques. - **New illustrations of zoology**, containing fifty coloured plates of new, curious, and non-descript birds, with a few quadrupeds, reptiles and insects. Together with a short and scientific description of the same. - pp. [1-6], 1-136, Pl. I-L [= 1-50]. Londres. (White).
: Omitted: A la quelle on a joint une description exacte de chaque espece, avec les citations des auteurs qui en ont traité, les noms qu'ils leur ont donnés, ceux que leur ont donnés les différentes nations, & les noms vulgaires. Ouvrage enrichi de figures en taille-douce.
- Cramer, P. 1779. **De uitlandsche kapellen** voorkomende in de drie waereld-deelen Asia, Africa en America, by een verzameld en beschreeven. II. Deel. Beschryving van Plaat XCII-CXCII. - **Papillons exotiques** des trois parties du monde l'Asie, l'Afrique et l'Amerique. Rassemblés et décrits. Tome second. Description des planches XCII-CXCII. - pp. [1], 1-151.. Amsteldam, Utrecht. (Baalde, Wild).
: Omitted: , secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis
- De Wilde, J. J., Marquet, R. & Van Goethem, J. L. 1986. **Voorlopige atlas** van de landslakken van België. - **Atlas provisoire** des gastéropodes terrestres de la Belgique. - pp. 1-285. Brussel/Bruxelles.

Sometimes it is useful or necessary to shorten exceptionally long titles. Omitted passages can be indicated by "(...)". Academic titles of persons mentioned in titles are also omitted. But titles should not be too short. It is very difficult to find very short titles in online library resources.

Examples:

- Linnaeus, C. 1758. **Systema naturæ per regna tria naturæ (...). Tomus I. Editio decima, reformata**. - pp. [1-4], 1-824. Holmiæ. (Salvius).
: Omitted: , secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis
- Brisson, M. J. 1760. **Ornithologie ou méthode contenant la division des oiseaux en ordres, sections, genres, especes & leurs variétés. (...). Tome IV**. - pp. [1-3], 1-576, j-liv [= 1-54], [1], Pl. I-XLVI [= 1-46]. Paris. (Bauche).
: Omitted: A laquelle on a joint une description exacte de chaque espece, avec les citations des auteurs qui en ont traité, les noms qu'ils leur ont donnés, ceux que leur ont donnés les différentes nations, & les noms vulgaires. Ouvrage enrichi de figures en taille-douce.
- Baker, H. 1742. **The microscope made easy; or, I. The nature, uses, and magnifying powers of the best kinds of microscopes described, calculated, and explained: (...). II. An account of what surprizing discoveries have been already made by the microscope: (...). And also a great variety of new experiments and observations, (...)**. - pp. [1-2], i-xvi [= 1-16], 1-311, [1-13], pl. i-xiv [= 1-14], 1 table. London. (Dodsley).
: Omitted were several passages.

Upper and lower case should be spelled according to the rules for fluent text (not those for text in a headline) in the respective language.

Do not simply copy and paste library catalogue records. Library catalogues are extremely inconsistent in terms of punctuation and upper and lower case spelling. Complicate standards used by libraries have frequently changed and were not well communicated to staff members who were responsible for compiling electronic library data. In Some Library Records Every Single Word In An English Title Is Capitalised.

Capitalised words in English titles should not be copied from the original title, they should be **replaced** by lower-case letters according to the rules for regular text. This is also required by many journal instructions.

The same applies to other languages which have had fixed standard rules since long (French, Latin, Russian). In German orthography all nouns are capitalised. In French words written in CAPITALS without diacritic marks the diacritic marks are added if the words are cited in lower-case.

Languages where the rules have steadily changed might better be cited as spelled in the original title (Scandinavian languages, Dutch).

Examples:

- Burch, J. B. 1989. **North American freshwater snails**. - pp. 1-365. Hamburg, Michigan. (Malacological Publications).
: English, in the original source North American Freshwater Snails.
- Buffon, G. L. L. de 1771. **Histoire naturelle des oiseaux. Tome second**. - pp. [1-7], 1-560, Pl. I-XXVII [= 1-27]. Paris. (Imprimerie Royale).
: French, in the original source HISTOIRE NATURELLE DES OISEAUX. Tome Second.
- Babor, J. 1900. **Über die Nacktschnecken der Grazer Umgehung**. - Verhandlungen der Deutschen Zoologischen Gesellschaft 10: 148-149.
: German.
- Bajdashnikov, A. A. 1990. **O vnutrividovykh formakh mollyuskov roda *Mentissa* (Gastropoda, Pulmonata, Clausiliidae)**. - Zoologicheskij Zhurnal 69 (8): 19-31. Moskva.
: Russian.
- Brünnich, M. T. 1781. **Beskrivelse over Trilobiten, en Dyreslægt og dens Arter, med en nye Arts Aftægning**. - Nye Samling af det Kongelige Danske Videnskabers Selskabs Skrifter 1: 384-395, pl. [1]. Kiøbenhavn.
: Danish, cited as in the original source.

- Chemnitz, J. H. 1799. **Om vanskabte Sneglehuse og Misfostere blandt Conchylierne**. - Nye Samling af det Kongelige Danske Videnskabs Selskabs Skrifter 5 (1): 216-226. København.
: Danish, cited as in the original source.
- Estlund, O. 1796. **Entomologiske Anmärkningar hörande til Fauna Svecica**. - Kongliga Vetenskaps Academiens Nya Handlingar 17 (4-6): 126-132, Tab. V [= 5]. Stockholm.
: Swedish, cited as in the original source.

English **animal names** are today spelled in lower-case letters (cats, dogs, insects, phasmatodeans, actinopterygian fishes), the same applies to names in French, Spanish and Italian (insectes, hyménoptères; insectos, himenópteros; insetti, imenotteri). In German all nouns are consistently spelled upper-case, this includes animal names.

Titles are usually cited according to these rules and not as in the original orthography.

Examples:

- Calcara, P. 1845. Esposizione dei **molluschi** terrestri e fluviatili dei dintorni di Palermo. - Atti della Accademia di Scienze e Lettere di Palermo (Nuova Serie) 1 (3): 1-46, Tav. [1].
- Cantraine, [F.] 1838. Notice sur un genre nouveau de la famille des **ostracés**. - Bulletin de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles 5: 111-113, Pl. Fig. 1-3.
- Coutagne, G. 1886. Description de quelques **clausilies** nouvelles de la faune française. - Annales de Malacologie 2: 229-236. Paris.
- Stanković, S. & Radoman, P. 1953. Contribution à la connaissance des **gastéropodes ancyliques** du lac d'Ohrid. - Zbornik na Rabotite, Chidrobioloski Zavod - Ochrid [Recueil des Travaux, Station Hydrobiologique - Ohrid] 1 (5): 115-122. Ochrid.

This does not apply to scientific names. Cite them as spelled in the original, do not correct orthography of scientific names in titles. Genera and species can be set in *italics* disregarding that this was not done so in the original source, families and higher groups should be cited in normal type disregarding that they might have been set in italics in the original source.

Examples:

- Brusina, S. 1876. Aggiunte alla monografia delle **Campylaea** della Dalmazia e Croazia. - Bollettino della Società Malacologica Italiana 2: 53-61. Pisa.
- Clark, B. 1797. Observations on the genus **Oestrus**. - Transactions of the Linnean Society 3: 289-329, Tab. 23. London.
- Caruana Gatto, A. 1892. New **Clausiliae** from Malta. - The Mediterranean Naturalist 1: 148-149. Malta.
- Caziot, E. & Margier, E. 1909. Classification proposée pour les espèces de la région paléarctique de la famille des **Pupidae** (ancien genre **Pupa**). - Bulletin de la Société Zoologique de France 34: 140-147. Paris.
- Cooke, C. M. 1921. Notes on Hawaiian **Zonitidae** and **Succineidae**. - Occasional Papers Bernice P. Bishop Museum 7 (12): 263-277, Pl. XXIV-XXV [= 24-25]. Honolulu.
- Darwin, C. 1851. A monograph on the fossil **Lepadidae**, or, pedunculated **cirripedes** of Great Britain. - pp. i-vi [= 1-6], 1-88, Tab. I-V [= 1-5]. London. (Palaeontographical Society).
- Davies, T. 1798. An account of the jumping mouse of Canada. **Dipus Canadensis**. - Transactions of the Linnean Society 4: 155-157, Tab. 8. London.
: The species name was capitalised in the original source, should not be cited in the present-day convention *Dipus canadensis*.
- Sevo, S. 1974. Note sur la repartition en Belgique de trois **mollusques gastéropodes** terrestres peu connus: **Acme inchoata** (**prosobranches**, **Acmeidae**), **Abida frumentum** (**stylommatophores**, **Vertiginidae**) et **Alexia denticulata** (**basommatophores**, **Ellobiidae**). - Malacological Review 7: 1-14.

If the title of another work is cited in the title, upper-case letters can be convenient.

Examples:

- Dance, S. P. 1968. J. R. Bourguignat's **Malacologie de l'Algérie**, 1863-1864. - Journal of the Society for the Bibliography of Natural History 5 (1): 19-22.
: French, the word malacologie would usually not be capitalised.
- Edwards, G. 1771. A catalogue of animals and plants represented in Catesby's '**Natural history of Carolina**'. With the Linnean names. - Appendix in: Catesby: The natural history of Carolina. [Second edition, volume 2].
- Froriep, L. F. 1806. C. Dumeril's **Analytische Zoologie**. Aus dem Französischen mit Zusätzen. - pp. [1], I-VI [1-6], 1-344. Weimar. (Landes-Industrie-Comptoir).
: German, usual would be analytische Zoologie (adjective in lower-case and noun capitalised).

Leave uncommon characters as in the original title and do not correct orthography. **Do not correct v to u** in titles of early works written in classical Latin or early German. A correctly cited title can be converted into an incorrectly cited one. An incorrectly cited title cannot be converted back.

Examples:

- Dall, W. H. 1870. On the genus **Pompholyx** and its allies, with a revision of the **Limnæidae** of authors. - Annals of the Lyceum of Natural History 9: 333-361. New York.
- Euphrasén, B. A. 1788. Beskrifning på **3:ne** Fiskar. - Kongliga Vetenskaps Academiens Nya Handlingar 9 (1-3): 51-55, Tab. IX [= 9]. Stockholm.
- Aldrovandi, U. 1603. Ornithologiae. Tomus tertius ac postremus. **Cvm** indice copiosissimo **variavm lingvarvm**. - pp. [1-10], 1-560, [1-23]. Bononiae. (Bellagambam).
- Müller, O. F. 1764. **Favna insectorvm** Fridrichsdalina, sive methodica descriptio **insectorvm** agri Fridrichsdalensis, **cvm** **characteribvs** genericis et specificis, **nominibvs trivialibvs**, **locis natalibvs**, **iconibvs** allegatis, **novisqve plvribvs specibvs** additis. - pp. I-XXIV [= 1-24], 1-96. Hafniae, Lipsiae. (Gleditsch).
- Salviani, H. 1557. **Aqvatilium animalium** historiae. Liber **primvs, cvm eorvndem** formis ære **excvsis**. - pp. [1-12], 1-256, Pl. 1-99. Romæ.
- Harrer, G. A. 1791. **Beschreibvngen zv** des Herrn D. Jacob Christian Schæffers natürlich **avsgemahlten Abbildvngen Regensbvrgischer** Insecten. Erster Band. - pp. [1-5], I-XII [1-12], 1-144. Regensbvrg. (Montag & Weiss).

Full stops (periods, dots) that did not appear in the original title, can be added to separate chapters within a long title of a monograph, or to indicate sections of the title separated by very different fonts. Library

catalogue records have used " : " or other control characters for such purposes, largely inconsistently and without an internationally fixed standard.

Examples:

Columna, F. 1616. **Pvrpura. Hoc** est de purpura ab animali testaceo fusa, de hoc ipso animali, alijsq rarioribus testaceis **quibusdam. Cum** iconibus ex ære ad vivum representatis elencho rerum, et indice. - pp. [1-7], 1-42. Romæ. (Mascardus).

Laspeyres, J. H. 1801. Sesiae **Europæae. Iconibus** et descriptionibus illustratae. - pp. [1-7], 1-32, Tab. [1]. Berolini. (Laspeyres).

Very old German and Dutch texts should be cited using the original orthography, including the original punctuation.

Examples:

Gesner, C. 1598. Fischbuch/ Das ist/ Außführliche beschreibung/ vnd lebendige Conterfactur aller vnnd jeden Fischen/ von dem kleinsten Fischlein an biß auff den grösten Wallfisch/ wie sie nicht allein in dem grossen hohen Meer/ sondern auch in den Seen/ Flüssen/ Bächen/ vnd allen Schiffreichen Wassern gesehen vnd gefangen werden. Sampt derselben Nutzbarkeit vnd güte/ so wol in Essensspeiß vnd Küchen/ als in der Artzney vnd Apotecken. (...). - pp. [1-11], 1-202. Franckfurt am Meyn. (Cambier).

Merian, M. S. 1679. Der Raupen wunderbare Verwandlung/ und sonderbare Blumen-nahrung/ worinnen/ durch eine ganz-neue Erfindung/ der Raupen/ Würmer/ Sommer-vögelein/ Motten/ Fliegen/ und anderer dergleichen Thierlein/ Ursprung/ Speisen/ und Veränderungen/ samt ihrer Zeit/ Ort/ und Eigenschaften/ den Naturkündigern/ Kunstmahlern/ und Gartenliebhabern zu Dienst/ fleissig untersucht/ kürzlich beschrieben/ nach dem Leben abgemahlt/ ins Kupfer gestochen/ und selbst verlegt. - pp. [1-5], 1-102, [1-8], pl. 1-50. Nürnberg.

If there is an inadvertent error (misprint, typo) in the original publication, use "[sic]" to indicate that the error was not secondarily generated.

Examples:

Brünnich, M. T. 1788. Om en ny Fiskeart, den draabeplettede Pladefisk, fanget ved **Helsingør [sic]** i Nordsøen 1786. - Nye Samling af det Kongelige Danske Videnskabers Selskabs Skrifter 3: 398-407, Tab. A. Kiøbenhavn.
: Danish, error for Helsingør.

Barrère, P. 1745. Ornithologiæ specimen novum, sive series avium in Ruscinone, Pyrenæis Montibus, atque in Galliâ Æquinoctiali observatarum, in classes, genera & species, novâ **methodo [sic]**, digesta. - pp. [1-13], 14-84, [1-8], pl. [1]. Perpiniani. (Simonem Le Comte).
: Latin, error for methodo.

Bosc, L. [A. G.] 1792. **Bostricus [sic] furcatus**. - Journal d'Histoire Naturelle 2: 259-260, Pl. 38. Paris.
: Error for *Bostrichus*.

Fabricius, J. C. 1792. Entomologia systematica emendata et aucta. Secundum classes, ordines, genera, species adjectis **synonymis [sic]**, locis, observationibus, descriptionibus. Tom. I. [Pars I]. - pp. I-XX [= 1-20], 1-330. Hafniae. (Proft).
: Latin, error for synonymis.

Füßly, J. C. 1781. Köchllins-Schwärmer, **Phinx [sic] Kæchlini**. - Archiv der Insectengeschichte 1: 1-4. Zürich, Winterthur.
: Error for *Sphinx*.

Luso da Silva, A. 1872. **Molluscos [sic]** terrestres e fluviaes de Portugal. (Continuação). - Jornal de Sciencias Mathematicas Physicas e Naturaes 3: 257-261. Lisboa.
: Portuguese, error for moluscos.

If names of authors are part of the text of the title, they are usually removed, so that the title will not contain the name of the author. A translator is not regarded as an author, and can be cited within the text of the title. Academic titles and society memberships of such persons are usually ignored or replaced by "(...)".

Examples:

Linnæus, C. 1758. Systema naturæ per regna tria naturæ...

: The title is not cited as "Caroli Linnæi (...) systema naturæ per regna tria naturæ..."

Osbeck, P., Toreen, O. & Eckerberg, C. G. 1771. A voyage to China and the East Indies, together with a voyage to Surat, and an account of the Chinese husbandry. **Translated from the German by John Reinhold Forster**. To which are added, a fauna and flora Sinensis. In two volumes. Vol. I. - pp. i-xx [= 1-20], 1-396, Tab. 1-9. London. (White).

: In the original title text the names of the authors with their titles were given in between the lines.

Osbeck, P. 1765. Reise nach Ostindien und China. Nebst O. Toreens Reise nach Surat und C.G. Ekebergs Nachricht von der Landwirthschaft der Chineser. **Aus dem Schwedischen übersetzt von J. G. Georgi**. - pp. [1-3], I-XXIV [=1-24], 1 p., 1-552, [1-26], Tab. 1-13. Rostock. (Johann Christian Koppe).

Merian, M. S. 1730. De europische insecten, naauwkeurig onderzocht, na t'leven geschildert, en in print gebraakt door Maria Sibilla Merian. **In't frans beschreven door J. Marret, en door een voornaam liefhebber in't nederduits vertaalt**. - pp. [1-2], 1-84, pl. I-CLXXXIV [= 1-184]. Amsterdam. (Bernard).

Some contributors of library catalogues do not know that academic titles and affiliations with academic societies are not cited in title sequences, or library staff members had difficulties in disambiguating academic titles and the title of the book. So academic titles appear occasionally in literature records. But this is not usual standard.

Examples of titles copied from BHL at www.biodiversitylibrary.org (2010):

Caroli Illigeri D. Acad. Reg. Scient. Berolinens. et Bavaricae Sod. Museo Zoologico Berolin. praefecti professoris extraord. Prodrum systematis mammalium et avium : additis terminis zoographicis utriusque classis, eorumque versione germanica.

The same work cited more regularly:

Illiger, C. 1811. Prodrum systematis mammalium et avium additis terminis zoographicis utriusque classis, eorumque versione germanica. - pp. I-XVIII [= 1-18], 1-301, [1]. Berolini. (Salfeld).

Caroli Linnæi Med. Doct. & in Academia Upsaliensi Prof. Reg. & Ord. Oratio de necessitate peregrinationum intra patriam : ejusque Elenchus animalium per Sueciam observatorum : accedunt Johannis Browallii examen epicriseos Siegesbeckianae in systema plantarum sexuale : et Johannis Gesneri ... dissertationes de partium veg

The same work cited more regularly:

Linnæus, C. 1743. Oratio de necessitate peregrinationum intra patriam. Ejusque elenchus animalium per Sueciam observatorum.

Accedunt Johannis Browallii examen epicriseos Siegesbeckianae in systema plantarum sexuale. Et Johannis Gesneri (...) dissertationes de partium vegetationis et fructificationis structura, differentia et usu, in quibus elementa botanica dilucide explicantur. - pp. [1], 1-94, 1-108. Lugduni Batavorum. (Haak).

Jobi Basteri med. doct., Acad. Caes. ... Opuscula subseciva : observationes miscellaneas de animalculis et plantis, quibusdam marinis, eorumque ovariis et seminibus continentia.

The same work cited more regularly:

Baster, J. 1760. Opuscula subseciva, observationes miscellaneas de animalculis et plantis quibusdam marinis, eorumque ovariis et seminibus continentia. Liber secundus [= Tom. I. Liber II]. - pp. [1-3], 53-95, [1], Tab. VII-X [= 7-10]. Harlemi. (Bosch).

A translator who changed significantly the textual contents of the original is occasionally cited as the author.

Example:

Otto, B. C. 1796. Herrn von Büffons Naturgeschichte der Vögel. **Aus dem Französischen übersetzt, mit Anmerkungen, Zusätzen** und vielen Kupfern vermehrt. Drey und zwanzigster Band. - pp. I-VIII [= 1-8], 1-318, [pl. 1], [pl. 1-88]. Berlin. (Pauli).

: Originally published by Buffon in French, translated and amended by Otto.

Presence and number of plates mentioned on the title page are rarely cited, only in early works and if there is more information involved than only the record.

Examples:

Büttner, D.-S. 1714. Coralliographia subterranea. Seu dissertatio de coralliis fossilibus, in specie, de lapide corneo Horn- oder gemeinem Feuer-Stein/ **Cum tabulis æneis.** - pp. [1-3], 1-68, index [1-4], Taf. I-IV [= 1-4]. Lipsiæ. (Groschuff).

Linnæus, C. 1756. Amoenitates academicae; seu dissertationes variæ physicae, medicae, botanicae, antehac seorsim editæ, nunc collectæ et auctæ **cum tabulis æneis.** Volumen tertium. - pp. [1-3], 1-464, Tab. I-IV [= 1-4], 1 table. Holmiæ. (Salvius).

Treutler, F. A. 1793. Observationes pathologico-anatomicae auctarium ad helminthologiam humani corporis continentes. **Cum IV. tabulis ad naturam pictis.** - pp. [1], I-IV [= 1-4], [1], 1-44, Tab. I-IV [= 1-4]. Lipsiæ. (Mueller).

Albin, E. 1720. A natural history of English insects. **Illustrated with a hundred copper plates, curiously engraven from the life: and (for those who desire it) exactly coloured by the author.** - pp. [1-111], Pl. I-C [= 1-100]. London. (Innys).

Sometimes titles are so difficult to interpret that it is better to cite them exactly as printed on the title page. But even if this is done, academic titles or society membership indications are the most rarely cited pieces of information.

Examples:

[Bianchi, G.] 1739. Jani Planci Ariminensis de conchis minvs notis liber, cvi accessit specimen aestvs reciproci maris svperi ad littvs portvmqve Arimini. - pp. 1-88, Tab. I-V [= 1-5]. Venetiis. (G. Pasquali).

: It is difficult to understand that Jani Planci was the genitive of Janus Plancus, a pseudonym of the author Giovanni Bianchi. The term Ariminensis means that J. P. was "from Rimini, Italy", but only few people would understand this. The 3 first words would usually not be cited.

Pallas, P. S. 1787. Charakteristik der Thierpflanzen, worin von den Gattungen derselben allgemeine Entwürfe, und von denen dazu gehörigen Arten kurze Beschreibungen gegeben werden; nebst den vornehmsten Synonymen der Schriftsteller. Aus dem Lateinischen übersetzt und mit Anmerkungen versehen von Christian Friedrich Wilkens (...), und nach seinem Tode herausgegeben von Johann Friedrich Wilhelm Herbst (...). - pp. 1-344, Tab. I-XII [= 1-12]. Nürnberg. (Raspe).

: This work could also be cited with Wilkens and Herbst as co-authors, or with only Wilkens as co-author.

De Cristofori, C. & Jan, G. 1832. Catalogus in IV. sectiones divisus rerum naturalium in museo exstantium Josephi De Cristofori et Georgii Jan plurium Acad. Scient. et Societ. Nat. Cur. Sodalium complectens adumbrationem oryctognosiae et geognosiae atque prodrumum faunae et floriae Italiae Superioris. Sectio II. - Pars I. - pp. [1-7], 1-8, [1], 1-4, 1-4, [1]. Parmæ. (Carmignani).

: Very complicate title, only very skilled experts in Latin would be able to separate pure information from useless academic titles.

Garsault, F. A. P. de [1764]. Les figures des plantes et animaux d'usage en medecine, décrits dans la Matière Medicale de Mr. Geoffroy medecin, dessinés d'après nature par Mr. de Gasault, gravés par Mrs. Defehrt, Prevost, Duflos, Martinet &c. Niquet scrip. [5]. - pp. [1-4], index [1-20], Pl. 644-729. Paris.

: Cited as in the original source, the term "medecin" could also be omitted as the cited profession of a person.

4.2.5 Journal titles

Don't abbreviate journal titles. Cite always the full title of the journal.

Many journals accept, recommend or even require abbreviated journal titles. In fields like physics with low numbers of journals this is no problem. Zoology is not a field with low numbers of journals. Zoologists published in thousands of journals. Abbreviating journals is certainly not a good service for zoological research. There is no standardized list of journal abbreviations. Various pseudo-standardized lists of journal abbreviations are used in library environments, also in online resources, none is used as a well accepted international standard covering all disciplines. All abbreviations work under the conception that insiders in a certain discipline should know the names of the journals and would quickly understand which journal is meant. But some are not disambiguated, others can lead to misunderstandings, particularly if incompletely cited. It gets very sophisticated if key words are repeatedly used in journal titles of various languages in the same way of order.

Examples:

J Conch -- Journal of Conchology (London) // Journal de Conchyliologie (Paris)

Arch Naturgesch -- Archiv für Naturgeschichte A (Berlin) // Archiv für Naturgeschichte, Zeitschrift für systematische Zoologie (Leipzig) // Archiv der Naturgeschichte oder Sammlung belehrender Abbildungen aus dem Thierreiche (Naumburg)

Mem Ent Soc - Memoirs of the Entomological Society of Canada // Memoirs of the Entomological Society of Southern Africa // Memoirs of the Entomological Society of India // Memoirs of the Entomological Society of Washington

Mem Soc Ent - Mémoires de la Société Entomologique de Belgique // Mémoires de la Société Entomologique d'Égypte // Memorie della Società Entomologica Italiana // Memorias de la Sociedad Entomológica de Españã // Mémoires de la Société Entomologique du Québec // Mémoires de la Société Royale Belge d'Entomologie

Ann Sci Nat -- Annales des Sciences Naturelles (Paris) // Anales de Ciencias Naturales (Madrid)

For the non-insider acronyms and abbreviations can (and very often do) provide serious obstacles. Abbreviations like Mem. Ent. or Arch. Nat. can have any meaning in any language, plural or singular, they could also refer to translated Serbocroatian journal titles. Search queries with wildcard options (arch* nat*) yield thousands of hits. If possible, cite always and consistently the full journal title.

Examples:

- Huang, Y. & Zhang, Z. N. 2005. Three new species of the genus *Belbolla* (Nematoda: Enoplida: Enchelidiidae) from the Yellow Sea, China. - **Journal of Natural History** 39 (20): 1689-1703.
- Asso, I. de 1801. Introduccion á la ichthyologia oriental de España. - **Anales de Ciencias Naturales** 4 (10): 28-52. Madrid.
- Frivaldszky, I. 1835. Köslések à 'Balkány' vidékén tett természettudományi utazásról. - **A' Magyar Tudós Társaság' Évkönyvei** 2: 235-276, T. I-VII [= 1-7]. Budan.
- Radoman, P. 1953. Jedan prilog izuchavanju Ohriskih gasteropoda. - **Arhiv Bioloških Nauka** 5: 55-59. Beograd.
- Petit, R. E. 2006. Notes on Sowerby's The genera of recent and fossil shells (1821-1834). - **Archives of Natural History** 33 (1): 71-89.
- Thiessé, J. 1884. Nouvelle hélice de Thessalie. - **Bulletins de la Société Malacologique de France** 1: 271-272. Paris.
- Da Silva Mengo, J. 1867. Descrição de um «*Helix*» novo de Portugal. - **Jornal de Sciencias Mathematicas Physicas e Naturaes** 1 ["1868"]: 170-171. Lisboa.

Cite the journal title completely, also if it is long.

Examples:

- Sturany, R. 1904. Kurze Diagnosen neuer Gastropoden. - **Anzeiger der kaiserlichen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Klasse** 41 (10): 115-119. Wien.
- : All zoological articles in this journal were published in the series mathematisch-naturwissenschaftliche Klasse, but a librarian does not know that, and an unexperienced researcher will stumble about various series in a library catalogue and not know which is the right one.
- Strobel, P. de 1844. Delle conchiglie terrestri dei dintorni di Innsbruck. - **Giornale dell'Imperiale Reale Istituto Lombardo di Scienze, Lettere e Arti e Biblioteca Italiana** 9 (26): 301-331. Milano.
- Soós, L. 1924. Csiki Ernő állattani kutatásai Albániában. - **Explorationes zoologicae ab E. Csiki in Albania peractae. XIII. Puhatestűek - Mollusca.** - **A Magyar Tudományos Akadémia Balkán-kutatásainak Tudományos Eredményei** 1: 177-197. Budapest.
- Klemm, W. 1939. Zur rassenmäßigen Gliederung des Genus *Pagodulina* Clessin. - **Zeitschrift für Wissenschaftliche Zoologie, Abteilung B, Archiv für Naturgeschichte (Zeitschrift für Systematische Zoologie)** (Neue Folge) 8 (2): 198-262, Taf. 1. Leipzig.
- Schellenberg, A. 1937. Kritische Bemerkungen zur Systematik der Süßwassergammariden. - **Zoologische Jahrbücher; Abteilung für Systematik, Ökologie und Geographie der Tiere** 69: 469-516. Berlin.

Cite the journal title always in its original language. For journal names in non-Latin scripts, use a standard transcription mode for Latin script.

Examples:

- Koelreuter, I. T. 1764. Descriptionis piscivm rariorum e Myseo Petropolitano exceptorum continvatio. - **Novi Commentarii Academiae Scientiarum Imperialis Petropolitanae** 9: 420-470, Tab. IX-X [= 9-10].
- : Russian journal with Latin title, the journal had no other title.
- Bilgin, F. 1980. Batı Anadolu'nun bazı önemli tatlı sularından toplanan Mollusca türlerinin sitematiği ve dağılışı. - **Diyarbakır Üniversitesi Tıp Fakültesi Dergisi** 8 (2 Supplement): 1-64.
- : Turkish journal in Latin script.
- Bole, J. 1984. [Fauna Durmitora. 1.] Mehkuzci (Mollusca: Gastropoda et Bivalvia). [The fauna of Durmitor: molluscs (Mollusca: Gastropoda et Bivalvia)]. - **Posebna Izdanja, Crnogorska Akademija Nauka i Umetnosti, Odjeljenje Prirodnih Nauka** 18 (11): 363-394. Titograd.
- : Serbian journal in Serbian Cyrillic script.
- Pálsyni, S. 1789. Um Húsblas eda Sundmagalim sem lítill vidbætir Lector Olafs Olafsonar ritlings um límtgundur (Fel. r. 6. Bind.). - **Rit þeð Islenska Lærdoms-Lista Felags** 9: 160-176. Kaupmannahöfn.
- : Icelandic journal in Latin script with some special characters (þ is only used in Icelandic).

If a Serbocroatian journal title has a French translation, cite both journal titles, and give the translation in [] square brackets or separate both by a hyphen.

Never use only the French or English title alone for a journal published in Poland and which also had a Polish title. Libraries record journals usually under their original title.

Examples:

- Bole, J. 1975. Anatomija in taksonomski položaj vrste *Pholeoteris euthrix* Sturany 1904 (Gastropoda). [Anatomie und taxonomische Stellung der Art *Pholeoteris euthrix* Sturany 1904 (Gastropoda)]. - **Razprave [Dissertationes], Slovenska Akademija Znanosti in Umetnosti [Academia Scientiarum et Artium Slovenica], Razred za Prirodoslovne Vede [Classis IV: Historia Naturalis]** 18 (2): 33-46. Ljubljana.
- : Slovenian journal with Slovenian name in Latin script, with a Latin translation of the journal title given on the title page of each volume.
- Hadžišće, S. 1958. III. - prilog poznavanju faune Gastropoda Prespanskog Jezera. - **Zbornik na Rabotite, Chidrobiološki Zavod - Ochrid [Recueil des Travaux, Station Hydrobiologique - Ohrid]** 6 (17 (33)): 1-4.
- : Macedonian journal with Macedonian name in Macedonian Cyrillic script, with a French translation of the journal title given on the title page of each volume.
- Kattoulas, M., Koukouras, A. & Economidis, P. 1973. Benthic fauna of the Evvoia Gulf. II. Polyplacophora (Mollusca). - **Epistimonike Epeteris tis Scholis ton Fisikon ke Matematikon Epistimon, Aristotelion Panepistimion Thessalonikis [Scientific Annals of the Faculty of Physics and Mathematics, Aristotelian University of Thessaloniki]** 13: 17-27, 1 map. Thessaloníki.
- : Greek journal with Greek name in Greek script, with an English translation of the journal title given on the title page of each volume.
- Babor, J. & Košťál, J. 1893. Příspěvky ku poznání poměrů pohlavních u některých limacidů. - **Věstník Královské Společnosti Nauk, Třída mathematicko-přírodovědecká - Sitzungsberichte der Königl.-Böhmischen Gesellschaft der Wissenschaften, mathematisch-naturwissenschaftliche Classe** 51 ["1894"]: 1-7. Prag.
- : Czech journal in Latin script, with Czech and German titles which appeared almost without preference for one on the title page of each volume.
- Lindholm, W. A. 1908. Materialien zur Molluskenfauna [sic] von Südwestrussland, Polen und der Krim. - **Zapiski Novorossijskago Obshchestva Estestvoispytatelej - Mémoires de la Société des Naturalistes de la Nouvelle-Russie** 31: 199-232. Odessa.

: Russian journal in Russian script, with Russian and French titles which appeared without preference for one on the title page of each volume. The article was in German.

If a journal changed its name, cite every article individually under the name then used on the title page of the volume.

Examples:

Gasull, L. 1964. Algunos moluscos terrestres y de agua dulce de Baleares. - **Boletín de la Sociedad de Historia Natural de Baleares** 9 ["1963"] : 3-80. Palma de Mallorca.

Gasull, L. 1981. Fauna malacológica terrestre y de agua dulce de la provincia de Castellón de la Plana. - **Bolletí de la Societat d'Història Natural de les Balears** 25: 55-102. Palma de Mallorca.

Bierkander, C. 1777. Rön om Rot-masken. - **Kongliga Vetenskaps Academiens Handlingar** 38 (1-3): 29-43. Stockholm.

Ljungh, S. I. 1797. Picus javanensis, en ny Fogel ifrån Java, beskrifven. - **Kongliga Vetenskaps Academiens Nya Handlingar** 18 (4-6): 134-137, Tab. VI [= 6]. Stockholm.

Westerlund, C. A. 1877. Sibiriens land- och sötvatten-mollusker. - **Kongliga Svenska Vetenskaps-Akademiens Handlingar** (Ny Följd) 14 (12): 1-111, Taf. [1]. Stockholm.

Hubendick, B. 1951. Recent Lymnaeidae, their variation, morphology, taxonomy, nomenclature, and distribution. - **Kungliga Svenska Vetenskapsakademiens Handlingar** (4) 3 (1): 1-223, pl. 1-5. Stockholm.

If you were not able to decode an abbreviation of a journal title you saw cited in a secondary source, cite the abbreviated title in the form you found it cited.

Do not try to spell out abbreviated titles which you were not able to decode. Arch. could mean Archive or Archives, Bull. could mean Bulletin, Bulletins or Bullettino, you do not know it. Often it is most likely that the source from which you cited it contained a mistake, but by citing exactly in this form you avoid adding more mistakes.

Examples:

Bole, J. 1961. Nove vrste poszemeljskih polžev iz Črne Gore. - **II. jugosl. speleol. kongr. Split** 1958: 205-207. Zagreb.

Simroth, H. 1912. Ueber die im Frühjahr 1897 von Herrn Kaznakov in den Gebirgen Buchara's erbeuteten Parmacellen. - **Annu. Mus. Zool. Acad. Sci. St. Petersburg**. 17: 41-52.

Ortiz de Zárate, A. 1962. Una nueva especie de *Helicella* (*Helicella* (*Xeroplexa*) *cobosi*). - **Arch. Inst. Aclim. Almería** 11: 41-43.

Wiktor, A. 1959. *Boettgerilla vermiformis* n. sp. (Mollusca, Pulm.). - **Comm. Poznan Soc. Friends Sci. (Dep. Math. Nat. Sci.)** 4: 1-2.

Evans, H. J. 1978. *Limax pseudoflavus* sp. nov. A new species of slug for Ireland. - **Ir. Nat. I.** 19: 173.

Bouchard-Chantreaux, N. R. 1838. Catalogue des mollusques terrestres et fluviatiles observés jusqu'à ce jour à l'état vivant dans le département du Pas-de-Calais. - **Mém. Soc. Agric. Sci. Arts Boulogne-sur-Mer** 1 (2) ["1836"] : 141-280, pl. 1.

Prashad, B. 1925. Notes on the lamellibranchs in the Indian Museum. 6. Indian species of the genus *Pisidium*. - **Rec. Ind. Mus.** 27: 405-422. Calcutta.

4.2.6 Page numbers, plate numbers

In all the examples given above, pages and plates were cited, for all works, usually the first and last pages, Roman and Arabic paginations, and plates. Index, errata and explanations of plates often have separate paginations, many works are chaotically paginated, with pagination restarting with each chapter. For such works there is usually no need to cite the exact pagination. If index and other parts are unpaginated in a work, it is convenient to cite them in an Arabic substitute pagination.

Examples:

pp. [1-34].

..., index [1-18].

For the plates, usually only the numbers of the plates are cited, but not the unpaginated separate sheets attached to the plates with their explanations.

Journals

Citing first and last page is common standard for journal articles and for articles in monographic works. Plates are often overlooked. Journal articles can hardly be ordered in interlibrary loan systems without indicated page numbers, and can hardly be found in digitized journals.

For finding journal articles you usually need the literature data in the following order:

Scientific works: Author, bibliographic year, true year, article title, journal title, volume, page numbers, (locality).

Library research: Journal title, bibliographic year, volume, (locality), (publisher), page numbers, (article title), (author).

Interlibrary loan systems: Journal title, (publisher), (locality), bibliographic year, volume, author, article title, page numbers.

Digitised literature (BHL): Journal title, (publisher), (locality), volume, (bibliographic year), page numbers, article title, (author).

Digital archives of journal publishers: Journal title, bibliographic year, volume, page numbers, author, article title.

Monographs

Citing first and last pages (including Roman pagination) in monographs is not always required, some journals instruct authors not to cite them. They are often not yet aware that page numbers have recently gained crucial importance in online literature research.

For finding monographs you usually need the literature data in the following order:

Scientific works: Author, bibliographic year, (true year), title, (page numbers), (locality), (publisher).

Library research: Title, author, bibliographic year, (locality), (publisher), (page numbers).

Interlibrary loan systems: Title, author, (locality), (publisher), bibliographic year, (page numbers).

Digitised literature: Title, author, (publisher), (locality), bibliographic year, page numbers.

The shortcoming in citing page numbers for monographs is a waste of printing space in journals with low budgets. Page numbers are not necessary to find monographs in libraries. Traditionally, monographs are usually found by their title, author and year, page numbers are rarely correctly cited in library catalogues.

Page numbers are helpful for verifying presence of the correct work, and for understanding errors in citations. Some monographs appeared in several editions, or in several volumes and parts, which differed only very slightly in their title and other data, if at all, but usually significantly in their page numbers.

In digitised works page numbers are much more important than in paper prints because pages are verified much more frequently. Online research in digitised literature, for example in the BHL viewer or at Gallica, allows very quickly to verify the page numbers in a scroll box, verifying correctness of a work by this method can be quicker than checking the text of the digitised title page.

Inconsistent page numbers always indicate that something went wrong in the literature research. Several error sources are possible and occur frequently. You can have been guided to other works with slightly different titles or years (the years of publication are not always given with the digitised metadata, also the authors are not always clearly recorded). Digitised books that were bound together with other books create the need to scroll down several sets of paginations (in such cases it is almost indispensable to know the page numbers of the work you are looking for).

Example:

Draparnaud, J.-P.-R. 1805. Histoire naturelle des mollusques terrestres et fluviatiles de la France. Ouvrage posthume. Avec XIII planches. - pp. [1-9], j-viiij [= 1-8], 1-134, [Pl. 1-13]. Paris, Montpellier. (Plassan, Renaud).

Digitized by Gallica: <http://gallica.bnf.fr/document?O=N099076>

: In the book bound in the museum library of Leiden, which was digitised here, Draparnaud 1805 was bound together with another work of the same author (Draparnaud & Michaud 1831). In the page viewer you immediately see in the pagination scrollbox that there are two main text sections in the digitised work, pp. 1-134 and 1-164. Only pp. 1-134 is likely to correspond to the work you are looking for, and the second set of pages (pp. 1-164) must correspond to another work.

Errors in the digitisation process are frequent, incorrectly or inaccurately given volume numbers or even mixups of titles or metadata by the digitisers. To understand the nature of such errors, knowing the correct page numbers can be very useful.

Plates

From the 1700s to the early 1900s it was necessary to print figures on separate sheets. These are called plates. By using copperplates and letterpress it was technically impossible to integrate figures in text passages, as this had been done in the 1600s with woodcuts, and is done today in modern prints.

Cite plates if they have separate plate numbers and are not paginated (in the regular block of pages).

Do not cite them if they have page numbers regularly integrated in the text pagination, as it has been done after 1907 in offset prints.

It is very important to cite plates in pre-1900 works, particularly in journal articles. Otherwise subsequent researchers will not get copied the plates if they order an article in interlibrary loan systems and just say "pp. 467-489". Presence of plates is not always clear from the title page of the article, they might be bound at the end of the volume, and librarians will not copy the plates if they do not know about it.

But if an article in a post-1920 work "pp. 156-188" contains a so-called "Plate 1" on p. 188 and you cite it, librarians will look for the additional plate, provoking error sources which may delay orders. This is why plates should not be cited if they are included to the regularly paginated sections of the work.

It is convenient to cite plates with a clear abbreviation, preferably of the term used in the work itself "Pl.", "Taf.", "Tav." or "Tab.". You can also cite "pl.", but a German librarian looking for an Italian article where the plates were named "Tav." will not necessarily know what "pl." means. If the plates are not named and not numbered in the original, it is convenient to use a lower-case "pl." for them, with substitute Arabic numbers:

Example:

pl. [1-60].

It is convenient to give Arabic numbers for ugly long Roman numbers:

Example:

pp. i-lxxxvii [= 1-87], Tab. CCXXVIII-CCXLIV [= 228-244].

It is convenient to cite upper-case or lower-case Roman numbers in the way they were given in the original:

Example:

pp. j-xxxvij [= 1-37], pp. i-xxxvii [= 1-37], pp. I-XXXVII [= 1-37].

Do not cite text figures which are integrated in the text. Library staff will look for figures published outside the regular text.

4.2.7 Locality of publication and publisher

Sometimes it is convenient to cite the locality of publication and the name of the publisher. This information helps to find the correct publication and is usually recorded in library catalogues and in the metadata of digitised works. It is not absolutely necessary, but helps to understand possible error sources.

For monographs it is usual standard to cite at least the locality, but often also the name of the publisher.

It is convenient to cite the locality in its original spelling, and not to correct genitive to nominative case. Sometimes library catalogues and digitised resources use the modern names of the cities, sometimes the originals, sometimes both, rarely one standard is applied consistently in all records.

Example:

Fabricius, J. C. 1775. *Systema entomologiae, sistens insectorvm classes, ordines, genera, species, adiectis synonymis, locis, descriptionibvs, observationibvs.* - pp. [1-31], 1-832. Flensbvr̄gi, Lipsiae. (Kort).

: The present-day names of the cities are Flensburg and Leipzig. Not all Hungarian and Argentinian librarians know that.

For **journals** the locality and the publisher is usually not important. In most modern international journals citing the locality and publisher is useless (in multinational publishing companies such as Elsevier, Springer and Wiley they are meaningless and change every few years), but in many early journals they can be necessary and indispensable. Many journals with identical journal titles can only be distinguished by their locality.

Societies used to be journal publishers in most of the 1800s and 1900s, this was part of the identity of the journal. Then the rights were eventually sold to big publishers such as Blackwell, Wiley, Elsevier or Springer, who kept the names of the journals to take advantage of their reputation. In these cases the publisher (and with them the locality) is not part of the identity of a journal any more.

Example:

Holthuis, L. B. 1987. The scientific name of the sperm whale. - *Marine Mammal Science* 3: 87-90.

: Blackwell Science in Oxford (England) was the publisher in 1987, the name changed to Blackwell Publishing in 2001, in 2007 Blackwell was taken over by Wiley, currently (2011) Wiley-Blackwell.

In some cases it is useful to add the locality of publication when citing a journal reference.

Examples:

Gittenberger, E. 1973. Eine *Zospeum*-Art aus den Pyrenäen, *Zospeum bellesi* spec. nov. - **Bacteria** 37 (5/6): 137-140. **Leiden**.

: Here it may be convenient to add the locality if readers are expected not to know the journal. A researcher or librarian may suspect a typographical error and look for a journal "**Bacteria**".

Anderson, R. 2005. An annotated list of the non-marine Mollusca of Britain and Ireland. - **Journal of Conchology** 38: 607-637. **London**.

Crosse, H. 1864. Catalogue des espèces appartenant au genre *Pomatias*, et description d'une espèce nouvelle. - **Journal de Conchyliologie** 12: 23-33. **Paris**.

: The locality is indispensable if both journals are abbreviated as **J. Conch.**

Riedel, A. & Mylonas, M. 1995. The Zonitidae of the south-east Aegean islets (Gastropoda: Pulmonata). - **Genus** 6 (2): 229-245. **Wroclaw**.

: A journal with such a name can hardly be found if one does not know the locality.

Jungbluth, J. H. & Knorre, D. von 2008. Trivialnamen der Land- und Süßwassermollusken Deutschlands (Gastropoda et Bivalvia). - **Mollusca** 26 (1-3): 105-156. **Dresden**.

: This journal was only published in 3 volumes between 2007 and 2009.

5. Is the name available?

If the original publication is found, it is necessary to verify if the name was correctly established and is available.

If a name was not correctly established and is not available, it cannot be used as a name. In cases of subspecies or rarely used species and genera, the usual way is to look for another name for the taxon and not to use the incorrect name any more. If such an incorrect name is in common usage for an important species or genus, a solution should be found that allows to keep using the well-known name. This is not always easy, and not always possible. If the name is very important and should be maintained, the ICZN Commission can be asked to make the name available in an Opinion.

If a name was not published, it is not available for zoological nomenclature, it cannot even be made available from an unpublished source by the Commission.

If a name was published but is not available, it can be made available by the Commission. But other solutions must be verified and are usually found, for example attributing the name to the next author who made the name available a few years later.

The rules for genera and species are slightly different. Verifying availability of genera is easier.

5.1 Published and unpublished work

The work in which the name was established, must be published in **published work** in the sense of zoological nomenclature.

The definition of published work in the ICZN Code (Art. 8, 9) does not entirely meet current practice in zoology. The Code's requirements are less accurate and strict than the commonly applied practice. We have to understand the Code's provisions as an attempt to put in words what since longer has been common practice in zoology.

Published work should meet the following requirements:

It must be **printed on paper**, by conventional printing methods (letterpress, offset) (Art. 8.4 and 8.1.3, for the details see the corresponding subchapter in the chapter "how to find published work"). It is commonly accepted that "numerous" identical copies (Art. 8.1.3) must have been printed (for the technical details see below).

"Published" means that it must have been obtainable to the public when first issued (not only to insider circles or members of an educational institution), either free of charge or by purchase (Art. 8.1.2, 9.9).

"Numerous" is under dispute. It means certainly more than two copies, but the Code gives no definition. Until recently some local periodicals have been issued in very low numbers for a small insider circle of very few persons (less than 10) interested in special groups such as myriapods. For modern publications a required minimum number of copies has repeatedly been brought up in discussions. It seems that the current trend tends towards accepting 20-50 copies. 50 was the required minimum number of printed doctoral theses in countries where the copies had to be given to university libraries. 100 copies have also been suggested, but with more opposed voices in the feedback. Less than 50 seems to be acceptable only for periodicals and if at least 20 or 25 copies of each volume were given to public libraries.

It must originally have been published **for the purpose of providing a public and permanent scientific record** (Art. 8.1.1). A person who takes two printed sheets of a home printer cannot seriously be assumed to have done this for providing a permanent record.

Newspapers are a problem. Information published in public newspapers is widely regarded to be in contrast to Art. 8.1.1, but the Code gives no direct statement concerning newspapers. Some scientific journals in the 1800s looked like common newspapers and were issued weekly, occasionally some are disputed but usually most are commonly accepted if they are obtainable in public libraries. Birds and fishes were occasionally described in local newspapers and used afterwards, so some exceptions have commonly been accepted.

Examples:

The vertebrate researchers Ramsay from Sydney (Australia) and Blasius from Braunschweig (Germany) published occasionally in local newspapers, these have been accepted for ornithological nomenclature.

If the authors had good reasons to publish their new names in local newspapers, the tolerance is usually extended.

Examples:

Some authors such as John Gould from England published in local newspapers to protect their own authorship for scientific names, as a strategy against the long time gap between the obligatory presentation of a new species at the Zoological Society of London and the corresponding publication of that name in the Proceedings. Those who did not do this (for example Louis Pfeiffer) occasionally lost their authorships because others (for example Lovell Augustus Reeve) published self-made descriptions in monographic works before the Proceedings appeared.

In 1886 the Czech researcher Uličný submitted a manuscript with a description of a new terrestrial gastropod species to the German journal "Malakozoologische Blätter" edited by S. Clessin. In 1887 Clessin published a book and established a different name for the same species. Uličný's paper with his description and name was issued in 1888. Initially Clessin's name was used, but later a short notice by Uličný was found in a 1887 issue of a local Czech newspaper "Vesmír", with a short description. The journal is present in a few public libraries outside the Czech Republic (for example Leipzig and München) and the article has commonly been recognized as published work.

It should be **extant in at least one copy**. Otherwise taxonomists have problems to provide evidence that the requirements of the Code were met. A work which is lost and only known from secondary sources is usually not recognized by all taxonomists as published work. How were the names really spelled? Were they provided with descriptions? Did new genera contain species included? It is easy to dispute that names were made available, and to argue that it had not been published for providing a permanent record. This concerns only surprisingly few publications, but may create problems.

Examples:

Sherborn 1922: lxxx listed a work by A. A. H. Lichtenstein "Comm. ent. de Phasma et Mantis", (Hamburg, 1796). "Seems to be lost, but a transl. is in Trans. Linn. Soc. VI, 1802, 1-.". The mantodean names claimed to have been established in the lost 1796 work are attributed to the next extant publication (Lichtenstein 1802). It is also possible that the 1796 work was not published for the purpose of providing a permanent scientific record, or it could have been a manuscript.

Unpublished work is (Art. 8, 9): printed handwritten manuscripts, photographs as such, proof sheets, microfilms, printed labels of specimens, copies of unpublished work, electronic files, online publications, print on demand, material issued for congress participants, private material not issued for the public, university scripts, material issued in educational institutions for internal teaching, auction catalogues printed in low numbers, publications with disclaimer statements (Art. 8.2), non-scientific periodicals (Art. 8.1.1).

Many taxonomists in many disciplines do apparently not accept **CD-ROMs** and **DVDs** as published work, but this has been disputed from the very beginning on since this was allowed in 2000 (Art. 8.6) (theoretically also floppy disks, USB sticks and other media of which copies can be produced, and which have approximately the same longevity but have probably never been accepted in the community). Those who published new names and nomenclatural acts on CD-ROMs "only" violated Recommendation 8B. In some disciplines CD-ROMs are still partly accepted, for example in the fish nomenclature until 2007 by Catalog of Fishes, but this seems to be associated with risks. In 2008 the Commission published a proposal to amend the Code and to remove Art. 8.6 from the Code. This was widely regarded as a stop signal. It is predictable that in a few decades nobody can read these media any more, and that the community will lastly have to rely on hardcopy outprints printed on demand. ICZN Commissioners have suggested in 2011 to regard only those CD-ROMs and DVDs as in agreement with Art. 8.3.1 ("durable copies") that were mass-produced in a process of stamping, while recordable discs (CD-R) manufactured by data recording by a process often referred to as "burning" on a home computer should not be regarded as published work. The longevity of both products differs, but neither one is expected to last longer than 50 years, much too short for the time spans necessary for the purposes of zoological nomenclature.

Doctoral and other theses printed by students in educational institutions must be disambiguated. Some have been recognized as published work (since more than 200 years), others not. The decisive criterion is not its frame of publication as a doctoral thesis. Doctoral theses were already published and widely distributed in the 1700s. The criterion is its wide accessibility, its presence in many libraries which made them obtainable for the public (Art. 8.1.2).

- Doctoral, master and diploma theses which were only printed in few copies for the teachers or professors of the institution and for a small insider circle, are commonly not recognized as published work.
- Doctoral (Ph. D.) theses (dissertations) published in countries where a minimum of 50 printed copies have obligatorily been donated to a public library (usually the university library) are usually recognized as published work. Libraries have distributional lists and send the copies to other libraries, so that these works are widely available. The proposed minimum numbers of 50 copies for modern works is derived from this experience.
- Doctoral theses published in countries where only an electronic version was required to be given to a public library (usually the university library) are not recognized as published work.

Wrappers printed to explain the arrangement of pages and plates in subsequently issued fascicles (livraisons, Lieferungen) and covers containing information on the content of plates issued at a date is sometimes a problem. In some cases wrappers were issued for the purpose of being bound in the volumes, and it was clear which wrapper should be bound in which volume. This may qualify for a permanent record.

In other cases the wrappers were clearly not thought for being bound in any of the volumes, for example if the texts and plates published at a time belonged to various different volumes and it was implicit and logical that the wrapper should be removed after the subscriber separated the published parts and moved them to the volume folders to which they belonged. These wrappers were not in accordance with Art. 8.1.1.

Some taxonomists accepted these sheets as published work and associated dates and names with them, even without checking if they were preserved anywhere. I would recommend to take the dates from the regularly published texts, not from the wrappers.

Examples:

Systematisches Conchylien-Cabinet von Martini und Chemnitz was a giant multivolume work on molluscs issued during more than 80 years in 584 fascicles (Lieferungen). Each Lieferung was accompanied by a wrapper, on which was printed the contents of the shipment, numbers of pages and plates including names of species, and instructions for the librarians and binders. The wrappers were clearly not thought to be preserved, the publishers gave no provisions for binding these and in fact most subscribers and librarians did not preserve them. Since the names of the species were usually not printed on the plates, the dates of publication must be taken from the text volumes, which were often issued years after the plate. Some taxonomists (for example in Clausiliidae) accepted the wrappers as published work and took the dates from there, others did not.

Pupa vergnesiana (Gastropoda) was probably mentioned as a synonym on such a plate wrapper from 1847 and referred to by Pfeiffer 1848 as *Pupa vergnesiana*, with reference to the plate. The text volume appeared in 1850 and the synonym was spelled *vergniesiana*. Pfeiffer 1853 cited the name again, this time *vergniesiana*, with references to both text and plate. Since no single wrapper was preserved anywhere, the original spelling cannot be verified. It is convenient not to accept the wrapper as published work.

Any name must be **published after 1757**.

All names published in works before 1758 are entirely unavailable from those works, with one exception: the 66 species and 1 genus published by Clerck 1757 (Svenska Spindlar). All other names must have been established in 1758 or later (Art. 3).

5.2 Did the author apply binominal nomenclature?

Any author must have applied the binominal Linnean nomenclature. Consistently (Art. 11.4), this is crucial. This means the author is only allowed to have used uninominal and binominal names. Subspecies and subgenera in combinations *Genus (Subgenus) species subspecies* are considered as binominal. Infrasubgeneric and infrasubspecies names are also allowed, as long as only one single name for a rank is used.

For judging this the style of the work must be considered, and the use of non-binominal scientific names must be ruled out.

5.2.1 Style of the work

The style of the work is free, every author can have a different style, this is very important and must be understood.

In many early works it is not sufficient to copy a single page (the original description) for the documentation in a taxonomic database, because important facts such as the generic combination or the use of the name as an accepted Linnean binominal name in the author's classification cannot be seen from one page alone. Not understanding the style can lead to incorrect conclusions.

Example:

A name "*Torpedo*" was mentioned by Houttuyn 1764: p. 453 in the margin column of a text page, this name was interpreted as a new generic name *Torpedo* Houttuyn 1764 (Chondrichthyes) by researchers who obviously saw only a copy of this page and did not understand the style of the work. This name has become an important fish genus since the 1970s. But Houttuyn 1764 had used this name (like all the other names mentioned at the text margin columns of other pages) only as a specific name, and had referred to the species *Raja torpedo* Linnæus 1758.

[Denis & Schiffermüller] 1775 subdivided the lepidopteran genus (in German "Gattung") *Phalaena* (which comprised most moths) into various subgenera (*Bombyx*, *Noctua*, *Geometra* etc.) and combined the names of the species with the subgenus. Those who did not understand German, such as Sherborn 1902 (Index Animalium), thought that the species were classified in the genera *Bombyx*, *Noctua*, *Geometra* etc., and cited the names incorrectly.

The authors did not need to use a design *Genus (Subgenus) species*. This is just a recommended convention today. It is also allowed to have spelled *G. Species*, or *genus* SUBGENUS *Species*, or *genus (Species)*. If it is clear from the context which genus is meant, combinations *Subgenus SPECIES* or simply *species* are also accepted.

Italics are not required for scientific names, italics can also be used for vernacular names.

Examples:

Scopoli 1763 (Entomologia Carniolica) used a design of the form PHALÆNA *Pulchella*.

De Geer 1771-1778 (Mémoires pour servir à l'histoire des insectes) used a design of the form *Carabus* (*granulatus*).

Müller 1774 (Vermivm terrestrium et fluviatilium) used a design of the form VERTIGO PUSILLA.

Held 1838 used the rankings "Sippschaft" (*Helix*), "genus" (*Polita*) and "species" (*cellaria*). This must be interpreted as genus, subgenus and species, spelled in today's conventions in the form *Helix (Polita) cellaria*.

Forskål 1775 (Descriptiones animalium) used ten different styles in fourteen sections of text, certainly the top scorer as the most chaotic work ever published in zoology.

In many early works the name of the genus was printed on a previous page. It was common in the extended accounts of species in the 1800s to abbreviate the genus ("H.") and to spell it out only at the beginning of the account. But there were also many early works where the genus was not repeated at all with the name of the species.

Linnaeus 1758 (*Systema naturæ*) mentioned the generic name only once in a chapter, in capitals (: TENEBRIO), and listed below the species at the left column in normal font, sometimes in upper-case and sometimes not, without repeating the genus (: *culinaris...*, *barbarus...*, *Fossor...*).

Fabricius (several important works, for example 1775 *Systema entomologiae*, 1787 *Mantissa insectorvm*, 1792-1798 *Entomologia systematica*) used basically the same style, the genus was not repeated, specific names were printed in *italics*.

Cramer 1779-1782 and Stoll 1787-1790 (*De Uitlandsche Kapellen*) mentioned only the specific names alone. For finding the associated generic names it is necessary to consult the index, the plates and the texts and to hope finding the genus coincidentally mentioned somewhere.

In some works the name of the genus was printed on a previous page, and the species was combined with the subgenus or its abbreviation, instead of with the genus. Adjectival specific names agreed in gender often with the subgenus and not with the genus. If only one page is copied and the style of the work is not understood, the true original genus can be overlooked. This is a frequent source of errors.

Beck 1837 (*Index molluscorum*) used a design of the form *G. multicolor*. *G.* referred to the subgenus *Orthostylus*, the genus *Bulimus* was mentioned several pages before, today we would write *Bulimus (Orthostylus) multicolor*. To know the genus it is necessary to go to the beginning of the chapter.

Swainson 1840 (*A treatise on malacology*) spelled genera in small caps, normal and upper-case (: LIMAX), subgenera in italics and upper-case (: *Limax*, *Arion*, *Vaginula*, *Parmacella...*), and combined species with the subgeneric name (: *L. variegatus*, *A. empiricoum*, *V. Taunaysii*, *P. Olivieri...*), today we would arrange the names as *Limax (Limax) variegatus*, *Limax (Arion) empiricorum* etc.

5.2.2 Use of non-binominal names

Using **polynominal names** as accepted scientific names for taxa (consisting of a combination *Genus-adjective-adjective-adjective...*, two or more words for a name at the specific rank which do not refer to a single entity) is not allowed and is commonly regarded not to be in accordance with a "consistent application of binominal nomenclature" (Art. 11.4).. But the exact limits are not explained in the Code. It is allowed to use a uninominal name for a species (Art. 11.4.1), and it is implicit that beyond certain limits specific names composed of more than one word are not admissible (Art. 11.9.5).

It is of course necessary to analyse the style closely and not to misinterpret the use of some Latin words as a Linnean name.

Vernacular names are allowed when it is clear they were meant as such, they are not regarded as scientific names. Establishing pseudo-binominal artificial English, German or French names is also allowed, this does not interfere with scientific names.

Example:

Schrank 1776 (*Beyträge zur Naturgeschichte*) presented many species with a German name followed by a Latin name-like short diagnosis, literature sources and a description. The Latin diagnosis looks often like a binominal or polynominal name (p. 46 *Ichneumon ovulorum*, p. 48 *Coccus abietis*, p. 49 *Dermestes thorace marginato*). But from p. 61 onwards the author used consistently italics for the specific name, italics were not used elsewhere. Only these should be recognized as scientific names, and they were consistently binominal.

In Latin texts it may not be easy to distinguish between Latin vernacular and scientific names. A Latin name which was defined by a scientist should be regarded as a scientific name and not as a vernacular name.

Vernacular names are usually vaguely defined and for their meaning dictionaries can be consulted.

Example:

Koelreuter 1766 published an article in Latin, the mentioned fish names were used as Latin vernacular names. In other articles Koelreuter used scientific names.

Any work must be verified individually. An author who did not apply the binominal nomenclature in one work did not necessarily publish a non-binominal work at another occasion. The term "non-binominal" is not attributed to an author as a person, but always individually to each published work, verifiable without the need to consult secondary sources.

Having understood the Linnean system in zoological nomenclature is not decisive. Neither is having known any other previous Linnean publication. The most decisive criterion is presence or absence of polynominal animal names.

Examples:

Geoffroy 1767 (*Traité sommaire des coquilles*) was clearly a non-binominal work and is not available. In 1799 the same author published *Histoire abrégée des insectes*, which was consistently binominal. **Geoffroy 1799** is available.

Koelreuter 1763 published a short article and mentioned a new fish name as *Trutta dentata*. No polynominal names were used in the article, so the name is available as *Trutta dentata* Koelreuter 1763, and the work was binominal. In the next volume of the same journal **Koelreuter 1764** continued his list of fishes deposited in the St. Petersburg museum, and mentioned some binominal and some polynominal names. This 1764 work was not consistently binominal and suggests that also in 1763 Koelreuter had not understood the Linnean nomenclature. This however, is not evident from the 1763 publication alone, which therefore remains binominal.

Garsault 1764 (*Les figures des plantes et animaux*) used polynominal names for plants, uninominal names for some animals and binominals only for those animals where the generic name was ambiguous, and did not cite one single binominal zoological work. Garsault 1764 is available for zoological nomenclature because no polynominal animal names were contained.

Many taxonomists have at present only very little experience with the limits of binominality, which frequently results in disputes and divergent classifications on early works in terms of Art. 11.4. It is not always easy to

understand why a work that contained polynominal names was considered as consistently binominal in the past, and it seems that in various disciplines different standards and criteria were applied, probably because only very few persons who were accepted as authorities more than 100 years ago took the decisions based on their own personal judgements. These decisions were not always aligned with each other. Conflicts arose when the concerned works covered more than only one discipline, or when young taxonomists consulted the Code and did not accept any more untenable decisions taken by previous generations.

Conflicts must also have been responsible to prevent clear definitions of binominality from being included to the Code, for example on the nature of polynominal names. Many French authors published French generic names long before their Latin equivalents or translations were mentioned somewhere. The Code does not address this problem. Some taxonomists attributed genera to the author who first mentioned it in French, or regarded species as having been included in a genus if they were presented with a French scientific name. Such a procedure is almost always a source of disputes.

Examples:

De Geer published an important multivolume work on arthropods in the 1770s containing thousands of scientific names, 1000 of which were new. Of these, 140 names were certainly not binominal under Art. 11.4, but in some insect disciplines De Geer's binominal names have been used for taxa. The availability of De Geer's 850 binominal names is the cause of the permanent dispute for many decades.

Christ 1791, an important work on hymenopteran insects was not consistently binominal because several names used for taxa did not match the provisions of Art. 11.4 and 11.9.5.

Férussac 1812 and **Férussac 1814** mixed up Latin and French scientific names, and regarded them as equivalently scientific (the French names were not vernacular names but scientific names, usually French translations of corresponding Latin names or Latin names transformed to a French form of pronouncing the words, for example *Paludina linnaei* would become *Paludine de Linné*). Since Linnean scientific names can either be Latin or latinised names, but not French names, the nomenclature used by Férussac was in conflict with the Code. Férussac published various important consistently binominal works after 1815 and became a widely respected authority in malacology, so the early works were also widely accepted as binominal.

A few polynominal or otherwise non-binominal names published undeliberately within a largely consistently binominal work does not necessarily make the work unavailable. An author can have overlooked a polynominal name in a manuscript, or tolerated a misprint for economic reasons, but the official tolerance is narrow. As said above, the Code does not define in detail the term "consistently binominal" used in Art. 11.4, and the limits remain unclear beyond which a name or work is unavailable.

Examples:

Garsault 1764 (*Les figures des plantes et animaux*) contained some scientific names for female animals different from those of males of the same species (*Cerva* for *Cervus*, *Vacca* for *Bos*, *Mulier* for *Homo*). These names were outside the tolerance of binominal nomenclature.

But they were published only on plates and not repeated in the text passages, so that we must assume that the author decided not to use them as names in his classification, and that the engravers of the copperplates may have added these names on their own account without instructions by the author.

Rossmässler 1835-1837 published a very important work on molluscs (*Iconographie*) and established hundreds of new names for species and varieties, many of which are used for important species today (5 % of the European mollusc names are currently attributed to this author). Among these were several polynominal names (*Helix fruticum* var. *albida concolor*, *Helix fruticum* var. *rufescens concolor*, *Clausilia ventricosa* var. *minor interlamellari pliculato*). Nobody has ever proposed to regard this work as not consistently binominal in the nomenclatural sense just because of these few names. These are commonly regarded as mistakes in a binominal work.

5.3 "Used as valid" when proposed

A name must be "used as valid" when proposed. The term "valid" in the ICZN Code is not in accordance with its usual meaning in a standard English dictionary, neither with its use in botany. I do not like to use it, but here it is necessary, it is the expression used in the important Article 11.5 of the ICZN Code.

Its meaning is (Glossary: valid) **used as "the correct name of a taxon in an author's taxonomic judgement"**. This very important regulation means that if a name was just mentioned as a synonym, or if it was simply cited in a pure documentation from another researcher's classification, it was not made available.

In many descriptions or lists of species, the authors cited various **synonyms**, regardless if published or unpublished. Innumerable new names were mentioned in those instances. All these synonyms were not made available at these instances.

This term "valid" must not be misinterpreted. It is not used in the sense that something is officially fixed or officially allowed, something that after an action comes into effect. Here it means that the name was accepted and used as the name for an animal in the classification in one single individual work. In this sense a name is not generally valid, it is only "used as valid" in a certain publication. Or in an internet resource. Or in spoken language.

Example:

I can classify humans as elephants and use a name *Elephas sapiens* as valid right here. Nobody will record it. Nobody will say "this is the current name of the species". Hopefully.

This is only an example to illustrate the idea. This manual is not a paper-based publication, and as such not published work in the sense of zoological nomenclature (Art. 9.8).

It is inappropriate to state "the name is valid" or "is valid as", but rather "the name was used as valid by..." or "currently used as valid as".

Example:

If Zhang 1980 regarded a name as valid, this does not mean that something official has come into effect. It is just that Zhang 1980 regarded it as the correct name for an animal.

Jiménez 2010 can decide to accept Zhang's classification and also use the name as valid in the same genus-species combination, or can publish an independent study and can coincidentally come to the same combination and use it as valid for entirely different reasons, or can use another name as valid. Jiménez 2010 does not need to consider or even know Zhang's 1980 classification. Jiménez 2010 is free in her or his choice to use any name as valid, and again, nothing official comes into effect.

In 2030 the online database provider Beeblebrox should follow one published source for the names to be listed in the database (Zhang 1980 or Jiménez 2010, or another source), but can also use two names for the same species, if this is convenient (for example if databases collect information taken from other databases and do not know that two names refer to the same species). In this case Beeblebrox 2030 would use two names as valid for the same species.

This is no problem. A database provider can have two brains - one name in one brain, and another name for the same species in the other brain.

5.3.1 Names cited in pure documentations of other sources

If a name was only **cited from another source**, for example in a documentation of a previous work, and not really used for a taxon in the author's own classification, it was not made available (Art. 11.5.2).

Names that were only cited from other sources were not made available by having been cited alone, even if descriptions were given and if they had scientific definitions. If they were not accepted and used in the classification of the author who cited the sources, they were not made available.

It happened occasionally that authors cited classifications by pre-Linnean authors, for documenting the history of a group of animals, or for comparisons. Such documentations did not make the pre-Linnean names available.

Example:

Walbaum 1792 cited several previously used classifications of fishes and mentioned in detail many names with descriptions. The taxonomic systems of pp. 579-587 were attributed to Klein, pp. 587-633 to Linnaeus, pp. 633-669 to Gronovius, pp. 669-686 to Bloch etc. The names in those chapters (including that of Linnaeus) were not used in Walbaum's own classification and were not made available.

Müller 1771 cited an unpublished name *Spio cirrata* attributed to König, without using this name explicitly in his own classification (Müller used German names). The name was not made available by Müller 1771.

5.3.2 Alternate names for the same taxon

If an author established two or more names for different taxa, with different types, and later it is found that the two taxa belonged to the same species, then the First Reviser decides which name has precedence (Art. 24.2.2). The problem with First Reviser rulings is that these were not always recorded and even important rulings are still unknown.

Example:

Linnaeus 1758 established *Strix scandiaca* and *Strix noctua* (Aves), for which he gave different descriptions and referred to different types, but both taxa later turned out to refer to the same species, the snowy owl. The two names are subjective synonyms. Lönnberg 1931 acted as First Reviser, cited both names and selected *Strix scandiaca* to have precedence.

For the sperm whale Linnaeus 1758 established three subjective synonyms, *Physeter macrocephalus*, *Physeter catodon* and *Physeter microps*. The First Reviser remains unknown, currently both names *Ph. macrocephalus* and *Ph. catodon* are used.

If **more than one name** was used as the correct name for objectively the same taxon, we have a problematic situation which is not explicitly ruled by the ICZN Code (but covered under the First Reviser Principle in Art. 24.2.2). The term "alternate names" may be used for this constellation.

Usually authors regarded only one name as correct, but sometimes authors proposed two alternate names for a species, the Latin term "**seu**" (= or) was sometimes used in this context.

The Code does not expressly give a restriction how many names can be used for a taxon. The definition for the term "valid" implies the use of only one name for a taxon. The Code does not address directly the situation if an author used two alternative names and regarded both as correct. Art. 24.2.2 rules that if two different names established in the same work are based on the same types (which implies that establishing more than one name for the same taxon in a work is tolerated), the First Reviser shall decide which name should have precedence. Art. 15.1 rules that names proposed conditionally before 1961 may be available. It does not state that the conditions must be defined.

Examples:

Pallas 1781 mentioned a new species as "*Ascaris pollicaris oder besser [= "or better"] acicularis*" (Nematoda). Both names were new and were made available, the First Reviser must have decided which one had precedence.

Forskål 1775 described an actinopterygian fish and proposed the names *Cottus rogam* and *Cottus insidiator*. Both names were used as correct names for the species without stated preference for one. Both were new and made available. The name *C. insidiator* must later have been selected by a First Reviser decision.

If two **alternate names** were mentioned and only one was new, then either a new objective synonym (if the new name had exactly the same name-bearing type) or an independent new name (if more than one name-bearing type was involved) could have been proposed. Both names are regarded as available.

Examples:

Fischer 1778 mentioned a species under the name *Mustela candida seu Ermineum* (Mammalia). *M. candida* was new, *Ermineum* referred to *Mustela erminea* Linnæus 1758 (to which Fischer gave a bibliographical reference). Both were used as correct names by Fischer, *Mustela candida* was new, *M. ermineum* a subsequent use (incorrectly declined) of the Linnean name. *M. candida* was not an objective junior synonym of *M. erminea* because both had different types.

Garsault 1764 gave a figure of a fish and named it "*Clupea seu Alosa*" (Actinopterygii), without specific names included. Garsault used both names as correct, and treated both names as valid. The name *Clupea* Linnæus 1758 had a different type species, so the name *Alosa* became available for Garsault's fish. Today the name is used as *Alosa* Garsault, 1764.

5.3.3 Unclear and conditional classifications

Unclear generic classification in the original source happened occasionally when an author applied several concepts in the same work. Usually this is not taken to regard a specific name as unavailable, but the Code does not rule which genus should be taken in such a case.

Example:

Swainson 1840 established *corrugata* Swainson 1840 (Bivalvia), classified on p. 268 in the genus *Unio*, on p. 281 in *Potomida* and on p. 379 in *Mysca*. Usually *Unio* is accepted.

Unclear classification between species and subspecies occurred in some publications. This has no influence on the availability for such a species-group name. The Code has no solution.

Example:

Hartmann 1840 established *polita* Hartmann 1840 (Gastropoda), classified as *Truncatella (Pupula) polita* on Tab. 2, and as *Truncatella (Pupula) acicularis polita* on p. 5. The name is currently used as *Platyla polita* (Hartmann 1840) without problems.

If a name was proposed conditionally before 1961, it is regarded to have been used as valid (Art. 11.5.1).

Examples:

Rossmässler 1834 mentioned two names *Helix lucernalis* and *Helix claustralis* (Gastropoda), gave descriptions and a statement that both should probably be classified as varieties of *Helix carthusianella* Draparnaud 1801. The names were made available.

Ortiz de Zárate y López 1949 established correctly a new genus *Mengoana* (Gastropoda), explaining that this name could be used as a subgenus for a given species. The name was made available.

Question marks are ignored in descriptions of new names (Art. 5.3).

Examples:

Paramastus goettingi Forcart 1961 (Gastropoda), originally established as *Paramastus? goettingi*.

Dysidea papillosa Johnston 1842 (Porifera), originally established as *Dysidea? papillosa*.

Hiltrudia globulosa Subai 2009 (Gastropoda), originally established as *Hiltrudia (?) globulosa*.

5.4 Was the name new when proposed?

A name is only available if it was new when proposed. It is not always easy to see that, because prior to 2000 it was not required to give an intentional statement that the name was meant to be new (spec. nov., n. sp., nov. gen.). This means that at any time when a name was mentioned and combined with a description, figure or reference it could have been new.

Any used name that had a description and was not previously established, was new.

If the author proposed a new name *P. glabra* with description and expressed that this should refer to *guttata* of a previous publication, without statement that *guttata* should be replaced for nomenclatural reasons, then the name *P. glabra* was established a simple new name. It is not an objective synonym of *P. guttata*, unless it is established that both names have one and the same name-bearing type.

The Code gives **no clear guide how to distinguish a new name *P. glabra* from an already established name *P. glabra***. This is a gap in the ICZN Code. It is more or less commonly agreed that a name is considered as new if it referred to a visibly different animal, and the author gave no indication of being aware that the name had already been used. A rest of a definition is given in the Code's Glossary "name, valid name": the oldest potentially valid name of a name-bearing type which falls within an author's concept of the taxon. This means that the author's subjective concept must be judged on personal experience. If *P. glabra* was used for a green frog and a previous author used it for a blue frog, the first name might not fall in the second author's concept. But if the second author knew that the colour in this frog genus was variable, then possibly yes.

If nothing indicates that the author knew that the name *P. glabra* was already established, but in fact it had already been established for the same species, then such a name is not regarded to have been established as new. This is only a subsequent use.

Technically it could be a new name, based on new types and independently established, but this is usually not recognized if it is clear that the same species was meant.

Most taxonomists in most disciplines seem to accept that it is not necessary that the author who used a name must have known its first original source. Most authors did or do not know the first original source. Many names were taken from Latin vernacular names, others from collection labels, most names were just used because authors knew them from somewhere.

The difference between a new name and a subsequent use is nowhere defined, but it seems that a usage of a name is considered a subsequent use if the second author, who did not know the first use, would have used the same name if he or she had known in which taxonomic sense it had been established by the first author.

Example:

Garsault 1764 established a name *Anguilla* (Actinopterygii), derived from the Latin vernacular name for the eel. Schrank 1798 also used a name *Anguilla* for the same animal, but it is clear that Schrank did not know Garsault's publication. Nonetheless Schrank used Garsault's 1764 name because the two referred to the same animal.

The limit is fluent and it may also depend on the community's subsequent interpretation of such a case. If two species were independently described, and their names were based on label data of collection material, but the authors did not use the same material, then we might deal with homonymous synonyms.

Examples:

In a work published by Strobel in 1853 a gastropod name *Helix villa* was established by Mortillet with a very short description and a locality. Pfeiffer 1856 also used Mortillet's name, spelled it *Helix villae* and gave a different description and locality. It seems that Mortillet had given different specimens to Pfeiffer. The community assumed later that if Pfeiffer 1856 had compared the shells he would probably have realized that two species were involved. However in 1859, when Pfeiffer finally had consulted the 1853 paper, he still cited *Helix villa* and *Helix villae* as synonyms. Strictly taken the 1856 use of the name should be regarded as a subsequent use and incorrect subsequent spelling of the 1853 name, but shortly after it became clear that the taxa were not conspecific and the community regarded them as different names.

Using a wrong name for a species does not imply establishing a new name. If we come to the conclusion today that the author misidentified a species, and in our view used a wrong name, this has no influence. The author used the previously established name, regardless of the correct identification. This is only a subsequent use of a name.

Example:

Deshayes 1835 established *Clausilia maculosa* (Gastropoda). Küster 1852 misinterpreted the name and used it for another species. Küster 1852 did not establish a new name, although Roth 1856 and Boettger 1878 used the name in Küster's sense and did not know that Deshayes had established it for a different species. It is commonly accepted that Küster, Roth and Boettger should have consulted the original types.

Sometimes authors misused a previously established name for a misidentified species, and subsequent authors did the same. Then it can be useful to record this misidentification. Here we come to *sensu* names and new names established by deliberate misidentifications.

5.4.1 *Sensu* names

If an author used a previously established name and attributed it (in the judgement subsequent authors) to a different species, this is only a misidentification and technically only a subsequent use of a name. It is possible that all other subsequent authors have used the name in the incorrect sense, because nobody had examined the types. Usually the term **sensu** is used for this phenomenon, meaning "in the sense of" a cited author who first used it in the wrong sense. These names are no new names, they just represent a subsequent use of previously established names (Art. 49).

Example:

Küster 1852 misinterpreted the name *Clausilia maculosa* Deshayes 1835 (Gastropoda) and used it for a different species. Roth 1856 and Boettger 1878 used the name in Küster's sense: *Clausilia maculosa sensu Küster 1852*.

If the original name was misspelled at the occasion where the taxon was for the first time misidentified, the situation remains the same. It is to be interpreted as an incorrect subsequent spelling and as such, only a subsequent use of the name, and unavailable (Art. 49).

Example:

Alix & Bouvier 1877 established *Gorilla mayema* for a form of the western gorilla from the present-day Republic of Congo. Rothschild 1908 used this name for another species, the eastern lowland gorilla, from the eastern parts of the present-day Democratic Republic of Congo, and misspelled it *Gorilla manyema*. In subsequent sources this name was occasionally used for the eastern lowland gorilla as *Gorilla manyema* Rothschild 1908, but *Gorilla manyema sensu Rothschild 1908* was not available because it was only a subsequent use and a misspelling of the name established by Alix & Bouvier 1877. The correct name of the Eastern lowland gorilla must be *Gorilla beringei graueri* Matschie 1914.

The narrow distance to the limit has been shown above in the *Helix villae* example, where a subsequent misspelling was interpreted by the community as a new name for a different taxon. The gorilla example differs

in that Rothschild demonstrably knew the previously established name, while in the *Helix* example Pfeiffer had not known it. This opened a slightly broader frame of tolerance.

In some cases these misidentifications have been adopted by many authors and maintained for long time. Taxonomists created unwritten priority rules for *sensu* names, to record the responsible source for all the incorrect usages. The most recent approach is to use the term *secundum* (*sec.*) to attribute the usage of a name to a major revision (it usually remains undefined how such a major revision should be distinguished from a moderate or minor revision or a regular use of such a name). Usually these names are simply replaced by others when the misidentification is discovered, in a few cases the Commission is asked to conserve current usage. Sometimes *sensu* names are involved in difficult nomenclatural problems.

Example:

Hartmann 1841 classified a species *Pupa ferrari* Porro 1838 in the genus *Sphyradium* Charpentier 1837 (Gastropoda). Westerlund 1887 argued that *Pupa ferrari* should belong to a different genus, and proposed a new name *Coryna* that contained *Pupa ferrari* and other species. Pilsbry 1922-1926 regarded *Coryna* as a new replacement name for *Sphyradium* Hartmann 1841 **non** Charpentier 1837. This is not tenable today, Pilsbry referred to *Sphyradium* Charpentier 1837 **sensu** Hartmann 1841. Hartmann 1841 just used Charpentier's 1837 name. This means that *Coryna* was not a new replacement name because it did not replace an available name (a *sensu* name is not an available name).

5.4.2 Deliberate misidentifications

This is a rare case, in which a misidentified species (a *sensu* name) is taken as the type species for a new genus (or subgenus). This species obtains author and year of the source where the new genus was established, not of the first author who had misused the *sensu* name (Art. 67.13, Art. 49).

Examples:

Leach 1817 took a species misidentified (by Geoffroy 1785 and others) as *Notonecta minutissima* Linnæus 1758 (Heteroptera) as the type species (*N. minutissima sensu* Geoffroy 1785 non Linnæus 1758) for *Plea* Leach 1817. The name of this species is ***Plea minutissima*** Leach 1817.

Ortiz de Zárate y López 1949 took a species misidentified (by Kobelt 1878) as *Helix brigantina* Da Silva Mengo 1867 (Gastropoda) as type species for a new subgenus *Mengoana* Ortiz de Zárate y López 1949, and suspected that the specific name was misinterpreted by Kobelt. *Helix brigantina sensu* Kobelt 1878 was made available as ***Mengoana brigantina*** Ortiz de Zárate y López 1949.

5.5 The frame within which a name can be spelled

Any available name must have been published in **Latin script** (Art. 11.2). This excludes Greek, Russian, Arabic or Chinese script. Special characters (ligatures, diacritic marks) are allowed, but must be corrected (Art. 32.5). The whole text can be entirely in Chinese script, including the names of the authors, but the name of the new taxon must be spelled in Latin script.

A generic or specific name must have at least **two letters** (Art. 11.8, 11.9). Names with only one letter are not allowed.

Examples:

Phalaena w mentioned by Röttemburg 1776 (Lepidoptera) is not available.

Trichoda s mentioned by Müller 1776 (Ciliata) is not available.

A zoological name may come **from any language** or can even be a fantasy name. The only requirement is that it must be a word (Art. 11.8, 11.9). The term "word" remains undefined in the Code, but common consensus is that this includes personal names, not only words found in dictionaries.

Many names are based on Latin and Greek, but this is just a tradition. Names derived from Tibetan, Arabic, Italian or Quechua are also allowed, mixtures of any kind (Art. 11.3).

In the early 1800s French authors used a system of French scientific names and regarded them as equivalent with Latin names. They often mixed up both systems and a list of species could contain a few French scientific names and a few Latin names.

Example:

Férussac 1814 mentioned three genera on p. 56 *Septaria*, *Helicina*, *Cyclostome*. The first two names were Latin, the third was the French equivalent of *Cyclostoma*. On p. 74 two species were mentioned as *Hélix pomatia* and *Hélix ambré*. *Hélix* was the French scientific name for the gastropod genus *Helix* (the French vernacular name was *hélice*), *pomatia* was a Latin scientific name, *ambré* a French name.

This problem is not directly addressed in the Code, but it seems to be commonly accepted that such French scientific names are not regarded as Linnean scientific names in the sense of modern zoological nomenclature, and that they cannot be treated as equivalent.

Often genera were first proposed in a French version, but these genera are not regarded as having been made available at these occasions. It is necessary to look for a publication where such a generic name was coincidentally mentioned in its Latin form, and take the authorship for the name from there.

Numerals are only allowed in a small frame of compound names, and must then be written as Latin words (Art. 1.2, 32.5.2.6).

A name *cbadfg* is not allowed, this is not a word in the sense of the ICZN Code (Art. 11.3). The Code does not explain why, but *bmnhi* is probably in line with *cbadfg*. Occasionally this is disputed because BMNH is an acronym.

Acronyms are names by definition (the Greek term translates literally "marginal peak / name") and seem to be generally regarded as words, but availability under the Code seems to depend on their pronunciation (this argument is often disputed because the Code does not give a statement that a word must be pronounced as such in some language). While NASA is euphonious and nobody would probably reject a name *nasa* for not being a word, this could not be done in any language with BMNH or MNHN. Language specific properties interfere when acronyms like ANSP or FBI should be evaluated under these criteria. The acronym CIA is not pronounced as a word in English and German, but in Spanish it is pronounced like a word "cía" (= "seeya" in South America, "theyya" in Spain).

In some cases the traditionally wide tolerance in zoology has been stretched, but these names are still accepted, at least by some taxonomists. It can certainly not be recommended to form such names.

Some of the worst examples:

Lainodon oruetxebarriai Gheerbrant & Astibia 1994 (Mammalia)

Apolysis zzyzxis Evenhuis 1985 (Diptera)

Theope archimedes zzyzxyx D'Abrera 1994 (Lepidoptera)

Zzyzxyx Pate 1937 (Hymenoptera)

Zzyzzyus Stechow 1921 (Cnidaria)

Speovelia aaa Gagne 1975 (Hemiptera)

Brachinus aabaaba Erwin 1970 (Coleoptera)

Prolasioptera aeschynanthusperottetii Mani 1943 (Diptera)

Virpazaria aspectulabeatidis Reischütz, Reischütz & Subai 2009 (Gastropoda)

Tetrastichus rhipophorathripicidis Narayanan, Subba Rao & Ramachandra Rao 1962 (Hymenoptera)

Some names were officially invalidated by the Commission for not being in accordance with the purpose of communication (actually not the names but the whole paper was suppressed in ICZN Opinion 105).

Examples:

Crassocornoechinogammarus crassicornis Dybowski, 1927 (Crustacea)

Gammaracanthuskytodermogammarus loricatobaicalensis Dybowski 1927 (Crustacea)

Siemienkiewicziechinogammarus siemienkiewitschii Dybowski 1927 (Crustacea)

Ambiguous abbreviations are problematic. A generic name must not be abbreviated when proposed. In specific names the tolerance is higher, especially when only the ending is truncated it is allowed to correct this (Art. 32.5.2).

Examples:

Hartmann 1821: 57 mentioned a new generic name abbreviated as *Lithoglyp*. (Gastropoda). The abbreviation was ambiguous and a generic name *Lithoglypter*, *Lithoglyphus* or *Lithoglypus* was not made available by Hartmann 1821.

Linnaeus 1758: 70 introduced a name for a taxon below the species level *Ovis aries polycerat*. (Mammalia). The abbreviation was not ambiguous and should be corrected to *polyceratus*.

If originally given in the genitive case in Latin texts, or in the plural, the name must be converted to the nominative case singular (Art. 11.8.1, 11.9.2, 32.5.2.7). This happened rarely. In these cases it is necessary to know how to form a nominative noun in Latin.

Examples:

Cercopithecus Linnaeus 1758 (Mammalia) was originally established in a Latin text in the plural as *Cercopitheci*.

Diptoxa Lowe 1863 (Diptera) was originally established in a Latin text in the genitive case as *Diptoxae*.

Argus Bohadsch 1671 (Gastropoda) was originally established in a Latin text in several cases as *Argo*, *Argi*, *Argam* and *Argus*.

Musca pavidam Illiger 1807 (Diptera) was originally established in a Latin text in the accusative case as *Pavidam*.

A generic name is generally easy to handle, it can be any pronounceable combination of letters, the only problem is its gender (see the gender chapter, this has no influence on availability).

A specific name (the second part in a genus-species combination) is more complicated. There are rules how to form correct Latin names. I would recommend to follow these rules, but I would also recommend not to take them too seriously.

Almost no zoologist is sufficiently skilled in Postclassical Latin today, so the ICZN Code (Art. 11.9.1, Art. 31.1) explains a little about Latin names. Latin names are either

adjectives (*esculentus*, *marmorata*, *cretensis*, *ater*, *minor*, *viridis*, *vibrans*, *caerulans*, *canescens*), or

nouns in apposition (*camelus*, *diana*, *umbilicus*), or

nouns or adjectival substantives **in the genitive case** (*rosae*, *osbeckii*, *oscari*, *oshanovae*, *ovulorum*, *thermopylarum*, *lusci*).

This is only interesting for the gender agreement, for which this manual has a special chapter. **Only adjectives (this shall include participles here) must eventually be changed** when they are combined with another genus,

all the other Latin words not. For the user only "changeable" (variable, declinable) or "unchangeable" (invariable, undeclinable) is interesting. There are adjectives which are not changed (*vibrans*, *caerulans*, *canescens*), these behave like the nouns.

In doubtful cases they are to be treated as nouns (Art. 31.2.2). This is an important point why it is not possible to tell a computer to do reliably the gender agreement for you.

Example:

The specific name in *Pupa umbilicus* Roth, 1839 (Gastropoda) can be a noun or an adjective (meaning umbilicus or umbilicated). Roth did not specify it, so it is a noun.

A name that does not fit in the frame proposed by the ICZN Code should be treated like an arbitrary combination of letters.

Example:

A specific name *gradatim* would not fit in the concept that a Latin name must either be an adjective or a noun. The name *gradatim* means "step-by-step" and is a Latin adverb, a rare case that was overlooked in the ICZN Code. Treating as a noun is most convenient.

Some taxonomists regard all names as arbitrary combinations of letters, especially those who are against the application of gender agreement in zoology.

5.6 Special requirements for availability

5.6.1 Requirements for genera

I avoid using the ICZN Code's term "genus-group names" here, this insider term is not widely understood. I will use the terms "genus", "generic name" or "genus and subgenus", in all cases this shall also include subgenera and infrasubgeneric names.

If a name was established as a subgenus or an infrasubgeneric name (secondary or further subdivision), it is available in the same way as if it was established as a genus (Art. 10.4), with the same author and date, and the same rules apply (Art. 42.1).

The term "specific name" represents the second name in a genus-species combination.

A new genus must either have a **description** (Art. 12.1, 12.2.6) or a **bibliographical reference to a description** (Art. 12.2.1, this is rare in genera), or must have been combined with an **available name of a species** (Art. 12.2.5) An **illustration** is a description in the sense of these provisions (Art. 12.2.7).

To determine the identity of the generic name, a combination with an available specific name is superior to a description. In other words, for a genus that was combined with an available specific name, a description or figure is mostly useless. A description does not need to be accurate or correct. In some special cases the figure, description or locality may indicate that the type species was misidentified. In such cases the description is important, but generally the names of the included species are primarily superior. **The identity of a genus is only defined by its type species**, which can only be selected among the originally contained species (Art. 67.2).

If no species was originally included, it is commonly accepted (but not explicitly ruled in the Code) that the generic name can only be used for a group of species that is in accordance with the original description or figure.

Example:

Garsault 1764 established a mammalian generic name *Leo* without included species, and based it only on a figure of a male lion. Only a specific name established for the lion (*Felis leo* Linnæus 1758 or one of its synonyms) can be selected as type species for *Leo* Garsault 1764.

Combination with a specific name that is a **nomen nudum** (a name mentioned without description or anything) is not sufficient. In such a case, if there is no description or figure, also the generic name is a nomen nudum.

5.6.2 Requirements for species

I avoid using the ICZN Code's term "species-group names" here, this is a manual written to be understood by a wide audience, and not a law text for insiders.

I use the terms "species", "specific name" or "species and subspecies", this shall also include subspecies, infrasubspecific names, varieties, forms and other names of this kind. In the Code the term "**specific name**" is used to denote the second name in a genus-species combination (some use the term "**epithet**" for it, this is officially outdated in zoology since 1961), while "species name" and "name of a species" denote both names of the genus-species combination.

If a specific name was established as a **subspecies**, or in old literature as a variety, almost the same rules apply as for species.

For nomenclatural purposes it is not always necessary to mention the name of the species in which the subspecies was originally classified. It is necessary to record the species if the same subspecific name was established in various different species.

Examples:

Westerlund 1894 established the gastropod variety *Clausilia (Albinaria) cytherae* var. *petronella*. This name is nomenclaturally treated as if it had been established as *Clausilia petronella*, there is no difference. Only the new name and the original genus are interesting.

Zonites verticillus var. *graeca* Kobelt, 1876 and *Zonites albanicus* var. *graeca* Kobelt, 1876 (Gastropoda) were established in the same work. It is necessary to disambiguate the two names, by citing the entire genus-species-subspecies combination. Both names are treated as if they were established as *Zonites graeca*, by First Reviser decision *Zonites verticillus* var. *graeca* has precedence.

Möllendorff 1873 established names for two different gastropods in the same paper *Clausilia serbica* and *Clausilia fallax* var. *serbica*. The name for the species has precedence, the name for the variety cannot be used (Art. 24.1, 57.7).

Boettger 1889 established a gastropod name *Clausilia proteus* for a species from Greece. Independently and at the same date another Retowski author established *Clausilia corpulenta* var. *proteus* for a variety of a different species from eastern Turkey. The name for the species has precedence, the name for the variety cannot be used (Art. 24.1, 57.7).

In contrast to the rules for genera, **infrasubspecific names** (below subspecies) are usually not available (Art. 10.2, 45.5). There are only few exceptions for names used before 1961 as names for taxa in current classifications (Art. 45.6.4.1).

Must be combined with a genus. The generic classification can also be tentative, published with doubts and marked with "?", but it must be the one and only one associated with the species. The name of the genus can also be implicit, or abbreviated ("P."), or mentioned somewhere else in the same paper, but it must be unambiguous (in the original source itself, without the need to consult secondary sources) (Art. 11.9.3). A specific name published without a genus is not available.

Examples:

Herbst 1783 gave descriptions for several coleopteran species for which he stated that he was not able to give an appropriate genus in the system (*litophilus*, *melinus*, *cimeterius*, *bipustulatus* and others). These specific names are not available.

Schaller 1785 published an article entitled "Beyräge zur Geschichte exotischer Papilions.". In this article two species "*Marcus*" and "*Phaenareta*" were described, without the genus *Papilio* being mentioned (Lepidoptera). The ICZN Code does not give a guide, but the names are regarded as available and established in the genus *Papilio*, this was implicit and clear from the title of the article (currently used as *Morpho marcus* (Schaller, 1785) and *Euploea phaenareta* (Schaller, 1785)).

Kühn 1774 mentioned two butterfly names *lycaon* and *tiphon*. At this time the only possible genus for a butterfly in the Linnean binominal system was *Papilio*. But this can only be derived from secondary sources, the name *Papilio* was not mentioned in the work itself. The two names were not made available by Kühn 1774.

In some very chaotic and carelessly redacted works authors used one genus for a species at one instance, and a few pages later placed the same species in a different genus. This is usually regarded as in agreement with the rules, Art. 11.9.3.6 suggests that such a procedure can be tolerated in such rare and exceptional cases.

Example:

Swainson 1840 (A treatise on malacology) presented a new bivalve species *corrugata* in the genus *Unio* on p. 268, in the genus *Potomida* on p. 281 and in the genus *Mysca* on p. 379.

Must be published with a description or indication (Art. 11, 12) of the taxon "that it denotes".

Presence of a **description** is one of the hearts of zoological nomenclature. This can either be given directly in the work where the name was established, or in a previous work with a bibliographical reference. **An illustration is a description** in this sense. Shortly said, a name for a new species has either a description, or an illustration, or a problem.

The term **indication** is an insider term used in the Code and is defined by a variety of conditions. The term "definition" used in Art. 12.1 is not necessary and could be removed, a definition is only a special kind of description.

Generally: The ICZN Code gives no statement about the quality of a description. This is natural, because correctness and accurateness cannot be objectively defined. A description does not need to be accurate, it does not need to be correct. A description is just a formal requirement.

Illustrations behave like descriptions: The quality of the image does not count, it does not need to show any diagnostic characters (or characters that will later show up to have been diagnostic).

When verifying availability of a name, it is usually not necessary to understand the text of the description. This can be in Latin, Serbian or Japanese. It is just necessary to understand that there is a text referring only to the taxon denoted by the new name, presenting at least one descriptive element that meets the formal requirement.

If the author used the same description for two species in the same genus, the description did not refer only to the new taxon and did not make a name available (because this description referred to a larger group of several species). If a new genus was presented with a description and 3 new species without description, only the genus was made available.

Example:

Künkel 1908 studied the behaviour of terrestrial gastropods of the genus *Arion*, compared the behaviour of several species and mentioned a new name *Arion simrothi*. Künkel gave several characters for *A. simrothi*, but reported the same character states also for *A. subfuscus* (Draparnaud 1805). Künkel did not give an individual description for *A. simrothi* (effectively he gave a description for a group that contained both species) so this name was not made available at this occasion.

A **vernacular name** does not count (Art. 12.3). It must not be interpreted as a description.

If only a **host** plant or host animal was given, this does not constitute a description (Art. 12.3).

A **locality** is not a description (Art. 12.3). Combining vernacular name, host plant and locality does not improve the situation.

Examples:

Linnæus 1758 mentioned a name *Aphis craccae* (Sternorrhyncha) on p. 452 and gave no description, only a host plant *Vicia cracca*. The name was not made available at this occasion. Linnæus 1761 listed the same species and added a short description, making the name available as *Aphis craccae* Linnæus, 1761.

[Denis & Schiffermüller] 1775 listed *Phalaena (Geometra) secundaria* (Lepidoptera) on p. 101, without description, only the German name Weißtannenspanner was given, indicating that Weißtanne (= *Abies alba*) was its host plant. The name *Phalaena secundaria* was not made available at this occasion.

[Denis & Schiffermüller] 1775 listed *Phalaena (Noctua) asteris* (Lepidoptera) on p. 312 without description, only the German name Sternblum-Eule was given, and a note that the species was from Saxonia. Sternblume (literally translated star flower, perhaps *Astrantia major*) indicated the host plant. The name *Phalaena asteris* was not made available at this occasion.

Many taxonomists did not know these rules and used the names for taxa.

Examples:

Peribatodes secundaria (Denis & Schiffermüller, 1775), *Cucullia asteris* (Denis & Schiffermüller, 1775) and many other currently used names.

It makes no sense not to use them. The usual procedure is either to look for the next publication in which the name was correctly made available, or to ask the Commission for a ruling (for example the Commission could take a decision that all the 2-300 names established in this form by [Denis & Schiffermüller] 1775 could by definition be regarded as available).

The scientific **name as such** does not count. It is allowed to select an inappropriate name (Art. 18).

Example:

Having selected the adjectival name *G. rubrofasciata* alone is not a description, although it means "with red streaks".

Before 1931: mentioning one single character state is sufficient. Illustrations are descriptions.

After 1930: the description must be distinctive, it must state in words characters that are purported to differentiate the taxon (Art. 13.1). This means a species must have been compared with other species (differential diagnosis). An illustration alone is not allowed after 1930.

Descriptions can be extremely short, but something must refer to the animal itself. It should make clear that the author knew at least a little about the animal, and did not only copy a name from a list of names. A description comprises usually morphological characters of an animal, but this is not a requirement. Specific properties in the behaviour of the animals are also regarded as descriptive elements, but this has limits. For birds it is certainly not sufficient that they migrate in September, but the exact duration and mode of copulation of a slug can be of crucial importance for a useful description.

Examples for very short descriptions:

Bigger (in Latin "major"); black ("nigra"); 12 mm long; bigger wings; fish tastes good.

A **locality** alone is not accepted (Art. 12.3), although an accurate locality would be much better for many locally distributed animals than a short description. The same applies to speech bubbles and texts without real scientific content. Only in some rare cases the limit is difficult to define.

Examples for unaccepted descriptions:

"Present in Suriname"; "can be seen in autumn"; "occurs only in the Wenlockian geological horizon"; "beautiful"; "resembles very much species B and C"; "size like in species B of the same genus"; "colour differs from species B"; "can be distinguished very easily from species B by its very well recognisable morphological characters".

Very difficult to decide but probably unavailable: "size ranges at the lower margin of that of species B".

Is a description based only on **differential DNA** allowed?

Theoretically yes, given that those exact character states are described which allow to distinguish the taxon from other taxa. Usually this is not done. Calculation programs consider numerous character states of DNA sequences and finally come up with a result. Results are usually given in form of molecular distances, and groups are lumped and separated according to these distances. This would be equivalent to a description in the form of "colour differs very much from species B", which does not meet the requirements. The exact character states (the different DNA sequences) in the sense of the Code which allow to differentiate two taxa are usually not given in this procedure.

Examples for unaccepted descriptions:

Differs from species B by differential DNA; molecular distance so large from species B that it must be considered a different species.

Sometimes there are sibling species without morphological or other differences, and reproductive isolation is strongly suggested by molecular studies. In such cases it is possible that the community would accept a new name based on DNA evidence, but the usual way is to look closer at the new species and to find some

diagnosable characters between two reproductively isolated units. It also happens that clade analyses result in new genera and the morphological understanding and knowledge of the involved groups is so low that scientists prefer establishing new genera on the base of their molecular studies. Bioscientifically there is no need to give a description for a genus, which is defined by its type species.

Example:

Catascopia Meier-Brook & Bargaes, 2002 (Gastropoda) was claimed to differ from *Stagnicola* only in having 444-449 base pairs in the rDNA ITS-2 sequence, instead of 468-484 base pairs, no morphological differences were found.

A bibliographic reference can also include a pre-Linnean or non-binominal work. In early zoological literature many references were given. Many species were established on the base of literature references alone.

Examples:

Aphis rosae Linnæus 1758 (Sternorrhyncha) was established with a host plant (*Rosa*), no description, and a reference to "Reaum. ins. 3. t. 21. f. 1-4." (= Réaumur 1737). The name was only made available by the bibliographic reference which contained an illustration.

Planorbis anceps Menke 1830 (Gastropoda) was established without description, but with a reference to "Lister Conch. tab. 139 fig. 44" (= Lister 1686). The name was made available by the bibliographic reference which contained an illustration.

The literature reference must have been published at the time when it was cited. Otherwise the name is not available. This surprise can happen when you verify a name, because in the past other standards were applied for publication dates. Sherborn's Index Animalium (1902/1922) seems to have regarded such names as available.

Example:

Fueßlin 1775 mentioned a new name *Curculio cordiger* (Coleoptera) with a vernacular German name, the statement that the species was rare in Switzerland, and a reference to a figure on a plate of another work by Sulzer (Sulz. Geschichte t. 4. f. 11), which Fueßlin had seen as a manuscript prior to publication.

Sherborn's Index Animalium (1902) regarded Fueßlin's name as available. But this was incorrect. Sulzer's plate appeared in 1776, it was not published when Fueßlin referred to it. The German vernacular name does not count, "rare in Switzerland" is no description. Thus the name was not made available by Fueßlin, and Sherborn's entry is not up to date with current nomenclature. *Curculio cordiger* as published by Fueßlin 1775 was a nomen nudum.

A reference to another taxonomic name, if published or not, is not an indication under Art. 12.2. Such a reference alone does not make a name available, except there is an expressed statement indicating a new replacement name (nom. nov.). In published catalogues containing pure lists of species this can be a problem.

Example:

Menke 1828 presented a long list of mollusc species present in a museum collection. The new name *Helix obvia* was used for a species and attached to a name mentioned as "*Helix neglecta* Hartmann", nothing more. Although it was clear what was meant, *Helix obvia* was not made available at this occasion.

A description is only necessary for the taxon, but not necessarily for the nominal taxon (Art. 12.1). A taxon encompasses all included taxa of lower rank, which means that if descriptions for **subordinate variants** were given, the new name had a description also in those cases where the "pure" name (nominal taxon) as such was not equipped with a description. But this view can be disputed, the Code's definitions for "taxon", "nominal taxon" and its usage, meaning and spirit in Art. 12.1 are not clear. Availability is not a problem, but we have a problem with the types to be selected for the "pure" names (subordinate variants have their own types, Art. 72.4.1).

Examples:

Helix draparnaldi Beck 1837 (Gastropoda, currently *Oxychilus draparnaldi*) was established with two subordinate variants a.gallica and b.italica, which had descriptions, but the main form (the nominal taxon *H. draparnaldi*) did not have a description. Since the subordinate variants had descriptions, the taxon *draparnaldi* (comprising the variants a.gallica and b.italica) was equipped with sufficient descriptions and was made available at this occasion.

Helix lenticula Férussac 1821 (currently *Caracollina lenticula*) was established with a description that referred only to a subordinate variant α , but with none for the main form (the nominal taxon *H. lenticula*). Since the taxon *H. lenticula* was equipped with a description for its subordinate variant α , the name *H. lenticula* was made available at this occasion.

6. Can the name be used?

Sometimes a name was correctly established and made available, but it cannot be used as a name for a taxon. These are homonyms, synonyms, names rejected under Art. 23.9 and names suppressed by the Commission.

6.1 Available names which cannot be used

6.1.1 Homonyms

Homonyms are names with identical spellings of the genus or genus-species combination. Homonyms are available names. Junior homonyms cannot be used, but they are available. Only the oldest homonym can be used for a name.

6.1.1.1 Generic homonyms

Genera can either be homonyms or not. This is easy. A one-letter difference is not tolerated (Art. 56.2).

Examples:

Argus Bohadsch 1761 (Gastropoda) (was made available for homonymy by ICZN in Opinion 429, Bohadsch 1761 was non-binominal)

Argus Scopoli 1763 (Lepidoptera: Lycaenidae: Polyommatainae)

Argus Scopoli 1777 (Lepidoptera: Nymphalidae: Satyrinae)

Argus Poli 1791 (Bivalvia)

Argus Temminck 1807 (Aves)

Argus Lamarck 1817 (Lepidoptera: Hesperidae)

Argus Walckenaer 1836 (Araneae)

Argus Gerhard 1850 (Lepidoptera: Lycaenidae: Theclinae)

Not homonyms of *Argus* are *Argua* Walker 1863 (Lepidoptera), *Argusa* Kelham 1888 (Aves), *Argusina* Hebard 1927 (Dermaptera),

Argus Hong 1983 (Diptera), *Argas* Latreille 1795 (Araneae), *Argulus* Müller 1785 (Crustacea).

Not homonyms are: *Isomya* Cutler & Cutler 1985 (Sipunculida), *Isomyia* Walker 1859 (Diptera).

Not homonyms are: *Adelomya* Mulsant & Verreaux 1866 (Aves), *Adelomyia* Bonaparte 1854 (Aves), *Adelomys* Gervais 1853 (Mammalia),

Adolomys Shevryeva 1989 (Mammalia), *Adulomya* Kuroda 1931 (Bivalvia).

6.1.1.2 Specific homonyms

In species there is a difference between primary and secondary homonyms (Art. 57). There can also be double homonyms (same genus and species, Art. 57.8.1). A slight difference in spelling is tolerated if Art. 58 applies.

Primary homonyms are those which have the same genus and the same species in their original combination (Art. 57.2). The difference between a primary junior homonym and a subsequent use of a name is undefined, but it is commonly accepted that if the name referred to another species or form, and if there is in addition no evidence the author knew that the name was previously used, it is considered as a junior homonym.

Example:

Drury 1773 established *Cerambyx maculatus* (Coleoptera) for a species from Jamaica. **Fueßlin 1775** established *Cerambyx maculatus* for a different species from Switzerland, and did not refer to Drury's name. Fueßlin's name is considered a junior primary homonym.

Primary homonyms were established frequently if genera contained many many species, and the specific names were very commonly used Latin adjectives. It happened that the same name was established over and over again for always different species, often by scientists from different countries.

Example:

Scopoli 1763 established *Curculio fasciatus* (Coleoptera) for a species from Slovenia. **Strøm 1768** established *Curculio fasciatus* for another species from Norway. **De Geer 1775** established *Curculio fasciatus* for a 3rd species from Sweden. **Müller 1776** established *Curculio fasciatus* for a 4th species from Denmark. **Fourcroy 1785** established *Curculio fasciatus* for a 5th species from France. **Olivier 1790** established *Curculio fasciatus* for a 6th species from France. **Marsham 1802** established *Curculio fasciatus* for a 7th species from Britain. All these names had descriptions which made clear that different species were meant, and that their authors had not known that the name had been established by a previous author. The name can only be used for the Slovenian species.

Secondary homonyms can be produced if taxa with the same specific name but different original genus are later classified in the same genus (Art. 57.3, 59). This happens when the same specific names were established in very closely related genera, which were later lumped. It is a special problem if authors work within a small restricted animal group and employ over and over again the same specific names for all their new species in very closely related genera.

Example:

Townsend 1891 established *Frontina acroglossoides* (Diptera). In a closely related genus Townsend 1926 established *Eophrissopolia acroglossoides* for another species. Later the genera were lumped and both species were placed in the genus *Chaetogaedia*. Both specific

names *acroglossoides* became secondary homonyms, only the 1891 name could be used, and the 1926 taxon needed a different name. Otherwise there would have been two *Chaetogaedia acroglossoides*.

A secondary homonym is only a temporary state, it is only effective in this classification. In another classification the secondary homonymy may not be produced, and the involved name **can be used again** (Art. 59.1). A name does not become unavailable or unusable if it was once in the course of history placed by some author in such a genus where it produced a secondary homonymy with another name (some taxonomists work with Art. 59.3, see below).

This is one of the rare cases where a zoological species does not have a stable specific name and a unique species-author-year combination, it can have two names at the same time.

Example:

Nunneley 1837 established *Limax maculatus* (Gastropoda), Wiktor 2001 classified it as a junior synonym of *Limax* (*Limax*) *maximus* Linnæus 1758 from S and W Europe. In a closely related genus Kaleniczenko 1851 established *Krynickillus maculatus* for a different species from Ukraine. Wiktor 2001 classified both *Limax maximus* Linnæus 1758 and *Krynickillus maculatus* Kaleniczenko 1851 in the genus *Limax*. This means that *L. maculatus* Nunneley 1837 and *K. maculatus* Kaleniczenko 1851 were classified in the same genus, so both names were secondary homonyms in the genus *Limax*, and the younger name (from 1851) could not be used for the Ukrainian species.

This made it necessary to look for another name to replace Kaleniczenko's name and to look for the next younger available name that could be used for the Ukrainian species. This was *Limax ecarinatus* Boettger 1881, a junior synonym of *K. maculatus* Kaleniczenko 1851. Normally a junior synonym cannot be used as a name, but here yes.

For Wiktor 2001 and those authors who follow Wiktor's system the name of the Ukrainian species must be *Limax* (*Limacus*) *ecarinatus* Boettger 1881.

For authors like Falkner et al. 2002 who classify *Limacus* as a genus and not as a subgenus of *Limax*, the name of the Ukrainian species must be *Limacus maculatus* (Kaleniczenko 1851), because here *L. maculatus* Nunneley 1837 is not classified in the same genus *Limacus*, but unvariably in *Limax* with its senior synonym *Limax maximus*.

So the Ukrainian species can have two names, depending from its current classification. *Limax ecarinatus*, *Limacus maculatus*, the same species. Every morning you can use another name for it.

Art. 59.3 rules that in exceptional cases junior secondary homonyms which were replaced before 1961 by substitute names can become "permanently invalid", another passage of the same Article adds "unless the substitute name is not in use", an exception of the exception. If this still causes confusion, the case is to be referred to the ICZN Commission (Art. 59.3.1), to rule an exception of the exception of the exception. Some taxonomists seem to work with this Art. 59.3, others try to avoid it. It remains undefined what the expression "is not in use" should mean. "To be in use" would refer to a general taxonomic state, but zoological names do not have general taxonomic states.

Example:

Glischrus caelata Studer 1820 (Gastropoda) was once classified in the genus *Helix*, and became a junior secondary homonym of *Helix caelata* [Vallot] 1801 for those who regarded Vallot's work as available. Locard 1880 did that and established a new replacement name *Helix glypta*, which has very rarely been used. The species is currently known as *Trochulus caelatus* (Studer 1820) by both those who regard [Vallot] 1801 as available and those who do not do it, some have argued that *glypta* must be used, and nobody likes to refer the case to the ICZN Commission.

Double homonymy (genus and species) is no homonymy (Art. 57.8): if the genera are homonyms and belong to different animal groups, the same specific names can be used in both groups.

Examples:

The name *Noctua* Linnæus 1758 was established for a lepidopteran subgenus. In 1764 he established a genus *Noctua* Linné 1764 for birds, ignoring the other name. *Noctua* Linné 1764 (Aves) is a junior homonym of *Noctua* Linnæus 1758 (Lepidoptera).

Garsault 1764 used *Noctua* for a bird and established a name *Noctua caprimulgus* Garsault 1764 (Aves). Fabricius 1775 used *Noctua* for a lepidopteran insect and established a name *Noctua caprimulgus* Fabricius 1775 (Lepidoptera), thus creating a double homonym.

Double homonymy is no homonymy, both names are available.

The same happened once again with *Noctua variegata* Jung 1792 (Lepidoptera) and *Noctua variegata* Quoy & Gaimard 1830 (Aves).

Art. 58: when specific names are considered not to differ in spelling

One of the more comfortable and useful articles in the ICZN Code is Art. 58, which regulates exactly how much homonyms are exceptionally allowed to differ from one another.

It is important that the name must be formed from the same derivation. If they have a different meaning, these rules do not apply (Art. 58).

Example:

The dipteran names *Chrysops calidus* (meaning: warm) and *Chrysops callidus* (meaning: clever) are not homonyms, Art. 58.7 is ignored.

The following cases are regarded as homonyms:

ae, oe or e (*caeruleus, coeruleus, ceruleus*);

c or k (*microdon, mikrodon*);

c before *t* (*auctumnalis, autumnalis*);

ch or c (*chloropterus, cloropterus*);

ei, i or y (*cheiropus, chiropus, chyropus*);

f or *ph* (*sulfureus*, *sulphureus*);
h or other aspiration or non-aspiration of a consonant (*oxyrhynchus*, *oxyrynchus*);
i as *y*, *ei*, *ej* or *ij* (*guianensis*, *guyanensis*);
i or *j* for the same Latin letter (*iavanus*, *javanus*; *maior*, *major*);
-i before a suffix or termination (*timorensis*, *timoriensis*; *comstockana*, *comstockiana*);
-i or *-ii*, *-ae* or *-iae*, *-orum* or *-iorum*, *-arum* or *-iarum* as the ending in a genitive (*smithi*, *smithii*; *patchae*, *patchiae*; *fasciventris*, *fasciiventris*);
th or *t* (*thiara*, *tiara*; *clathratus*, *clatratus*);
u or *v* for the same Latin letter (*neura*, *nevra*; *miluina*, *milvina*);
single or double consonant (*litoralis*, *littoralis*);
different connecting vowels in compound words (*nigricinctus*, *nigrocinctus*);

6.1.2 Synonyms

Synonyms are names which refer to the same taxon. The term "synonym" is used in different senses in nomenclature, in taxonomy, in biodiversity informatics and in practical life.

In **practical life** *Felis uncia* and *Panthera uncia* are often regarded as synonyms, different names for the same animal, the snow leopard. This is also in alignment with the situation in botanical nomenclature.

In **biodiversity informatics** the two are different strings and may be called synonyms, like any two names that deviate in at least one letter. The misspelling *Pantera uncia* would be a third synonym in this sense.

In **taxonomy** there is no fixed definition, since the Code rules only nomenclature and treats taxonomy only marginally. The definition for "synonym" in the Code's Glossary says "each of two or more names of the same rank used to denote the same taxonomic taxon", the term "rank" refers here to the rank "species" of the species-group (Art. 45.1). This would specify the Glossary's definition to be meant as "each of two or more *names of a species* used to denote the same taxonomic taxon", in which the crucial term "name of a species" is defined in the Glossary as "a scientific name of a taxon at the rank of species". A scientific name of a species is a binomen, which is a genus-species combination, so *Felis uncia* and *Panthera uncia* could be regarded as synonyms in the taxonomic sense. This is contradicted by the fact that taxonomists must deal with objective and subjective synonyms, junior and senior synonyms, no third kind of synonyms is defined. So this definition is incomplete and could probably not be applied for this reason. Presence of synonymy or not in such a case is a question of personal views, there is no generally accepted guideline or usage.

In **nomenclature** there are objective and subjective synonyms (Art. 61.3), absence of a third option suggests that the situation must be different here. Art. 48 rules that a species-group name "becomes part of another combination whenever it is combined with a different generic name", this excludes an interpretation that a new second species-group name is created at this occasion. A "species-group name" is (Glossary) "a specific name or a subspecific name", in our case a specific name, which is the second name in a genus-species combination. So the specific name *uncia* remains the same, it is just combined with a different genus. A second name *uncia* is not created. Without presence of a second name the idea of synonymy cannot emerge. *Felis uncia* and *Panthera uncia* are not synonyms in the nomenclatural sense, they are just **different combinations**.

Objective synonyms have the same name-bearing type, implying that the names refer exactly to the same taxon. In species this can only be one single type specimen (holotype, lectotype or neotype) (Art. 61.3.4), in genera the type species must be identical (Art. 61.3.3). The descriptions are irrelevant, only the type selection counts. New replacement names (Art. 72.7) and unjustified emendations (Art. 33.2.3) are objective synonyms by definition.

It is usual practice to convert uncomfortable or disputable names into junior objective synonyms of well-known names, by way of type selections.

Example:

Linnæus 1758 established the specific name *Curculio frumentarius* Linnæus 1758 (Coleoptera), based on several type specimens. De Geer 1775 established *Curculio sanguineus* De Geer 1775 for the same animal, based on partly the same type specimens. This was considered as a junior subjective synonym. Thompson & Zarazaga 1988 designated one and the same specimen of the Stockholm museum as lectotype for both names *Curculio frumentarius* and *Curculio sanguineus*. This converted the two into objective synonyms.

Both original descriptions differed from each other, and it was unlikely that Linnæus and De Geer had referred to the same species. But De Geer referred bibliographically to Linnæus 1758, so that by definition also those specimens were part of De Geer's types. This allowed Thompson & Zarazaga 1988 to select one of these specimens as lectotype, to convert *Curculio sanguineus* into a junior objective synonym of the older name, so that it cannot be used any more for a taxon. Nobody needs to find out any more what De Geer eventually could have meant in his unclear original description.

Subjective synonyms do not have the same name-bearing type (Art. 61.3.1). This applies to all cases where at least one of the names was based on more than one specimen. If *firstspecies* has one type and *secondspecies* has

two syntypes, then they are not objective synonyms. Even if both names are both based on the same two syntypes, they are not objective synonyms. Anyone can select specimen No. 1 as the lectotype for *firstspecies*, specimen No. 2 for *secondspecies*, and these type specimens could belong to different species if the syntypes belonged to two species.

6.1.3 Names rejected under Art. 23.9

An old and largely unknown name that has not been used as the accepted name for a taxon since 1899 can be set aside, given that a younger name has widely been used for a taxon since long (the term "**nomen oblitum**" is used for such old and almost forgotten names, the younger name "nomen protectum"). This "reversal of precedence" is a deviation from the Principle of Priority. The conditions are not easy to meet.

An author must find and cite

at least 25 works where the younger name was used,

written by at least 10 authors

in the immediately preceding 50 years,

in a time span not less than 10 years,

and give evidence that the old name has never been used since 1899.

The last condition is certainly the most problematic one, but it seems that these actions are also accepted in those cases where a name could have been used in some not very well researched works in the early 1900s. It seems that it is necessary to claim that the name was not used after 1899, and the claim stands until another author provides evidence for the contrary. It is implicit that citing must be done individually, it would not suffice to ask the readers to research the 25 publications in a previously published list of 1000 references.

Example:

Voluta bidentata Montagu 1808 (Gastropoda), currently widely used as *Leucophytia bidentata* (Montagu 1808) is a junior homonym of *Voluta bidentata* Schröter 1804, a name for another species that had not been used after 1899. Falkner et al. 2002 cited 25 references individually in the usual form (by author and year) on p. 101 and listed them in the literature section at the end of the publication. In this form they validly fixed *Voluta bidentata* Schröter 1804 as a nomen oblitum, so that Montagu's 1808 name can be used for the *Leucophytia* species.

In earlier versions of the ICZN Code the term "nomen oblitum" had different meanings and definitions, in popular sources the term is also occasionally used.

Example:

In internet resources such as Wikipedia a name "**Scrotum humanum** Brookes 1763" is occasionally given as an example for a nomen oblitum, a senior synonym of the well known dinosaur *Megalosaurus bucklandii* Mantell 1827. *Scrotum humanum* might have been regarded by some authors as an available name, perhaps they only saw a copy of one single page of Brookes' 1763 work and did not analyse the style of the work. Brookes did not use Linnean names in his own classification. Names can only be established if the author applied binominal nomenclature, and only an established Linnean scientific name can become a nomen oblitum. So Brookes 1763 did not establish a name *Scrotum humanum*.

6.1.4 Names suppressed by the Commission

Some available names were later officially suppressed in Opinions published by the ICZN Commission who has the power to declare an available name to be unavailable (Art. 81.1). Such rulings by the Commission are usually widely accepted, with some rare exceptions. A name can be totally, partially or conditionally suppressed (Art. 81.2).

In most cases the Commission has suppressed names either "for priority and homonymy", or "for priority but not for homonymy" (the official terms are longer, Art. 81.2.1).

A name suppressed "for priority and homonymy" cannot be used from the first source, but usually from a subsequent younger source specified in the Opinion. This name as such is not really dead.

Example:

Weber 1795 established a new genus *Idotea* (Crustacea: Decapoda) and included 2 species. Fabricius 1798 did not know this and established *Idotea* for a group of 10 species (Crustacea: Isopoda). The name became an important genus in isopod taxonomy. In 1963 the Commission was asked and in Opinion 643 suppressed *Idotea* Weber 1795 for priority and homonymy, which had the effect that the younger name *Idotea* Fabricius 1798 can be used for the isopods.

A name suppressed "for priority but not for homonymy" is a really dead name, it cannot be used any more at all, neither in the sense of the suppressed source nor from anyone else for regardless which taxon.

Example:

Phalaena Linnæus, 1758 (Lepidoptera) was suppressed in Opinion 450 from 1957 for priority but not for homonymy. This means that nobody in no animal group can establish and use a name *Phalaena* any more.

A conditionally suppressed name cannot be used in certain taxonomic classifications, in others yes. This usually sounds like "for those who regard the two taxa as conspecific, the older name is suppressed". Those who do not regard them as conspecific, the name is not suppressed and they can use it.

Example:

Blatta germanica Linné 1767 (Blattodea) was established for the German cockroach (currently *Blattella germanica*). In 1763 Brünnich had established a name *Blatta transfuga* for a very closely related form. Some authors considered both as synonyms. The Commission was asked in 1982 and decided that *transfuga* should not be given priority over *germanica* whenever the two are considered synonyms. Those who consider the two as conspecific must use the younger name and call the species *Blattella germanica*. Those who think *transfuga* is a separate species can use the name as *Blattella transfuga*.

In some rare cases suppressed names are currently used for species. The regular procedure is that the suppressed name should later be restored by the Commission.

Example:

Sphyaena acus La Cepède 1803 (Actinopterygii) was suppressed in 1969 (Opinion 900), but continued to be used. In Opinion 2169 from 2007 the official availability of the name was restored.

This has not always been done, in some cases it seems that scientists did not know that the name was once suppressed and nobody asked the Commission to restore such a name.

Example:

Bulla canaliculata Linnæus, 1758 (Gastropoda) was suppressed in 1958 (Opinion 539), but continues to be used as *Tonna canaliculata* (Linnæus, 1758).

6.2 Unavailable names which can be used

In some cases unavailable names can be used for taxa, names that were originally not correctly established. In Opinions published on individually requested cases, the ICZN Commission has the power to declare an unavailable name to be available (Art. 81.1), for which the simple and easily intelligible expression "to **validate**" had been used until 2000. Such rulings by the Commission are commonly accepted.

"To validate" means "to make available a name that would otherwise remain unavailable". Since 2000 the term "**conserved**" is used by the ICZN Commission, a new insider term not in alignment with its common use in standard English. It means that the status of a name is changed (from unavailable to available), which in commonly understood English is exactly the opposite of "to conserve" something. The term "conserved" includes cases where names were allowed to be used which had never been used before.

Example:

In order to find a solution in a conflict between common usage of two generic names *Trichia* De Haan 1839 (Crustacea) and *Trichia* Hartmann 1840 (Gastropoda), names which had both been used for decades, it was necessary to find a new and stable name for the gastropods. The Commission decided in 2004 (Opinion 2079) that the gastropod genus should take the name *Trochulus* Chemnitz 1786, a name that had never been used for this genus and was discovered in a very old non-binominal work. This name took automatically precedence over all other generic names inside this group and at its disputable margins. In the official terminology, the name *Trochulus* was "conserved". Neither its usage nor its status was retained or preserved during this action, in the contrary.

In this manual I will keep using the term "validated" in alignment with its usage in the commonly spoken language, to avoid confusion.

6.2.1 Art. 11.6: validated synonyms

Synonyms were names that were not used for taxa by the authors who mentioned them, and as such they were not made available (if they were new) and cannot be used (Art. 11.5). Art. 11.6 just repeats this.

Art. 11.6.1 is the exception of this rule and allows to validate synonyms under certain circumstances.

Art. 11.6.1 rules that when a name first published as a synonym had been treated before 1961 as an available name (adopted as the name for a taxon or treated as a senior homonym), it was validated (or made available) and dates from the first publication as a synonym.

The ICZN Code also rules which should be the types in such a case (Art. 67.12, 72.4.3), and the authorship (Art. 50.7), but several other extremely important points were overlooked and not fixed.

This Article has recently been discussed and is probably going to be modified in a future edition of the Code. At the beginning when the Article was incorporated to the Code in 1963 only few cases were known. With ongoing time the problems increased and in molluscan nomenclature after a few decades reached a level in which 2 % of all names became involved in problems in this Article and its increasingly divergent interpretations. Every year new synonyms have been discovered in the early literature. Synonyms have never been recorded before by indexers and nomenclators and with more literature being online many users can discover old synonyms. The basic problem is that several important issues have remained unclear in this Article.

It is unclear whether such a synonym must have had a description (or figure or bibliographic reference). A synonym was not established as a new name, and there is no requirement in the ICZN Code that a synonym must have a description. It seems that presence of a description should be required.

It is unclear whether the author who adopted such a name for a taxon should have known the previously published synonym from that source. This point is probably disputed.

It is unclear if the names should have referred to (subjectively) the same species. It seems that this should have been so.

It is unclear whether the synonym must have been used as a synonym of an available name (Art. 11.6.1 only requires "of a name used as valid"). It seems that this should have been so.

It is unclear how the original combination should be cited, and which one should be taken as the original genus (which is important for the parentheses). This point is under dispute.

It is also possible that a future regulation tries to stop the ongoing process of digging out "new" synonyms in the old literature, because this distorts the dates for the names and provides an obstacle to their stability.

7. Special chapter: new replacement names

If a name must be replaced, a new replacement name can be proposed, to be used as a substitute. This new replacement name takes the types of the old name (in all cases, Art. 72.7), but has its own (younger) date.

If a new replacement name was unnecessarily proposed (for an available name which under the present-day rules would not have needed a substitute name), the name is nonetheless available (Art. 12.2.3).

Names intended to substitute sensu names or otherwise unavailable names are not available as new replacement names (Art. 72.7), because a new replacement name gets only types (and with them an identity) if an available name is replaced. If an unavailable name would be substituted, the new name would be equally unavailable. They might be available as regular new names, given that they referred bibliographically to the source of the sensu name (Art. 72.4.4).

Example:

Betpakodiscus aliminimus Brenckle, 1993 (Foraminifera) was expressly established as a new replacement name for *Archaeodiscus minimus* Reitlinger, 1950 sensu Grozdilova & Lebedeva 1953. This was a sensu name and not an available name, so Brenckle's name was made available as a regular new name based on the bibliographic reference to Grozdilova & Lebedeva 1953.

Genera with already fixed type species: the new replacement name takes this same type species (Art. 67.8). New replacement names for genera are usually needed when a genus turns out to be a junior homonym of a genus established in another animal group. The term "non" is used to indicate "not (the same name)".

Examples:

Olympicola Hesse 1916 (Gastropoda) was expressly established as a new replacement name for *Olympia* Vest 1867 non *Olympia* Risso 1826 (Crustacea). *Olympia* Vest 1867 had as type *Clausilia olympica* Pfeiffer 1848 by original designation. This became automatically the type for *Olympicola*. Type fixed by **original designation** (by Vest 1867).

Sciocochlea Boettger 1935 (Gastropoda) was expressly established as a new replacement name for *Phygas* Wagner 1914 non *Phygas* Treitschke 1833 (Lepidoptera). *Phygas* Wagner 1914 had as type *Serrulina collasi* Sturany 1904 by monotypy. This became automatically the type for *Sciocochlea*. Type fixed by **monotypy** (by Wagner 1914).

Iberellus Hesse 1908 (Gastropoda) was expressly established as a new replacement name for *Balearica* Kobelt 1904 non *Balearica* Brisson 1760 (Aves). *Balearica* Kobelt 1904 had as type *Helix balearica* Rossmässler 1838 by absolute tautonymy. This became automatically the type for *Iberellus*. Type fixed by **absolute tautonymy** (by Kobelt 1904).

If a type species had not been fixed for the old genus, the type can be selected when the new replacement name is proposed. Only a species originally included in the old genus can be selected (Art. 67.8.1). Anything else is ineffective.

Example:

Muticaria Lindholm 1925 (Gastropoda: Clausiliidae) was expressly established as a new replacement name for *Lamellifera* Monterosato 1892 (not *Lamellifera* Westerlund 1890, also Gastropoda: Clausiliidae, but a different subgroup). Monterosato 1892 had included two species and no type had been fixed until 1925. Lindholm 1925 designated as type one of the two species, automatically for both generic names (*Clausilia scalaris* Pfeiffer 1850). Type fixed by **subsequent designation** (by Lindholm 1925).

The ICZN Code does not specify if absolute tautonymy can also refer to the new replacement name, but it would certainly be in the spirit of zoological nomenclature. I have never seen such a case.

If the author of the new replacement name gave a type species different from the already fixed type species, or gave a type species which was not originally contained, we have a conflict between two possible mistakes. The question is, which mistake is superior, which one inferior? The Code does not help us here. There is no sound chapter on new replacement names.

Usually this name is interpreted as a new replacement name and the type given by its author is regarded as in error. Art. 67.8 seems to give priority to this solution, and I would recommend to regard this as the superior rule. But it is also possible to interpret the new replacement name as a new generic name with its own type species (Art. 12.2.5), and that the definition as a new replacement name was in error.

It gets easier when more mistakes were involved. Usually these are complicate cases, not shortly described.

Example:

Aegopinella Lindholm 1927 (Gastropoda) was expressly established as a new replacement name for *Polita* Held 1838 in the sense of authors who regarded *Helix pura* Alder 1830 as its type species (the original description of *Polita* did not contain this species, but the name *Polita* was widely used in this sense), in contrast to others who regarded *Helix cellaria* Müller 1774 as the type (which is correct in the sense of the 4th edition of the Code). Lindholm gave *Helix pura* as type species for *Aegopinella*. But he intended to replace a sensu name, so it was not a proposal of a new replacement name for an available name (Art. 72.7), and so no new replacement name was effectively proposed as such. *Aegopinella* was made available as a regular new name because Lindholm had included a species (Art. 12.2.5), *Helix pura*, which is type species by original designation.

In species the new replacement name gets its identity always from the substituted name (Art. 72.7). A neotype could theoretically be referred to a new replacement name (and then the original name would get the same neotype, so the new replacement name would define its identity), this case is not mentioned in the Code.

In addition to genera, species can be replaced because of secondary homonymy. This is necessary if the specific name cannot be placed in a certain genus because another taxon with the same name is already contained in it. Often it is not necessary to establish a new replacement name in such a situation because another junior synonym can be used.

Examples:

Philippi 1836 established *Carocolla limbata* (Gastropoda) from Sicily and ignored that this genus was so closely related to *Helix* that most contemporary authors would classify *Carocolla* in *Helix*. *Helix limbata* Draparnaud 1805 from France interfered, so when Rossmässler 1838 classified Philippi's taxon in the genus *Helix*, both became secondary homonyms. Rossmässler 1838 expressly established *Helix amanda* as a new replacement name for *Carocolla limbata* Philippi 1836.

Fuchs & Käufel 1936 established *Albinaria weneri* (Gastropoda). Nordsieck 1977 revised *Albinaria* and saw that a name *Clausilia weneri* Sturany 1902 was among the synonyms of *Albinaria grisea* (Deshayes 1835), and thus a secondary homonym of *Albinaria weneri*. Nordsieck 1977 established *Albinaria fuchskaeufeli* as a new replacement name for *Albinaria weneri* Fuchs & Käufel 1936, not *Clausilia weneri* Sturany 1902 (currently classified in *Albinaria*).

When *Krynickyllus maculatus* Kaleniczenko 1851 is placed in the genus *Limax* it becomes a junior secondary homonym of *Limax maculatus* Nunneley 1837 which is also classified in *Limax*. In this case *K. maculatus* cannot be used. If no other name was available, a new replacement name would be established. But it can be substituted by *Limax ecarinatus* Boettger 1881, the next available junior synonym of *K. maculatus*.

Secondary homonymy does not occur if a new generic combination produces one that had already been served as the original combination for another name in the past. This is because the secondary homonymy depends strictly on the currently applied classification. No substitute name is needed here. The fact that a name had already been used for another animal does not provide obstacles for its usage.

Examples:

Pomatias elegans Clessin 1879 (Gastropoda), currently classified as *Cochlostoma elegans* (Clessin, 1879), did not get problems when *Nerita elegans* Müller, 1774 was later classified in the genus *Pomatias* in a combination *Pomatias elegans* (Müller, 1774). Both names are currently used.

Käufel 1928 established *Iphigenia umbrosa* (Gastropoda: Clausiliidae), not very closely related to *Clausilia umbrosa* Charpentier, 1852 which since the 1920s has been classified in the genus *Cochlodina*. Later the species of the genus *Iphigenia* were classified in the older genus *Clausilia*. Nordsieck 1993 discovered that *umbrosa* Käufel was now in the same genus *Clausilia* as *umbrosa* Charpentier had been some years before 1928, and proposed a new replacement name *Clausilia umbrosella* Nordsieck 1993. This was not necessary, both names *Cochlodina umbrosa* (Charpentier 1852) and *Clausilia umbrosa* (Käufel 1928) are not in conflict with each other and can be used.

New replacement names have requirements, this is often overlooked. There must be an **expressed statement** that the name was established to replace another name (Art. 72.7, Art. 13.1.3) ("nom. nov.", "nomen novum", "substitute name", "I propose this name because of...", "this name is necessary because..."). The substituted name must be mentioned, and it should be clear from the contents why the name should be replaced. An **explicit** statement ("nom. nov.", "substitute name") is good, but not needed, any expressed statement concerning the action of substituting the other name is sufficient. It must definitely be more than only implicit evidence (there would be no need for the term "expressed" in Art. 72.7, if it could be deleted without a change in meaning of the Article, "expressed" clearly contrasts "implicit").

This is why the term "was expressly established as a new replacement name" is used here. The need for an expressed statement is so often overlooked that it makes sense to record not only that the name was established as a new replacement name, but also that this requirement was met. Simply saying "was established" could mean that there was no expressed statement.

This detail ("need of an expressed statement") is disputed in the community. Many scientists regarded also implicit evidence and insider knowledge as sufficient to recognise new replacement names. This is a situation in which the provisions of the Code are possibly not in alignment with the zoological tradition. It is possible that the Code will some day be better aligned with the current practice, but in such cases it is always difficult for the Code Committee to find a solution that find the exact words describing how the community actually behaves. This is the more a problem if various disciplines have different traditions. Currently it might be best to work with a relatively strict interpretation of the Code, and to keep in mind that the community is probably slightly more tolerant.

For species it is not necessary that the new replacement name is established in the same genus as the substituted name. Usually the genus is taken in which the species is currently classified.

Examples:

Theodoxus pallasi Lindholm 1924 (Gastropoda) was expressly established as a new replacement name for *Neritina liturata* Eichwald 1838 non Schultze 1826, both homonyms were mentioned.

Carychium ibazoricum Bank & Gittenberger 1985 (Gastropoda) was expressly established as a new replacement name for *Auricula gracilis* Morelet 1845 non Grateloup 1828, both homonyms were mentioned.

Borysthenia Lindholm 1913 (Gastropoda) was expressly established as a new replacement name for *Jelskia* Bourguignat 1877, not *Jelskia* Taczanowski 1871 (Araneae), both homonyms were mentioned.

Leucophytia Winckworth 1949 (Gastropoda) was expressly established as a new replacement name for *Leuconia* Gray 1847 non Grant 1833 (Porifera), both homonyms were mentioned.

The reason why the new replacement name was proposed is irrelevant (Art. 12.2.3, 13.1.3). Frequently names were replaced because the previous name was regarded as inappropriate. In such cases the new replacement names are available. It means also that the author did not need to mention the exact homonym.

Examples:

Pagodulina subdola gracilior Pilsbry 1926 (Gastropoda) was expressly established as a new replacement name for ***Pupa pagodula forma gracilis*** Westerlund 1887. Pilsbry did not mention a previous homonym, but remarked that "the name *gracilis* had been used many times in *Pupa* before it was applied to this form". This was correct (for example as *Pupa megacheilos* var. *gracilis* Rossmässler 1842). But if not, this would not have changed the situation.

Oxychilus seidli Riedel 1999 (Gastropoda) was expressly established as a new replacement name for *Hyalina cypria* var. *major* Martens 1889. Riedel just mentioned that *major* was preoccupied by various previous names. This was extremely likely, both as a primary homonym in *Hyalina* and as a secondary homonym in *Oxychilus*.

Without expressed statement a new replacement name does not come into effect, as explained above (Art. 72.7). It is not sufficient if the presence of a new replacement name is implicitly clear from the context, or clear to the insider. Not any name established possibly as a substitute for another name is automatically a new replacement name. There are many such cases, and taxonomists often did not acknowledge or apply Art. 72.7. Often the involved names were made available as regular new names, but in unlucky cases not.

But see the comment above: in this manual the pure and strictly applied rules are explained. In the unlucky cases absence of an expressed statement should not necessarily be taken to distort the nomenclature of widely used names. So it is necessary to evaluate such cases under the Code's strict rules, as well as under more tolerant aspects. However, in most cases a more tolerant interpretation is either not necessary or leads to undesired results.

Examples:

Argna Cossmann 1889 (Gastropoda) was mentioned as *Pupa (Argna) proexcessiva* in a list of species cited from Sacco 1888 who had established the name as *Pupa (Coryna) proexcessiva*. Cossmann just replaced *Coryna* by *Argna* without any comment and without mentioning the name *Coryna*. *Argna* was not established as a new replacement name for *Coryna* Westerlund 1887 non Bosc 1802 (Cnidaria) because Cossmann 1889 did not give an expressed statement and did not explain why the name was replaced. *Argna* Cossmann 1889 is available as a regular new name (Art. 12.2.5) with *Pupa proexcessiva* Sacco 1888 as its type species.

The name eventually to be replaced was not mentioned.

More tolerantly: In this case knowledge derived from a second source is necessary, since there is absolutely no evidence for a substitute name in Cossmann's original publication itself.

Usage: *Argna* is today used for a genus in agreement with both candidate type species (*proexcessiva* and the one for *Coryna* Westerlund).

It is not necessary to consider it as a new replacement name (it can be used as a regular new name).

Petasina Beck 1847 was used in a list with 4 species contained. Beck 1837 had listed basically the same species and spelled the genus *Petasia*, among the included synonyms was a name *Helix unidentata* Draparnaud, 1805. There is no indication in the 1847 source why the name was spelled differently.

The name eventually to be replaced was not mentioned.

More tolerantly: It is necessary to research and consult a second source (Beck 1837), to see that the name was spelled *Petasia* there and to know that *Petasia* was preoccupied by *Petasia* Stephens, 1828 (Lepidoptera). There is no evidence for a substitute name in the 1847 source itself.

Usage: The name *Petasina* has recently been used for a genus or subgenus with *Helix unidentata* as its type. It is necessary to consider it as a new replacement name (in 1847 the type species *unidentata* was not contained).

Salamandra maculosa Laurenti 1768 (Amphibia) was obviously but not expressly established to replace *Lacerta salamandra* Linnaeus 1758 to avoid tautonymy. Laurenti did not cite the Linnean name and gave no bibliographical reference to the 1758 source. *Salamandra maculosa* cannot be regarded as a new replacement name because of the lack of an expressed statement and because *Lacerta salamandra* Linnaeus 1758 was not mentioned.

The name eventually to be replaced was not mentioned.

More tolerantly: In this case insider knowledge is necessary to understand Laurenti's behaviour and to detect a name replacement for nomenclatural reasons, and in addition a second source must be researched, consulted and screened. It is also necessary to compare every single description of Laurenti's *Salamandra* species with that of the Linnean names to see which ones were probable synonyms, since Laurenti did not cite the Linnean sources. Any name could have been the one to replace the Linnean name.

Usage: *S. maculosa* is today regarded as a junior synonym of *Salamandra salamandra*. It is not necessary to consider it as a new replacement name.

Planorbis carinatus Müller 1774 (Gastropoda) was obviously but not expressly established to replace *Helix planorbis* Linnaeus 1758 to avoid tautonymy. Müller did not cite the Linnean name but cited the 1758 description and gave a bibliographical reference to the 1758 source. But the cited figures were not the same. *Planorbis carinatus* cannot be regarded as a new replacement name because of the lack of an expressed statement.

The name eventually to be replaced was not mentioned.

More tolerantly: In this case insider knowledge is necessary to understand Müller's behaviour and to detect a name replacement for nomenclatural reasons. A second source must be consulted and compared.

Usage: *Planorbis planorbis* and *Planorbis carinatus* are today regarded as two different species, both names are used and important. It is necessary not to consider it as a new replacement name (otherwise *Pl. carinatus* cannot be used).

Dentistomus bielzi Kimakowicz 1890 (Gastropoda) was mentioned with a reference to the previously published description by Bielz 1853, referring to a species for which Bielz had used the names *Dentistomus eximius* and *Buliminus grandis*. Due to the lack of an expressed statement *D. bielzi* was not a new replacement name for either of the two names Bielz had mentioned. It was established as a regular new name, because it had a bibliographic reference to Bielz 1853.

The name eventually to be replaced was not mentioned.

More tolerantly: In this case it is necessary to consult a second source and it is also necessary to have sufficient taxonomic insider knowledge to see which one of the two candidate names mentioned by Bielz should have been the one to be substituted, and why. It is also possible that Kimakowicz intended to replace a *sensu* name, which of course, would not be effective.

Usage: The name is currently used for the species *Mastus bielzi*. It is not necessary to consider it as a new replacement name (it can be used as a regular new name).

Helix zebra Férussac 1821 (Gastropoda) was established for a species from Turkey without description, but with bibliographical reference to a plate published by Olivier 1801. Olivier 1801 had used a name *Bulimus zebra* for it, Férussac did not mention this. It was not *Bulimus zebra* Bruguière 1792 from Madagascar. The name was not a new replacement name because no expressed statement was given. It was made available as a regular new name based on the bibliographic reference to Ollivier's illustration.

The name eventually to be replaced was not mentioned.

More tolerantly: In this case it is necessary to consult a second source, to look up the name used in this source and to have insider knowledge to know that the name used there was preoccupied by another name.

Usage: The name is currently used for a species. It is not necessary to consider it as a new replacement name (it can be used as a regular new name).

Cochlicopa Férussac 1821 (Gastropoda) was established with a short description and a name *Polyphemus* Montfort, 1810 cited among its synonyms. This was not *Polyphemus* Müller 1776 (Crustacea). Férussac gave no indication that he was aware of the homonymy. Among the first species included to *Cochlicopa* was not the type species of *Polyphemus* Montfort 1810. *Cochlicopa* was not established as a new replacement name for *Polyphemus* Montfort 1810 non Müller 1776 because Férussac 1821 did not give an expressed statement. *Cochlicopa* Férussac 1821 is available as a regular new name with its own type species.

The name eventually to be replaced was mentioned.

More tolerantly: In this case insider knowledge is necessary to understand that the synonym *Polyphemus* was a name that had a senior homonym. This is not clear from the original source.

Usage: The name is currently used for a genus. It is necessary not to consider it as a new replacement name (it cannot be used with the type species of *Polyphemus* Montfort which was fixed earlier).

Helix murcica Schmidt 1854 (Gastropoda) was used for a species from Spain with a bibliographical reference to a figure published by Rossmässler 1854. Rossmässler 1854 had used the name *Helix derogata* var. *angulata* for it. Schmidt attributed the name *murcica* to Guirao and argued that it was a separate species. Schmidt gave no indication that he was aware that *Helix angulata* had previously been established for other taxa, for example by Rackett 1821 for a species from Canada.

The name eventually to be replaced was mentioned.

More tolerantly: In this case insider knowledge is necessary to understand that the synonym *angulata* was a name that had a senior homonym. This is not clear from the original source. It is also possible that Schmidt used Guirao's name *murcica* because he thought that this name had precedence over Rossmässler's name *angulata*. In these times many authors regarded unpublished manuscript names as available.

Usage: The name is a candidate name for a species and has not been used recently. It is not necessary to consider it as a new replacement name (it can be used as a regular new name).

Mutilla scabra Thunberg 1788 (Hymenoptera) was mentioned without description or bibliographical reference, only with a name attached "*formicaria* L.". There was no expressed statement of substituting the Linnean name *Mutilla formicaria* Linnæus, 1758. *M. scabra* cannot be regarded as a new replacement name and was not made available by Thunberg 1787.

The name eventually to be replaced was mentioned.

More tolerantly: In this case it was clear from the original source that the two names must have had some relationship, but insider knowledge is necessary to understand this case. It was not clear why the name should have been substituted, and if it was for a nomenclatural reason. Some authors cited Linnean names just as synonyms, there were no fixed priority rules in these times.

Usage: The name is probably not used today. It is not necessary to consider it as a new replacement name.

Helix rosmaessleri Pfeiffer 1842 was mentioned for a species without description or reference, with a synonym *Helix advena* Rossmässler, 1842. This was a name for a Slovakian species. It was not *Helix advena* Webb & Berthelot, 1833 from the Canary Islands, Pfeiffer 1842 did not indicate this. The name was a nomen nudum and not made available as a new replacement name because it had no expressed statement. Pfeiffer 1848 used the name, gave a description and a bibliographical reference to Pfeiffer 1842.

The name eventually to be replaced was mentioned.

More tolerantly: In this case it was clear from the original source that the two names must have had some relationship, but insider knowledge is necessary to understand this case. It was not clear why the name should have been substituted, and if it was for a nomenclatural reason. It is necessary to know that Pfeiffer was an accurate scientist and if he used a new name and mentioned a synonym, this must usually have had a good reason.

Usage: The name is currently used for a species. It is not necessary to consider it as a new replacement name (it can be taken from the next source, Pfeiffer 1848).

Helix obvia Menke 1828 (Gastropoda) was listed without description or bibliographic reference as an available name with a synonym *Helix neglecta* Hartmann. On the same page Menke listed a name *Helix neglecta* Draparnaud. Both were different species. *Helix obvia* cannot be recognized as a new replacement name for *Helix neglecta* Hartmann 1821 non Draparnaud 1801 because of the lack of an expressed statement.

The name eventually to be replaced was mentioned.

More tolerantly: In this case it was clear in the original source that the author knew that there were two names *neglecta*, so the implicit evidence why one of the names should be substituted was obvious in the original source.

Usage: the name is currently used for the species *Xerolenta obvia*. It is necessary to consider it as a new replacement name (it cannot be used from the next source, another synonym interferes).

8. How is the name correctly spelled?

Taxonomists and database providers should always verify the correct spellings of the names used in their sources of information. In many cases these spellings are not consistent with the original spellings, but appear in a slightly modified form. Often these modified spellings are correct, but in other cases they turn out to be incorrect and not in accordance with the original description and the rules. In most cases it is convenient to use the correct original spelling for a name, especially if names are not very commonly used.

8.1 The names of genus and species

In a taxon name author string genus-species-author-year, the spellings of genus and species are relatively well determinable under the ICZN Code.

In a binominal name of species, the genus must always be spelled correctly. For this it is necessary to consult the original description of the genus, which involves additional research, because author and year of the genus is not shown in the taxon name author string of the species.

Usually the names of the genera are very well researched and an incorrect spelling for a genus is rarely discovered when the original source is consulted. It may also happen that a different type species than commonly believed is discovered for a genus, and that the genus cannot be used as the generic name for the involved group of species any more. See the chapter on types for this case. But also this occurs extremely rarely. Discovering an incorrect spelling for a species occurs much more frequently, perhaps by the factor 200:1 (species:genus) or more.

8.1.1 Incorrect original spellings that must be corrected

The roughly 3000 published Opinions by the ICZN Commission are almost always accepted in terms of spelling issues. This applies also if decisions were based on questionable backgrounds, and when the (incorrectly used) spelling was not subject of the Case.

Examples:

Margaritifera Schumacher 1815 (Bivalvia), original spelling was *Margartifera*, ruled to be on incorrect original spelling of *Margaritifera* in Opinion 495.

The spelling *Limax Sowerbii* Férussac, 1823 (Gastropoda) was corrected in Opinion 336 to *Limax sowerbyi* (currently *Tandonia sowerbyi*). Only *sowerbyi* is used today, although Férussac's spelling was absolutely correct: it was the correct genitive of the correctly Latinised form Sowerbius of the English name Sowerby.

8.1.1.1 Technical corrections

In specific names only the basic Latin set of 26 lower-case letters and exceptionally a hyphen are allowed (Art. 11.2, 32.5.2.4.3). Names with other letters in Latin script are available, but must be corrected afterwards. Spaces, diacritic marks, punctuation marks, numerals and abbreviated titles of persons must be removed or replaced (Art. 32.5).

It goes without saying that long s (ſ) (a variant spelling of the s and used commonly before 1790, outdated since the 1820s) is converted to short s (the long s is not even used when the original spelling is cited). Stylistic ligatures which only have technical relevance for the printer (ct, fi, fl, ff, ffi, st, tz etc., but not ß or æ) are either used or not used, this depends on the typeface and has no relevance in the citation. If the typeface allows a choice between separate letters and stylistic ligatures (st st̄, fl fl̄, ff ff̄, ffi ffī, ffl ffl̄) the original spelling is cited with separate letters. Hyphens used for line breaks are also ignored and not cited.

Examples:

The coleopteran Linnean names originally printed as *Chrysomela Cerafi* (with ligature of long s and i) *Ch. minutiffi-ma* (with hyphenated line break and double long s ligature), *Ch. Armoricae* (with ae ligature), *Ch. faſtuofa* (with long s and t ligature) and *Ch. ſpeciofa* (with long s) are cited as if they were spelled *Chrysomela Cerasi*, *Ch. minutissima*, *Ch. Armoricae*, *Ch. fastuosa* and *Ch. speciosa*.

The lepidopteran names originally printed as *Phalaena Artesiaria* [Denis & Schiffermüller], 1775 (with long s) is cited as *Artesiaria* with short s, *Ph. Coarctaria* (with ct ligature) is cited as *Ph. Coarctaria* with separate letters c and t.

Upper-case letters in species and subspecies must be corrected to lower-case (Art. 28).

Examples:

Aranea Raji becomes *Aranea raji* Scopoli 1763 (Araneae), *Pupa Genesii* becomes *Pupa genesii* Gredler 1856 (Gastropoda), *Helix Daghestana* becomes *Helix daghestana* Kobelt 1877 (Gastropoda), *Perca Radula* becomes *Perca radula* Linnæus 1758 (Actinopterygii).

Diacritic marks must be removed, ligatures must be separated, all characters must be reduced to their basic 26 Latin letters (Art. 32.5.2). Diacritic marks are always simply removed regardless of the rules applied in local languages, except that *ä ö ü* in names derived from German are converted to *ae, oe* und *ue* (not Swedish or

Turkish, and after 1985 also German is converted to *a o u*). Danish *å* is converted to *a*, not to *aa*. Ligatures are separated (*æ* to *ae*, *œ* to *oe*, *ß* to *ss*).

Examples:

Rhabdoëna becomes *Rhabdoena*, *bureši* becomes *buresi*, *núñezi* becomes *nunezi*, *soósiana* becomes *soosiana*, *mülleri* (dedicated to a German before 1985) becomes *muelleri*, *böttgeri* (dedicated to a German before 1985) becomes *boettgeri*, *Döderleinia* (dedicated to an Austrian before 1985) becomes *Doederleinia*, *Microstomus grönlandicus* Reinhardt 1840 (Actinopterygii) was based on the German name "Grönland" for the island known in Danish as Grønland, so the name is corrected to *groenlandicus*. *Planorbis strömi* Westerlund 1881 (Gastropoda) was dedicated to a Norwegian person Strøm and published in the Swedish mode where *ø* is converted to *ö*, so not of German origin, must be corrected to *stromi*. *Muraenophis haiü* La Cepède 1803 (Actinopterygii) was dedicated to a French person, so the name is corrected to *hauy*. *Phalæna* becomes *Phalaena*, *Lymnæa* becomes *Lymnaea*, *ranaeformis* becomes *ranaeformis*, *fætida* becomes *foetida*.

Spaces and punctuation marks must be removed (Art. 32.5.3).

Examples:

novae hollandiae becomes *novae-hollandiae*, *bonae spei* becomes *bona-espei*, *terrae novae* becomes *terraenovae*, *septem spiralis* becomes *septemspiralis*, *Tate Reganii* becomes *tatereganii*, *abu dafar* becomes *abudafar*, *loa loa* becomes *loaloe*, *De Natale* becomes *denatale*, *d'urvillei* becomes *durvillei*, *j-beameri* becomes *jbeameri*, *m'fongosi* becomes *mfongosi*, *o'connori* becomes *oconnori*, *striato-radiatus* becomes *striatoradiatus*, *aquae-dulcis* becomes *aquaedulcis*, *bella-maris* becomes *bellamaris*, *anti-vertigo* becomes *antivertigo*, *sex-maculatus* becomes *sexmaculatus*, *Adolphi-frederici* becomes *adolphifrederici*, *harcourt-butleri* becomes *harcourtbutleri*, *awo-ara* becomes *awoara*, *chan-choa* becomes *chanchua*, *?nigra* becomes *nigra*.

The only exception is the *c-album* case, where one single Latin letter denotes a character of the taxon (Art. 32.5.2.4.3). These are extremely few cases.

Examples:

Papilio c-album Linnæus 1758 (Lepidoptera), *Curculio c-album* Scopoli 1763 (Coleoptera), *Phalaena l-nigrum* Müller 1764 (Lepidoptera), *Chrysomela s-litera* Linnæus 1758 (Coleoptera), *Curculio t-album* Linnæus 1758 (Coleoptera), *Araneus v-notatus* Clerck 1757 (Araneae), *Cimex v-luteum* Lichtenstein 1796 (Heteroptera), *Araneus w-insignitus* Clerck 1757 (Araneae), *Phalaena w-latinum* [Hufnagel] 1766 (Lepidoptera), *Araneus x-notatus* Clerck 1757 (Araneae), *Prodoxus y-inversum* Riley 1892 (Lepidoptera).

It seems that this is also used for multiple letter combinations (although Art. 32.5.2.4.3 implies only one letter).

Example:

Drepana x-z-nigrum Bryk 1843 (Lepidoptera).

If originally spelled without hyphen, the hyphen must be added.

Example:

Hypopsis xpunctata Hubbs & Crowe 1856 (Actinopterygii), must be corrected to *H. x-punctata*.

This does not work with Greek letters, neither if they were written in Greek script (Art. 11.2, unavailable) nor if they were spelled as words.

Examples:

Chaetodon tau-nigrum Cuvier 1831 (Actinopterygii) must be converted to *taunigrum*. *Phalaena ygraecum* as mentioned by Retzius 1783 (Lepidoptera) must not be converted to *gammagraecum* because the Greek letter gamma formed part of the name and was not spelled in Latin script. The name was not made available.

Genera established with hyphens are usually united, although in contrast to species (Art. 11.9) the Code does not have a provision that allows compound names for genera (Art. 11.8). It seems to be usual practice to regard such names as available and to remove the hyphen.

Examples:

Channo-Muraena Richardson 1848 (Actinopterygii) becomes *Channomuraena*, *Hemi-Rhamphus* Cuvier 1816 (Actinopterygii) becomes *Hemirhamphus*, *Xero-Campylaea* Kobelt 1871 (Gastropoda) becomes *Xerocampylaea*.

Abbreviated titles of persons must be removed (Art. 32.5.2.4.2), full titles remain.

Examples:

R.P.Podae becomes *podae* (R. P. = Reverendissimus Pater, a Christian religious title). *Pimelodus Baronis Mülleri* Troschel 1865 (Actinopterygii) becomes *Pimelodus baronismuelleri*.

Abbreviated names of places and saints are written in full Latin letters (Art. 32.5.2.4.1). Common practice is to use Postclassical Latin for this purpose. The connecting vowels for the saints seem to depend on the sex of the person (for females *sanctae-*, for males *sancti-*), not on the ending.

Examples:

st.-johannis becomes *sanctijohannis*, *s. helenae* becomes *sanctae-helenae*, *s-thomae* becomes *sanctithomae*. *n-hollandiae* becomes *novae-hollandiae*.

If the names were spelled out and incorrectly, the names are not changed or corrected. If the abbreviation mandates an incorrect connecting vowel, this incorrectness should be maintained.

Examples:

The name established as *Agrotis sanctmoritzi* Bang-Haas 1906 (Lepidoptera) is not modified to *sanctimortzi*.

The name established as *Eudryas Stae. Johannis* Walker 1856 (Lepidoptera) becomes *sanctaejohannis*, not *sanctijohannis*.

The name established as *Papilio leonidas santa-marthae* Joicey & Talbot 1927 (Lepidoptera) becomes *santamarthae*, not *sanctamarthae*.

The name established as *Protogrotis novaguinensis* Bethune-Baker 1906 (Lepidoptera) is not modified to *novaeguineensis* or *novaeguineensis*.

The name established as *Earis novoguineana* Bethune-Baker 1906 (Lepidoptera) is not modified to *novaeguineana*.

The name established as *Argynnis cybele novascotiae* McDunnough 1935 (Lepidoptera) is not modified to *novaesotiae*.

Numerals (1, 2, 3...) must be written in full as Latin words (Art. 32.5.2.6), but the Code does not specify which ones. Most zoologists have used Postclassical Latin for this purpose, which is not in accordance with Classical Latin in present-day standard dictionaries. It is convenient not to use a standard Latin dictionary (because these show only Classical Latin), and to work with the following guide:

1 = *uni-*, 2 = *bi-*, 3 = *tri-*, 4 = *quadri-* (not *quatuor-*, not *quattuor-*) 5 = *quinque*, 6 = *sex*, 7 = *septem*, 8 = *octo*, 9 = *novem*, 10 = *decem*, 11 = *undecim-*, 12 = *duodecim-*, 13 = *tredecim-* (not *tridecim-*), 14 = *quattuordecim-* (not *quatordecim-*), 15 = *quindecim-*, 16 = *sedecim-* (not *sexdecim-*), 17 = *septendecim-* (not *septemdecim-*), 18 = *octodecim-* (not *duodeviginti-*, not *octodecem-*), 19 = *novendecim-* (not *undeviginti-*, not *novemdecim-*), 20 = *viginti-*, 21 = *vigintiunus-* (not *unusetviginti-*), 22 = *vigintiduo-* (not *duoetviginti-*), 23 = *vigintitres-*, 24 = *vigintiquattuor-* (not *vigintiquatuor-*), 25 = *vigintiquinque-* (not *quinqueetviginti-*), 26 = *vigintisex-*, 27 = *vigintiseptem-* (not *septemetviginti-*), 28 = *vigintiocto-* (not *octoetviginti*, not *duodetriginti-*), 29 = *vigintinovem-* (not *novemetviginti-*, not *unusdetriginti-*), 30 = *triginti-*, 32 = *trigintiduo-*, 40 = *quadraginti-*, 50 = *quingaginti-*, 60 = *sexaginti-*, 70 = *septuaginti-*, 80 = *octoginti-*, 90 = *nonaginti-*, 100 = *centum-*

These are very frequent cases, especially in coleopteran insect groups where dots and stripes can be counted.

Examples:

2fasciata becomes *bifasciata*, *3-punctata* becomes *tripunctata*, *4 fasciata* becomes *quadrifasciata*, *5punctata* becomes *quinquepunctata*, *6-pustulata* becomes *sexpustulata*, *7-guttata* becomes *septemguttata*, *8maculata* becomes *octomaculata*, *9-maculata* becomes *novemmaculata*, *10 lineata* becomes *decemlineata*.

If the numerals were spelled out in the original work, the original spelling must stand, even if it was not in accordance with the guide given above.

Examples:

Echeneis sex-decim lamellata Eydoux & Gervais 1837 (Chondrichthes) must be corrected to *sexdecimlamellata*, not to *sedecimlamellata*. *Cantharis quatuor punctata* Piller & Mitterpacher 1783 (Coleoptera) must be corrected to *quatuorpunctata*, not to *quadripunctata* or *quattuorpunctata*.

It is usual practice to correct *v* to *u* (or *u* to *v*) in Latin names spelled in a classical typesetting, and *J* to *I* in those cases where *J* was consistently used instead of *I* as the initial character. This is not ruled in the Code, but commonly done.

Examples:

Callidivm Fabricius 1775 (Coleoptera) becomes *Callidium*.
Sphaerivm Scopoli 1777 (Bivalvia) becomes *Sphaerium*.
Argvs Poli 1791 (Bivalvia) becomes *Argus*.
Cancer Vca Linné 1767 (Crustacea) becomes *Cancer uca*.
Leptura vcranica Laxmann 1770 (Coleoptera) becomes *Leptura ucranica*.
Nais elingvis Müller 1774 (Annelida) becomes *Nais elinguis*.
Gordius inqvilinus Müller 1774 (Nematomorpha) becomes *Gordius inquilinus*.
Cardium casertanvm Poli 1791 (Bivalvia) becomes *Cardium casertanum*.
Mvsca aestiua Müller 1764 (Diptera) becomes *Musca aestiva*.
Jberellus Hesse 1908 (Gastropoda) becomes *Iberellus* (Hesse used consistently *J* instead of *I* as the initial character).
Jnopsis Felder 1874 (Lepidoptera) becomes *Inopsis*.
Jschnognatha Felder 1874 (Lepidoptera) becomes *Ischnognatha*.
Jrcinia Nardo 1833 (Porifera) becomes *Ircinia*.
Julus Linnæus 1758 (Diplopoda) does not become *Iulus* because in the original source the *I* was not substituted by *J*.

Caution with *Jhering-*, names dedicated to a person of this name are not converted to *Ihering-*.

Caution with *ae* and *oe* ligatures *æ* and *œ*, do not misinterpret the characters, both ligatures may look extremely similar in Times italics. Most OCR programs are not able to distinguish them.

Times: *æ œ æ œ æ œ æ œ*

Arial: *æ œ æ œ æ œ æ œ*

In cases of doubts other names with ligatures should be compared in the same work. Many taxonomists are not aware of this error source, not even when reading the publications carefully, for example when they prepare cases for the Commission. The Commission members are not always aware of this problem either and do not verify and correct such errors.

Example:

Cyclops caeruleus Müller 1776 (Crustacea), originally spelled *cæruleus* (*cæruleus*) on p. 200 in Times italics, was misinterpreted by the ICZN Commission in Opinion 203 as *coeruleus* (compare p. 71 *fetidus* with *oe* ligature).

8.1.1.2 Content-related and grammatical corrections

Zoological nomenclature is much more strictly fixed to the original spelling than botanical nomenclature. Mistakes and errors for which the authors were responsible are only very exceptionally corrected, the original spelling has a very strong position.

Inappropriate names are never corrected for that reason, but also incorrect Latin grammar is not corrected. A name *brasiliensis* must not be corrected if the species is later found not to live in Brazil and the author gave an incorrect locality. A name *smithi* is not corrected if the true name of the person was Smyth and the author did not research that. A name *nigra* is not changed if it later turns out that only some animals are black and the author did not study the variation. A name *striatimarmorata* is not modified with its incorrect connecting vowel, the author was alone responsible for the incorrect Latin. A name *meriani* is not changed to *merianae* if the name was dedicated to Mrs. Merian and the author did not know that Merian was a woman or knew it and did not consult advice to form a correct Latin genitive. Only the last case is occasionally under dispute, but it seems that accepting the original spellings is supported by modern zoologists (Brandon-Jones et al. 2007, Dubois 2007).

The argument "had the author known that this name/spelling was incorrect (or inappropriate), he would not have published it" does not count. The idea behind this ruling is that the author is alone responsible to do all the research before submitting the manuscript, the zoological community is not responsible for correcting an author's mistake afterwards. There are too many animal names, and correcting 30 % of these would be too much. A serious problem is that various persons would regard different spellings as "correct", under Classical and Postclassical Latin, under different perceptions of grammar, perceptions of correctness regarding variant spellings of names of persons who did not have passports in the 18th century. The "original spelling stands" rule helps to avoid many many endless disputes.

Inadvertent errors must be corrected (Art. 32.5.1). These are relatively rare cases. An inadvertent error is an error for which the author was **not** responsible, such as a typographical error, a lapsus calami, copyist's or printer's error. The Code gives a theoretical example of a misspelling *ninnaei* instead of *linnaei*. It is not sufficient that the author did not intend to spell a word incorrectly. It must also be **outside the responsibility of the author**.

For correcting a name under Art. 32.5 it must be evident that the author knew how the name was to be spelled correctly, the manuscript should have contained the correct spelling. The author had the task to research the correct spelling before submitting a manuscript. If the error was already contained in a source the author had used, the author was responsible for not having verified the correctness of that source.

An inadvertent error must always be clear from the work itself. Consulting secondary sources (including notes by the same author in another publication 2 years later) is not accepted (Art. 32.5.1). See chapter 2 for examples.

Separate sheets "errata" or "corrigenda" issued at the same dates (or slightly later in other parts of the same volume) belong to the works and must be acknowledged. The errata or corrigenda must basically have been published simultaneously with the work where the name was established (Art. 32.5.1.1, French version).

This applies to any correction, also to content-related modifications.

Examples:

Buprestis ignita Linnæus 1758 (Coleoptera), originally on p. 408 *gnita*, corrected on p. 824 in emendanda to *ignita*.

Cardium aculeatum Linnæus 1758 (Bivalvia), originally on p. 679 *muricatum*, corrected on p. 824 in emendanda to *aculeatum*.

Turbo cylindraceus Mendes da Costa 1778 (Gastropoda), originally spelled once *cylindraceous*, and two times *cylindraceus*. Corrected to *cylindraceus* in the author's own errata.

If the corrigendum was published in a journal, a multivolume work or a work issued in parts or fascicles (Lieferungen), and was issued after the pages in which the name was established, the ruling in Art. 32.5.1.1 is ambiguous ("if in a journal, or work issued in parts, in one of the parts of the same volume"). It basically means that the Code allows some tolerance, perhaps up to one year or so. It would certainly not mean that a name could be corrected in corrigenda many years later in a publication defined as a part of the same volume of a multivolume work. Some multivolume works were issued in many fascicles with large time gaps in between, often decades.

Example:

Vultur albicilla Linné 1766 (Aves), originally on p. 123 *Vultur Albiulla*, corrected 1 year later by Linné 1767 in the second part of the same volume (last page, "errata") to *Vultur Albicilla*. This is accepted. The correct original spelling must be *Vultur albicilla*.

Oriolus xanthorus Linné 1766 (Aves), originally on p. 162 *mexicanus*, corrected 1 year later by Linné 1767 in the last part of the same volume (last page, "errata") to *xanthorus*. This is accepted. The correct original spelling must be *Oriolus xanthorus*.

The requirement for "clear evidence in the original publication itself" means that an inadvertent error is only accepted if the name gives no sense, or if the spelling is clearly and obviously not in accordance with the content.

Examples:

Clausilia jabucica Boettger 1878 (Gastropoda), originally spelled *iabucica*. The incorrect spelling was due to a misprint, provoked by spots of dirt on the printing plate. The best and most outstanding example for an inadvertent error.

Chrysomela ruficollis Fabricius 1775 (Coleoptera), originally spelled *uficollis*. Printer's error, a space was inserted instead of the r. The name *uficollis* would give no sense.

Raja capensis Gmelin 1789 (Chondrichthyes), originally spelled *rapensis*. Gmelin reported the species from "caput bonae spei" (= Cape of Good Hope, South Africa), *rapensis* gives no sense, must have been an error in typesetting.

Bulimus cinereus Mortillet 1851 (Gastropoda), originally spelled *cinereus*. This is not a Latin word, obviously a typesetting error.

Auchenionchus Gill 1860 (Actinopterygii), originally spelled *Anchenionchus*. The *n* was probably a copyist's error.

Psectrogaster amazonica Eigenmann & Eigenmann 1889 (Actinopterygii), originally spelled *amazonica*, the name was based on amazons, *amazonica* gives no sense.

Pygidium dorsostriatum Eigenmann 1917 (Actinopterygii): originally spelled *dorsotriatum*. Composed of *dorso-* and *-striatum*, the suffix *-triatum* gives no sense. The fish was reported to have been dorsally striated.

Boleosoma barratti Holbrook 1855 (Actinopterygii), originally spelled *barretti*, expressly dedicated to Mr. Barratt, the *e* instead of *a* was an error in typesetting.

Barbus leptopogon Schimper 1834 (Actinopterygii), originally spelled *leptopagon*, a lapsus calami, *-pagon* gives no sense.

Agonus accipenserinus Tilesius 1813 (Actinopterygii), originally spelled *accipenserimus*, this gives no sense, the *m* instead of *n* was a lapsus calami or typesetting error.

Melanagromyza flacourthiae Séguéy 1951 (Diptera), originally spelled *flacourthiae*, referring expressly to the correctly spelled host plant *Flacourtia*. The additional *h* must have been an error in typesetting, the original source suggests that the author knew the correct spelling.

In some cases the presence of an inadvertent error decides on whether a name must be regarded as new or not.

Examples:

Acanthus as used by Bloch 1795: 105 (Actinopterygii) is regarded to have been a typesetting error for *Acanthurus* Forskål 1775, not a new name. At the other occasions in the same work (p. 106 etc.) Bloch had spelled the name *Acanthurus*.

In those cases where two modes of spelling were published at different occasions in the original work, for example in the text and on a plate, it is easier. If the correct spelling is clear from the context, the spelling at one occasion is regarded as an inadvertent error, and the original spelling is taken from the other occasion.

Examples:

Bulimus gibber Krynicki 1833 (Gastropoda), originally spelled once *gibler* and once *gibber* in the text and *gibber* on a plate. The *l* instead of *b* must have been an error in typesetting, *gibber* is a Latin word and *gibler* gives no sense.

Girardinus uninotatus Poey 1860 (Actinopterygii), originally spelled in the main text *uninotatus* and in conspectus and index *uninotatus*. The *n* instead of *u* was a typesetting error, *uninotatus* gives no sense.

Abudefduf trilineatus Wang 1941 (Actinopterygii), originally spelled in the main text *trileniatus* and in abstract and summary *trilineatus*. The mixup of *i* and *e* in the main heading is regarded as a typesetting error, *trileniatus* gives no sense.

Vertigo dupotetii Terver 1839 (Gastropoda), expressly dedicated to Mr. Dupotet and originally misspelled *Dupoteli* on p. 32, but *Dupotetii* on p. [40] (plate explanations).

Chondrostoma lipocheilos Valenciennes 1844 (Actinopterygii), originally spelled *lipocheilos*, on Plate 513 the name was incorrectly spelled *lipocheilos*. The *a* instead of the *e* is regarded as an inadvertent error.

Alopias biloba merditana Wagner, 1914 (Gastropoda), originally spelled in the main text *merditana* and in the figure caption of the plate explanations *merditan*. The misspelling *merditan* is regarded as a typesetting error, the name was derived from a landscape Merdita.

Gillellus quadrocinctus Beebe & Hollister 1935 (Actinopterygii), originally spelled in the main text *quadrocintus* and on the plate *quadrocinctus*. The omitted *c* is regarded as a typesetting error, *-cintus* gives no sense.

Not giving sense can only be taken as a criterium in a small frame. If a name did not seem to give sense, it is not corrected to something else to give it some sense. Names can also be fantasy names, Latin is not obligatory.

Examples:

Buliminus munitus Westerlund 1894 (Gastropoda) must not be corrected to *minutus* (small) for the simple reason that *munitus* (protected, fortified) makes not much sense for a gastropod. There was no evidence in the original source that the author regarded the species as small.

It can generally not be recommended to establish complicate names, these lead frequently to misspellings, as can sometimes be demonstrated already in their original descriptions where the original authors misspelled their own names when they mentioned them various times in the original source.

Examples:

Dinematchthys Bleeker 1855 (Actinopterygii), originally spelled three times *Dinematchthys* and one time *Dinematchthijs*. The spelling *ij* is considered as an inadvertent error, in Dutch the *ij* is frequently used synonymously with *y*.

Leyvaichthys Dahl 1960 (Actinopterygii), originally spelled at least three times *Leyvaichthys* and one time *Leyvaichthys*. The suffix *-ichthys* means fish, *-ichthys* was a typographical error.

Dienbienia namnuaensis Ngyuen & Nguyen 2002 (Actinopterygii), originally spelled in the main text *namnuaensis* and in the abstract *namnuaensis*. The *m* instead of *n* in the abstract is regarded as a typesetting error.

Planorbis metidjensis Forbes 1838 (Gastropoda), originally spelled *Metidgensis* in the text and *Metidjensis* on a plate. In the work the name of the locality Metidja was mentioned several times correctly.

There are many questionable cases for inadvertent errors. In the past zoologists tended to correct more, so that many incorrect spellings are currently used, and taxonomists tend to justify them as mandatory corrections of inadvertent errors. In some cases it is convenient to allow slightly more tolerance than literally allowed, especially if the names are very frequently used.

Examples:

Ammicola antipodarum Gray 1843 (Gastropoda), originally spelled *antipodanum*. It is not clear from the original work why *antipodanum* should be an inadvertent error. The name is currently used as *Potamopyrgus antipodarum* (Google hits 15,000 : 10 in 08.2009) a very frequently used name.

Brachyrus Swainson 1838 (Actinopterygii), originally spelled *Brachirus*. Regarded as an inadvertent error by some authors, but it is likely that the author was responsible for the misspelling.

Clarias Scopoli 1777 (Actinopterygii), originally spelled *Chlarias*. The name was based on a name *Clarias* published in a non-binominal work (Gronovius 1763), *Chlarias* is regarded as a typographical error. But this was not visible in Scopoli's work itself.

Holocentrus Scopoli 1777 (Actinopterygii), originally spelled *Holocenthrus*. The name was based on a name *Holocentrus* published in a non-binominal work (Gronovius 1763), *Holocenthrus* is regarded as a typographical error. But this was not visible in Scopoli's work itself.

Mastacembelus Scopoli 1777 (Actinopterygii), originally spelled *Mastocembelus*. The name was based on a name *Mastacembelus* published in a non-binominal work (Gronovius 1763), where the name was spelled with the correct connecting vowel. There is a clear provision in the Code (Art. 32.5) that incorrect connecting vowels are not considered as inadvertent errors. Google Scholar 12.2011: *Mastacembelus* was preferred at a rate of 1480 : 78 (all time), 475 : 19 (since 2005).

An error which produced by coincidence a new word (with a meaning that did not contradict the contents of the description), means that there was no clear evidence for the error in the work itself. Taxonomists usually have problems with such cases and do not like to accept Art. 32.5.1 in this point.

Examples:

Clausilia macrostoma Cantraine 1835 (Gastropoda), originally spelled *macrosoma*. Both *-stoma* and *-soma* have meanings, the description gave no clear constraints for *-stoma*. Cantraine 1840 made the printer responsible for the error, this should be accepted as evidence that the author was not responsible. But since the error is not visible in the original source alone, the requirements of Art. 32.5.1 are not met. Only the spelling *macrostoma* is currently used, based on common acceptance in the community.

8.1.2 Names that must not be corrected

This list is much longer.

Most original spellings that are commonly regarded as incorrect, are not inadvertent errors.

In the past (for example in Sherborn's Index Animalium) taxonomists tended to correct more than we do today. There has been a continuously strong trend in the past century to correct as few as possible. In the ICZN Code there are still long and unnecessary passages how to form a correct name (Art. 31, unnecessary because incorrectness has no consequence). In Art. 32.5 the ICZN Code gives only power to correct inadvertent errors, and not to touch incorrect transliterations, latinisations, incorrect connecting vowels.

There are some additional cases which are not explicitly mentioned in Art. 32.5, cases where Latin grammar is incorrectly applied. It is widely agreed that incorrect Latin of names should not be corrected, but disputes arise almost always in those cases for which Art. 31 tells how a name should be correctly formed. In the present manual Art. 32.5 is considered to be superior to Art. 31 because Art. 31 tells us what is incorrect but contains no provisions for correcting an incorrect name. Only Art. 32.5 provides a frame in which an incorrectly spelled name can be corrected.

In a more tolerant interpretation of the Code Art. 31 is considered to allow correction of incorrectly formed names implicitly (the Code would not state that something is incorrect without allowing to correct it). These two positions are eternally arguing against each other, no commonly accepted solution has ever been found. This has to do with different traditions in various disciplines (see below, "incorrect genitives of names dedicated to persons").

In the past, incorrect Latin names were corrected in some disciplines, often not consistently, in others sometimes and in again others consistently not. The result is that some names are in use in a corrected version that would not be corrected today. If two versions are in use, the usual trend is to shift back to the original spelling, or to start discussions on a possible application of Art. 33.2.3.1 or Art. 33.3.1 to see if the incorrect spelling is in prevailing usage and can be used for this reason. In the present paragraph these two Articles are entirely ignored and only the "pure" rules are explained. In every case where is said "must not be corrected" this implies that in the next step the discussion can start again and the incorrect spelling can be evaluated under aspects of "prevailing usage".

There are various sources for errors which are not inadvertent errors.

In many cases names dedicated to persons were (most probably) spelled incorrectly in the original sources, and the names of the persons **were not mentioned**. I would not recommend to research to which and how many persons the names were dedicated. This creates only problems, sooner or later two spellings will both come into usage because some taxonomists interpret Art. 31.1 in a form that the Code gives the power to correct incorrectly formed names dedicated to persons and the others argue that the original spelling is not corrected, only Art. 32.5.1 allows a correction (see below, "incorrect genitives of names dedicated to persons").

Examples:

Callyodon iseri Bloch 1789 (Actinopterygii), dedicated to Mr. Isert, Bloch's name *iseri* could be regarded as an inadvertent error for *iserti*, but Bloch spelled the name 3 times as *iseri*. This does not support the presence of an inadvertent error.

Pseudothyria jheringi Miranda Ribeiro 1915 (Actinopterygii), was corrected by some authors to *iheringi*. The author used *j* instead of *i*, but the German name is sometimes spelled Jhering (and pronounced Yering), sometimes Ihering, so there is no clear evidence for an inadvertent error in the work itself. The fact that Miranda Ribeiro spelled the name *iheringi* in later publications has no influence.

Helix frivaldszkyi Calcar 1847 (Gastropoda), *Bulimus frivaldskyi* Pfeiffer 1847 (Gastropoda) - both names remain unchanged, Mr. Frivalds(z)ky's true name on his 1847 passport is not of interest and does not need to be researched.

Trichobuthus grubleri Vachon 1942 (Scorpiones), obviously dedicated (as suggested by Vachon 1952) to Mr. Gübler, must not be corrected to *T. guebleri* because there is no evidence in the work itself for an inadvertent error, Gübler's name was not mentioned.

Arenea osbekii Scopoli 1763 (Araneae), obviously dedicated to Mr. Osbeck, gives no evidence for an inadvertent error in the work itself, and must not be corrected to *osbeckii* or *osbecki*.

In other cases names dedicated to persons were spelled in the original sources with incorrectly applied or hardly acceptable Classical Latin rules or incorrect transcriptions, and the names of the persons **were mentioned**. These cases are frequent. The original spelling is not corrected.

Examples:

Stewardia Gill 1858 (Actinopterygii), expressly dedicated to Mr. Steward, use of v instead of w can be deliberate.

Limois emelianovi Oshanin 1908 (Auchenorrhyncha), expressly dedicated to Mr. Emel'yanov (spelled Emelianov on the original work), must not be corrected to *emeljanovi*.

Iburiella kasawae Jordan & Hubbs 1925 (Actinopterygii), expressly dedicated to Mr. Kazawa, incorrectly transcribed and with incorrect or disputable ending, must not be corrected to *kazawai*.

Zua boissii Dupuy 1850 (Gastropoda), expressly dedicated to Mr. de Boissy, formed from a latinized form Boissius, must not be corrected to *boissyi*.

Pomatias gracilis var. *sturanii* Wagner 1897 (Gastropoda), expressly dedicated to Mr. Sturany, formed from a latinized form Sturanius, must not be corrected to *sturanyi*.

Doris fontainii D'Orbigny 1837 (Gastropoda), expressly dedicated to Mr. Fontaine, formed from a latinized form Fontainius, must not be corrected to *fontainei*.

Pupa stabili Martens 1865 (Gastropoda), substitute name for *Pupa mortilleti* Stabile 1864 of which the author was mentioned, name was formed from a latinized form Stabilus, must not be corrected to *stabilei*.

Often names based on **localities** were spelled incorrectly. These cases are very frequent, in all graduations and colour shades. The original spelling is not corrected.

Helix balthica Linnæus 1758 (Gastropoda), named after the Baltic Sea, must not be corrected to *baltica*.

Malapterurus ogoensis Sauvage 1879 (Actinopterygii), derived from Ogooué river in Congo, has later been spelled *ogoensis* and *ogooensis*, but there is no evidence for an inadvertent error in the original work. It is possible that the author selected this name for phonetic reasons.

Careproctus atacamensis Andriashev 1998 (Actinopterygii), from the Atacama region in Chile, certainly not a typographical error for *atacamensis*.

Pomatias sardous Westerlund 1890 (Gastropoda), named after the island of Sardinia in Italy, must not be corrected to *sardus* or *sardosus*.

In some cases the original spelling has **no meaning** and it is likely that the author intended something else. These cases are not very frequent, often such corrections were made by authors who did not consult the original source. The original spelling is not corrected.

Examples:

Aerotylenchus Fotedar & Handoo 1979 (Nematoda) was translated by Fortuner 1984 as "flying" *Tylenchus*, who suggested an inadvertent error for *Aerotylenchus* because nematodes don't fly. This is unacceptable, other interpretations are possible and the prefix *Aero-* has a meaning.

Sometimes **incorrect connecting vowels** were used in a compound name. These cases are rare, but can involve names of important genera. The original spelling is not corrected.

Examples:

Gymnocanthus Swainson 1839 (Actinopterygii), was later corrected by authors to *Gymnacanthus*, but there is no evidence for an inadvertent error in the original work, where the name *Gymnocanthus* was mentioned three times. The author was responsible for the incorrect connecting vowel.

Coniasaurus Owen 1850 (Squamata) must not be corrected to *Coniosaurus* because the connecting vowel was incorrect.

Occasionally names were based on incorrectly spelled Latin words or had unusual endings. Such cases are not very frequent. If the author already misspelled the Latin words on which a name was based, there is evidence that the author was alone responsible for the error. The original spelling is not corrected.

Examples:

Centrostephanus rubicingulus Clark 1921 (Echinodermata), the prefix *rubi-* was derived from *rubus* = red as the author explained in a footnote. The name must not be corrected to *rubicingulus* despite of the fact that *rubus* did not mean *red*. It was evident that the author had not consulted a Latin dictionary and that the author was responsible for the mistake.

Ornithomya Latreille 1802 (Diptera) must not be corrected to *Ornithomyia* because today most dipteran genera have the ending *-myia*.

Incorrect genitives of names dedicated to persons. In various cases the ending of a name dedicated (expressly or putatively) to one or several female or male persons was definitely or probably incorrect. This is a highly disputed issue. Many taxonomists have intended to correct such names. This varies among disciplines. Correctness and incorrectness of the genitive endings as such have also been disputed (some authors like Brandon-Jones et al. 2007 have argued that the etymological meaning of the family name should be regarded as decisive for forming the genitive, not the sex of the person).

The correct endings are explained in Art. 31.1, which has the effect that some taxonomists interpret Art. 31.1 in a form that the Code gives the power to correct incorrectly formed names dedicated to persons. Others argue that the intention to extract power from Art. 31 for the correction of errors in taxonomic names fails because Art. 32.5.1 is the only Article in the Code that expressly allows to correct original spellings (Brandon-Jones et al. 2007, Dubois 2007). Art. 32.2 rules that any original spelling is deemed to be correct if it is not incorrect under Art. 32.5. This rules out that an incorrectly formed name under Art. 31 would be an incorrect original spelling under Art. 32.

The ICZN Commission was asked in a mailing list query in 2012 how to interpret Art. 31.1, with the result that various Commissioners expressed contrary positions, so that no final ruling for the current situation in the sense

of Art. 89.1.1 was possible. This was the usual situation. Some Commissioners argued that Art. 31.1 does allow correcting such names by zoologists who regard their endings as incorrect. There was however sufficient agreement to modify this Article in the next Code edition into a form that expressly will not allow any subsequent corrections of the endings of such names any more.

The following are the correct formations of names dedicated to persons (Art. 31.1): dedications

to one male person end in *-i*,

to one female person *-ae*,

to several persons containing at least one male person *-orum*,

to several female persons *-arum*.

Examples:

Name dedicated to Mr. John Smith: *smithi*.

Name dedicated to Mrs. Eileen Smith: *smithae*.

Name dedicated to Mr. John and Mr. Frank Smith: *smithorum*.

Name dedicated to Mr. John and Mrs. Eileen Smith: *smithorum*.

Name dedicated to Mrs. Eileen and Mrs. Mary Smith: *smitharum*.

It is allowed to latinize names (Art. 31.1.1), so that words can end in *-ii* (Cuvier becomes Cuvierius, giving *cuvierii*).

It is usual practice to regard at least some male names ending in *-a* as feminine Latin words (Art. 31.1.1), giving *podae* or *sebae*. It remains unclear if this can also be applied to Italian and Japanese names, but it is occasionally done. These cases are relatively frequent. In all these cases it is strongly recommended not to correct the original spelling, and even less if the "correct" name had not been used before.

Examples:

Acicula vezzanii Bodon, 1994 (Gastropoda), expressedly dedicated to Mrs. Vezzani, must not be corrected to *vezzaniae*.

Helix cavannae Paulucci 1881 (Gastropoda), expressly dedicated to Mr. Cavanna, must not be corrected to *cavannai*.

Zonites festae Pollonera 1916 and *Parmacella festae* Gambetta 1925 (Gastropoda), both expressedly dedicated to Mr. Festa, must not be corrected to *festai*.

Plesiops nakaharae Tanaka 1917 (Actinopterygii), expressedly dedicated to Mr. Nakahara, must not be corrected to *nakaharai*.

Iburiella kasawae Jordan & Hubbs 1925 (Actinopterygii), expressedly dedicated to Mr. Kazawa, must not be corrected to *kasawai*.

Helix prophetarum Bourguignat 1852 (Gastropoda), dedicated to male prophets, must not be corrected to *prophetorum*.

Not modifying a personal name to the genitive case is allowed (Art. 31.1), but not recommended. Also these names are not corrected. It is not necessary to research which sex the person(s) had to whom the names were dedicated. Prior to 2000 the genitive ending was added in such cases, today this is not done any more.

Examples:

Cerambyx scopoli Fueßlin 1775 (Coleoptera), expressly dedicated to Mr. Scopoli, must not be corrected to *scopolii*.

Lamia scopoli Herbst 1784 (Coleoptera), expressly dedicated to Mr. Scopoli, must not be corrected to *scopolii*.

Clausilia strobil Strobel 1850 (Gastropoda), dedicated to Mr. Strobel, must not be corrected to *strobili*.

Pomatias porro Strobel 1850 (Gastropoda), dedicated to Mr. Porro, must not be corrected to *porroi*.

Pupa ferrari Porro 1838 (Gastropoda), probably dedicated to Mr. or Mrs. Ferrari, must not be corrected to *ferrarii* or *ferrariae*.

Bodianus jacobevertsen La Cepède 1802 (Actinopterygii), originally spelled *Jacob Evertsen* and *jacob-evertsen*, named after a Dutch man, must not be corrected to *jacobevertseni*.

Endings *-i* and *-ii* stay as they were originally published (Art. 31.1.3, 33.4).

This is a very important and very frequent case. Very often the verification of the original description of a name brings the result that the usual spelling must be corrected from *-ii* to *-i* or vice-versa. There have been long debates and unsuccessful attempts in the late 1900s to establish rules not to use the ending *-ii* any more. This resulted in a very strong ruling in the 4th edition that the original spelling is not corrected (Art. 31.1.3), and that subsequent corrections are largely ignored (Art. 33.4).

Examples:

Helix rothii Pfeiffer 1841 (Gastropoda): currently used as *Monacha rothii*.

Isthmia rothi Reinhardt 1916 (Gastropoda): currently used as *Truncatellina rothi*.

Other very similar letters were also corrected in the past. This is usually not done today and had to do with the situation that many scientists spoke Latin in the old times, and everyone claimed to speak it correctly.

Examples:

Cuculus sinensis Linné 1766 (Aves), *Oriolus chinensis* Linné 1766 (Aves).

Scopelus novaeseelandiae Steindachner 1900 (Actinopterygii), *Bowenia novaeseelandiae* Haast 1873 (Actinopterygii), *Craptalus novaeseelandiae* Günther 1861 (Actinopterygii).

This subchapter has summarized what must not be corrected under Art. 32.5.

8.1.3 Selection procedure between two equivalent original spellings

If a name was originally established in various equivalent spellings, the **First Reviser** decides which one to use. This is usually the first publication that proposed to solve the problem. The spellings must be cited, and the selected correct spelling must be determined (Art. 24.2.3).

Examples:

Patagonina Eigenmann 1929 (Actinopterygii), originally spelled three times *Patagonina*, one time *Patagonia*. White 1985 selected *Patagonina* as the correct spelling.

Otocinclus obtusus Miranda Ribeiro 1911 (Actinopterygii), originally spelled *obtusos* and *obtusus*. Britski & Garavello 1984 selected *obtusus* at the correct spelling.

Orestias agassizii Valenciennes 1846 (Actinopterygii), originally spelled *agassizii*, *agassisii* and *agassii*. Garman 1895 cited only two names *agassizii* and *agassii* and selected *agassizii*. This seems to have been commonly accepted.

Usually the First Reviser is difficult to find. Authors rarely cited both versions, they just used one as correct. So there is an auxiliary rule (effective since 2000) that if the original author (or one of the co-authors) used one spelling as correct in a subsequent work, this can count as a First Reviser decision even if the two spellings are not cited (Art. 24.2.4).

Example:

Simroth 1886 proposed a new species as *Agriolimax sardus* (Gastropoda) on p. 319, and as *Agriolimax sardinus* on the plate explanation of plate 10. Simroth 1900 mentioned this species as *Agriolimax sardus* (only using this spelling) and at this occasion fixed *sardus* as First Reviser.

8.1.4 Treatment of subsequently modified spellings of names

If a name was subsequently spelled in a different orthography than in the original source, and definitely not in accordance with the rules given above and those of gender agreement, it is necessary to decide about the nature of the incorrect spelling.

In such a case three interpretations are possible: an incorrect subsequent spelling (Art. 33.3), an unjustified emendation (Art. 33.2.3) or a new name.

8.1.4.1 Unjustified emendations

To qualify for an **unjustified emendation**, there must either be an explicit statement of intention, or the original and the modified spelling must both have been cited (Art. 33.2.1), and the modified name must have been used as name for the same taxon (Art. 33.2.3). Art. 33.2.1 contains a provision that we are also dealing with an emendation "when two or more names in the same work are treated in a similar way". This provision is often overlooked and frequently disputed because it is not entirely clear and not equipped with examples to understand its exact intention. It is an example where insider knowledge is necessary to understand the Code, and this insider knowledge has got lost in the course of the past decades.

The spelling must differ in more than only *-i/-ii* (Art. 33.4, this concerns also *-ae/-iae* etc.).

The unjustified emendation has its **own authorship and year**, dating from the source where the unjustified emendation was established, and is available as a name for a taxon. It is an **objective junior synonym** of the correct name, enters homonymy and can be used as a substitute name.

Examples:

Amphitrite cirrata Müller 1776 (Annelida) was an unjustified emendation for *Nereis cirrosa* Linnaeus 1758. Both names were cited, *cirrata* was used as the name. In a previous publication Müller 1771 had explained that he considered *cirrata* as more correct Latin than *cirrosa*, but in that publication had not used the name as valid. So it was not an unjustified emendation there.

Noctua cincta Fabricius 1787 (Lepidoptera) was an unjustified emendation for *Phalaena (Noctua) i-cinctum* [Denis & Schiffermüller], 1775 (original spelling [*Phalaena*] *Noctua I cinctum*). Fabricius 1787 had cited the 1775 name as *Noctua i cinctum*.

Hyalinia aegopsinoides Westerlund 1886 (Gastropoda) was an unjustified emendation for *Helix aegopinoides* Maltzan 1887, both spellings were mentioned.

Pupa ringens var. *bigerrensis* Moquin-Tandon 1856 (Gastropoda, currently in genus *Abida*) was an unjustified emendation for *Pupa bigoriensis* Rossmässler 1837 which was explicitly cited (not *Pupa bigorriensis* Des Moulins 1835, currently in genus *Chondrina*).

Moquin-Tandon's name can be used as a substitute name for Rossmässler's *Abida* species because in contrast to Rossmässler's spelling (single/double consonant, Art. 58.7), Moquin-Tandon's spelling *bigerrensis* was not a homonym of *bigorriensis*.

In some cases an unjustified emendation seems less likely than an inadvertent error (Art. 32.5.1), and should possibly not be regarded as available.

Example:

Fabricius 1781 mentioned a name *Papilio hyacinthinus* (spelled *hyacin-cinthus* with a line break between *cin* and *cin*) and in the next line quoted "*Papilio Hyacinthus*" with a bibliographical reference to Cramer 1775. A name *hyacinthinus* does not give sense. It seems more likely that the name was not meant as new, that *Papilio hyacinthus* Cramer 1775 was intended to be used, and that the double *cin-cin* was a printer's error. *Papilio hyacinthinus* should not be seen as an unjustified emendation.

8.1.4.2 Incorrect subsequent spellings

An **incorrect subsequent spelling** is either a misspelling or a deliberately different spelling, not in accordance with the rules given above, and always without an explicit statement of intention, or without having cited both the original and the changed spellings.

This occurs extremely frequently.

Technically this produces a new name, but this new name does not count, it is not recorded, it obtains **no authorship and no year**, it **does not enter homonymy** and a name in this spelling can be established at any time as new for other animals in the future.

The Code rules that in cases of doubts between incorrect subsequent spellings and unjustified emendations, the misspelling shall be interpreted as an incorrect subsequent spelling (Art. 33.5). But this is usually not the problem, I do not know a single example of this kind. Art. 33.2.1 lists the requirements for an unjustified emendation quite exactly so that the definition of that term is usually no problem. Only the provision "treated in a similar way" may cause confusion.

The real problem is however, that the Code (Glossary and Art. 33.3) does not define minimum standards for identifying incorrect subsequent spellings at all, which means that an incorrect subsequent spelling remains an entirely **undefined term in relation to a new name**. Anyone can regard any incorrect spelling as a new name, and fix a new type for the taxon. Until recently the Commission has not given any restrictions to such a practice, in the contrary. The arbitrary interpretation of incorrect spellings as new names was encouraged.

Example:

Aranea Linnæus 1758 (Araneae) was defined in Opinion 2224 (2009) to have been established as a new name and not as an incorrect subsequent spelling for *Araneus* Clerck 1757 (in both cases the same result would have been obtained, except that arachnologists now have to disambiguate species which were established in *Araneus* and in *Aranea*: names established in *Aranea* will need parentheses). The Commission neglected that both authors used the name for the same group of species and Linnæus 1758 referred clearly to Clerck's 1757 work in the species accounts.

Zoological nomenclature is not based on a case law (Art. 80.5) and the Opinion does not have direct impact on other cases. But since the decision between "new name" and "incorrect subsequent spelling" in this case was arbitrary, it demonstrated that the Commission was not aware that they were promoting the lack of definition for the term "incorrect subsequent spelling", and that they were encouraging authors to interpret this term arbitrarily.

In most disciplines it is usual practice to distinguish an incorrect subsequent spelling from a new name by using a short unwritten catalogue of criteria.

- The names must have referred to subjectively the same taxon (from the point of view of the author who spelled the name incorrectly).
- Genera should (at least implicitly) contain largely the same species.
- There must be no change in meaning of the name.
- The change in spelling must be of a minor degree, not more than perhaps 4 letters would differ.
- A change in the ending is regarded a change of minor degree, even if the gender of a genus is modified.

Examples:

A good set of examples of the limits within a generic name can have incorrect subsequent spellings was given in ICZN Opinion 495 for *Lymnaea* Lamarck 1799 (Gastropoda) (in parentheses the numbers of letters difference): *Lymnaeus* (2), *Lymneus* (3), *Lymnoeus* (3), *Lymnea* (1), *Lymnoea* (1), *Lymnula* (2), *Lymnus* (3), *Limnaea* (1), *Limnaeus* (3), *Limneus* (3), *Limnoeus* (4), *Limnoea* (2), *Limneus* (3), *Limnea* (2) - but not *Limnaea* Poli 1791 (Bivalvia) which was used for a different group of species.

In the AnimalBase team, after some years of experience with many incorrect spellings we decided to set the maximum limit of difference arbitrarily at 4 letters. This seemed to be the limit beyond which there was only little acceptance in the taxonomic community to regard a name as an incorrect spelling, even if all other criteria summarized above applied. Of course this did not apply to very short words, but in these short words, this magnitude of difference in letters was usually associated with a change in meaning.

If there were more than 4 letters difference, we tended to regard it as a new name. Sometimes 5 letters provoked discussions.

Examples:

Phalaena alstroemeriana as mentioned by Linné 1767 (Lepidoptera) was an incorrect subsequent spelling of *Phalaena alstromeriana* Clerck 1759. 1 letter difference (*e*). *Pyralis alstroemiana* as mentioned by Fabricius 1775 used for the same species was a 2 letters difference (*em* against *mer*). *Phalaena alstromiana* as mentioned by Linnæus 1761 was a 2 letters difference (*er*).

Myrmeleon libelluloides as mentioned by Linné 1767 (Neuroptera) was an incorrect subsequent spelling of *Hemerobius libelloides* Linné 1764. 2 letters difference.

Nepa cicomocoides as mentioned by Poda 1761 (Heteroptera) was apparently an incorrect subsequent spelling of *Nepa cimicoides* Linnæus 1758. 3-4 letters difference (*como* against *mi*, the *m* was contained in both).

Correct name *Driessena* Van Beneden 1835 (Bivalvia), incorrect subsequent spellings *Dreissena* (2 letters difference), *Dreissensia* (4 letters difference).

Correct name *Viviparus* Montfort 1810 (Gastropoda), incorrect subsequent spelling *Vivipara* (2 letters difference).

Correct name *Buccinum praemorsum* Linnæus 1758 (Gastropoda), incorrect subsequent spelling *B. praerosum* (2 letters difference).

Occasionally it can be necessary or desirable to cite an authorship for such an unavailable name. If such a name is technically treated like an available name of a taxon, with author and year, it should always be mentioned with a distinct comment that the name is not available (Recommendation 50C, 51F). For example, it can be shown in a different colour, or with an attached comment "unavailable name", or the authorship is not directly combined with the name and separated by a term like "as mentioned by".

There are innumerable examples for incorrect subsequent spellings. The more complicated the names are, the more incorrect subsequent spellings can be expected. It is strongly recommended not to establish complicated names.

Examples:

Homo sapiens is an incorrect subsequent spelling for *Homo sapiens* Linnæus 1758 (Mammalia).

Hipparchia fagi is an incorrect subsequent spelling for *Hipparchia fagi* (Scopoli 1763) (Lepidoptera).

Neptis sankara xishuannabannaensis is an incorrect subsequent spelling for *N. s. xishuanbannaensis* Yoshino 1997 (Lepidoptera).

Thecla betulae yiliguoziguanæ is an incorrect subsequent spelling for *T. b. yiliguozigounæ* Huang & Murayama 1992 (Lepidoptera).

Sczurekia is an incorrect subsequent spelling for *Sczurekia* Gonzalez-Sponga 1992 (Opiliones).

Neomrozkowskiella is an incorrect subsequent spelling for *Neomrozkowskiella* Kania 1999 (Coleoptera).

8.1.4.3 New names

A **new name** can result from a modified spelling of a previously established name, if there are constraints in the description that the new name denoted something different from the original taxon.

But the Code does not discourage to arbitrarily interpret any slightly different name referring to the same taxon either as an incorrect subsequent spelling or as a new name. There has probably not been a consistent interpretation of rules in this point, such cases are not very frequent and every case was probably judged individually with an independent result and history.

Examples:

Attelabus formicaroides Schrank 1776 (Coleoptera): The author referred to *Attelabus formicarius* Linnæus 1758 and explained that the present form was slightly different, but belonged to the same species. The name *formicarioides* was not thought to replace entirely the original name *formicarius*, but to make clear that there was a slight difference between the present form and the original species. The name was established as new, and it was used as the correct name for the species the author had in mind, in the author's taxonomic judgement. The name was new and is available.

Crioceris melanopoda Müller 1776 (Coleoptera): The author described a chrysomelid beetle under this name and the style indicates that the author considered the name probably as new. It is also possible that Müller had *Chrysomela melanopus* Linnæus 1758 in mind, but the original publication gives no constraints to substantiate this assumption. It is likely that *Crioceris melanopoda* was meant as a new name.

The same name used for other animals

If the same name was used for another animal, it is necessary to analyse the intention of the author. It is either a new name (and as such, a junior homonym), or a sensu name, or a deliberate misidentification. The last case is very rare.

New names (junior homonyms)

If there is no evidence in the original source that the author intended to use the previously established name, which involves that the name is used in a different animal group, it is a new name. This happens very frequently.

Examples:

Jelskia Bourguignat 1877 (Gastropoda), not a subsequent use of *Jelskia* Taczanowski 1871 (Araneae).

Coryna Westerlund 1887 (Gastropoda), not a subsequent use of *Coryna* Bosc 1802 (Cnidaria), *Coryna* Wolff 1811 (Heteroptera), *Coryna* Billberg 1813 (Coleoptera) or *Coryna* Lepeltier & Serville 1828 (Hymenoptera).

Lymnaea Poli 1791 (Bivalvia), not an incorrect subsequent spelling of *Lymnaea* Lamarck 1799 (Gastropoda).

For the limit between a new name and a subsequent use see the chapter "Was the name new when proposed?".

8.1.5 Prevailing usage

In the 4th edition of the ICZN Code rules were incorporated that an incorrect spelling "must" be maintained if it is in "prevailing usage" (Art. 33.2.3.1, Art. 33.3.1). The main idea behind this and other new rules was that regulations in the ICZN Code should not be applied if this distorts commonly accepted usage of names. Well-known names should not need to be changed. The idea behind this is expressed in the term "stability".

But on the other hand the new rules can also be interpreted in a way that the Code can be regarded as a proposal how to spell a name correctly, but if taxonomists have spelled a name incorrectly, they can define this as "prevailing usage" and the Code is not needed any more. These are currently the two extreme positions in the discussions about this provision.

The term "prevailing usage" is not well defined and its meaning is under dispute, this concerns both parts of the term. The Glossary ("usage, prevailing") defines it as "that usage of the name which is adopted by at least a substantial majority of the most recent authors concerned with the relevant taxon, irrespective of how long ago their work was published."

This definition has various drawbacks. It is only indirectly said that usages in the sense of this definition must be published work under the Code - which excludes all internet usages and important online databases which in various animal groups are much more important resources for consulting information than individual publications. The term "substantial majority" suggests that the name should have been used by many authors, which is also suggested by the examples given in Art. 33 *Trypanosoma brucei* and *Helophorus*, extremely frequent names with thousands of hits in Google Scholar (12.2011). Literally it covers also cases in which a name was only used 3 times in the past 40 years, or by only 3 authors, or where the most recent authors lived more than 100 years ago.

The term "substantial majority" remains undefined and is not a standard expression, it can mean anything between 50 and 100 %, "substantial" suggests clearly more than 50 % and "at least" suggests that 100 % would not fall under this definition. If I interpret this term now to mean 80 %, other will dispute it and either argue that more is needed, or less.

The disputes start with the interpretation of the rule itself, even before beginning to analyse the individual case itself. Analysing the case will open new disputes.

It is not clear where to count an author who used one spelling in one paper and another spelling in another paper. Shall a paper with 10 co-authors have the same weight as 10 papers with single authorships?

The definition has a temporary component, prevailing usage can only be determined at a certain time. If the majority situation changes, the spelling will come out of prevailing usage. This can quickly affect names of rarely mentioned species. The regulation provides a base for endless fights in those cases where only few authors are involved.

A good recommendation might be not to apply Art. 33.2.3.1 and Art. 33.3.1 for those cases which would not meet the conditions of Art. 23.9.2, in other words, for rarely used names mentioned by less than 10 authors in less than 25 papers in the past years.

Personally I would extend this to at least 20 or 30 authors, otherwise it is questionable to talk of a "substantial majority". And I would only count the first author in each paper. I would generally not recommend to apply "prevailing usage" except in extremely frequently used names - the examples given in Art. 33 are misleading because the ICZN Commission took official decisions concerning the emended spellings of *T. brucei* and *Helophorus*.

It is always possible to determine the correct original spelling.

It is almost always difficult to determine if and when an incorrect spelling has been in "prevailing usage". Many publications must be consulted, authorships must be analysed, careless research can lead to incorrect conclusions, the result can be disputed.

It is almost always better to stick with or shift back to the correct original spelling.

The Google method

I experienced that counting **Google hits** for "genus-species" combinations have produced for the past years relatively reliable results in terms of comparability, and that it has been the only practicable method to estimate "prevailing usage". In practical life it is impossible to consult quickly 50 or 100 papers to determine the correct spelling of a name.

Google (general search engine) underwent an unfavourable development during the past years 2007-2011. Disambiguating slightly different spellings (and counting hits for them) was distorted since Google started lumping results of variant spellings, the number of indicated hits became increasingly arbitrary, the maximum number of true hits was after 2009 limited at around 5-700. After 2009 Google began an increasingly strong preselection of hits by countries and by user preferences. At the same time genuine internet content was repeatedly copied and reproduced thousands of times. In 2011 the Google results could practically not be used any more except for providing some evidence that uncommon spellings are not or extremely rarely used.

Since 2009 **Google Scholar** became an increasingly important tool for testing prevailing usage. This engine lists only scientific publications, analyses full texts of PDF files and can be restricted to exclude scanned old literature. This reduces the usage to purely scientific environments. Caution also here, it is possible that hundreds of red lists (red data sheets) are listed, all in slightly different versions containing basically the same information.

In both search engines it was possible to estimate the importance of a name. Google hits below 100 indicated (2009/2010) rare use, 1000 was slightly above average, but still mostly within a narrow frame of scientific websites, more than 10,000 hits indicated more frequent use, also outside a special discipline, and more than 100,000 hits indicated worldwide use of a very important name. In European non-marine molluscs, which is probably an average group of animals (less well-known than vertebrates and easier to identify than insects), only 3 of more than 2000 species belonged to the last group.

Usage depends generally on continent or region and general public interest in the concerned animal group. Africa and SE Asia have lowest hit rates, Europe, Australia and N America highest, SE Europe has substantially less hits than Central Europe.

In Google Scholar it is possible to select time spans in the menu. It is convenient to proceed in 4-year steps, this allows a relatively quick analysis to see trends. Minimum date in 2011 was 1992. "Date ignored" means any time, this query yielded around 2 times higher proportions than "since 1992" and included mainly papers published after 1992, without recorded date in the metadata.

Application of "prevailing usage"

In the same sense the "prevailing usage" concept could also be applied to some cases where entire disciplines deviate broadly or nearly consistently from some provisions of the Code, like for example many arachnologists who associate Clerck's spider names with the 1757 date (disregarding Art. 3.1 that says 1758) or many lepidopterists who disregard gender agreement. At least parts of the dinosaur research community seem to correct genitives of names dedicated to persons if formed incorrectly in the original source.

Example:

Seismosaurus hallorum Gillette 1991, originally established as *Seismosaurus halli* and dedicated to Mr. and Mrs. Hall. Subsequent authors have proposed to correct *halli* to *hallorum*.

Google Scholar (02.2011): "seismosaurus-halli" 34, "seismosaurus-hallorum" 26, "diplodocus-halli" 0, "diplodocus-hallorum" 3.

Google Scholar (12.2011): "seismosaurus-halli" 35, "seismosaurus-hallorum" 34, "diplodocus-halli" 0, "diplodocus-hallorum" 8.

When an author proposes using an older name, it is usually not convenient to attempt maintaining usage of the younger name, especially if the species is not very frequently mentioned.

Example:

Papillifera bidens (Linnæus 1758) (Gastropoda) from Italy was known until the late 1900s as *Papillifera papillaris* (Müller 1774). Most authors used *P. papillaris* mainly because the identity of *Turbo bidens* Linnæus 1758 was unclear. Falkner et al. 2002 proposed to use *Turbo bidens*, which had rarely been used before, but never for a different species. A proposal to conserve the use of *papillaris* was officially rejected by the ICZN in Opinion 2176 (Sep 2007). Comparing Google hits within two years suggests that *bidens* is about to replace *papillaris* slowly.

Google hits (general search):

07.2007: "papillifera-papillaris" 430, "papillifera-bidens" 100 (81 : 19 %)

07.2009: "papillifera-papillaris" 500, "papillifera-bidens" 240 (68 : 32 %)

02.2011: "papillifera-papillaris" 2280 / 350, "papillifera-bidens" 656 / 230 (60 : 40 %)

Google Scholar:

02.2011, date ignored: "papillifera-papillaris" 45, "papillifera-bidens" 35 (68 : 32 %)

02.2011, since 1992: "papillifera-papillaris" 20, "papillifera-bidens" 4

02.2011, since 1996: "papillifera-papillaris" 18, "papillifera-bidens" 4

02.2011, since 2000: "papillifera-papillaris" 16, "papillifera-bidens" 4

02.2011, since 2004: "papillifera-papillaris" 14, "papillifera-bidens" 4

02.2011, since 2008: "papillifera-papillaris" 2, "papillifera-bidens" 2

12.2011, date ignored: "papillifera-papillaris" 45, "papillifera-bidens" 49 (47 : 53 %)

There are some extremely rare cases where the original spelling has never been used, and Google gives no hits at all indicating a use of the original spelling. In such a case it seems convenient not to shift to the original spelling, at least as long as no author uses it in a publication.

Example:

Muticaria macrostoma (Cantraine 1835) (Gastropoda), originally spelled *macrostoma*, most probably not an inadvertent error, but some authors may dispute this and argue that the name *macrostoma* would not fit the description of the species.

Google hits 07.2009: "muticaria-macrostoma" 0, "muticaria-macrostoma" 160.

Google Scholar 12.2011: "muticaria-macrostoma" 0, "muticaria-macrostoma" 7

8.1.6 Gender agreement

Gender agreement in zoological names is a heritage of the Latin language.

Like most languages spoken between Bangladesh and Europe and unlike English, Chinese, Japanese and many other languages, Latin has genders. An adjective will change its ending according to the gender of the noun with which it is combined (participles are adjectives in the sense of this manual).

Genera are nouns, and specific names can be adjectives. Every adjectival specific name which is used for a taxon "must" agree in gender with the genus with which it is combined (Art. 31.2 - the "must" is incorrect because if not, there are no consequences). This is called gender agreement.

Not many zoologists know Latin today. Many consider it as an unnecessary obstacle to taxonomic work, to force biologists to apply something they are absolutely not skilled in. This is argued to prevent scientists from doing more biological research, to add more knowledge to science and to help protecting nature. Those who are in favour of maintaining gender agreement argue that Latin gender agreement is easy, that zoology should keep its historical heritage, and that the endings of many well-known names would have to be changed and sound uncommon afterwards.

This is a steadily ongoing dispute, yet without perspectives for a solution. A neutral comment on gender agreement could hardly be expected in a manual or guide written by a contemporary taxonomist.

As a German native speaker, genders are common to me, but nonetheless I belong to the first fraction. If I try to explain some Latin grammar rules here, this is not in the intention to add a contribution to maintain Latin and

Greek as important languages or tools for the purposes of the ICZN Code. It is rather to show how little we know as zoologists about this language and how much could be achieved and time and energy of skilled zoologists could be saved if all names were simply regarded as arbitrary combinations of letters. But this is only my position, others have others.

Art. 30: gender of genera.

Art. 31.2: gender agreement of species.

In the 1750s, when Linnaeus established the nomenclatural system, Latin was still used as a scientific language (though its use was already declining and replaced by a variety of modern European languages: German, French, Swedish, English, Danish, Dutch and Italian). This had the effect that Latin (and also Greek) gained high importance for zoological nomenclature. English was not very important in the 1700s.

A gender as such is nothing useful. Genders just survived historically. Many languages have 2 or 3 genders, sometimes defined as "feminine and masculine", or "feminine, masculine and neuter", sometimes defined otherwise ("neuter and uter" in Danish or Low German, Indian languages also have other genders). Latin and Greek have three genders **feminine**, **masculine** and **neuter**, and in Latin some nouns have **common** gender (both masculine and feminine at once).

In zoology every genus must have a well defined gender. This provokes the need to create rules how to deal with common gender.

As said above, if gender agreement would be removed, nomenclature would be much easier and we could skip this whole chapter explaining how to apply the rules for gender agreement. And remove long articles from the Code.

The only shortcoming of such a simplification of the Code would be that 4-8 % of the specific names, depending on the animal group, would have to change their endings in their currently used combinations. Otherwise we would need long and complicate chapters to conserve such endings - in such a case we could leave gender agreement in the form it is.

Example:

Locusta migratoria (Linnaeus 1758) (Caelifera) would have to be called *Locusta migratorius*, since it was originally established as *Gryllus migratorius*.

I will keep this chapter shorter than it should be, because like most zoologists I know only basic Latin and I don't like applying genders in zoology.

A gender is nothing useful.

8.1.6.1 How to determine the gender of a generic name

This is difficult and sophisticated.

Zoological generic names can have three genders: feminine (58 %), masculine (38 %) or neuter (4 %). 5 % of the zoological genera are basically of common gender, but the zoological rules do not allow common gender.

These proportions differ among animal groups. In birds the proportions are 47 f + 51 m + 2 n, in European non-marine gastropods 77 f + 19 m + 4 n.

It is possible that the genus was once mentioned in an Opinion published by the ICZN Commission. The genders of more than 850 generic names were specified at these occasions. If the gender was incorrect, it is convenient to accept the gender as having been recorded by the Commission.

Example:

In Opinion 335 the genus *Cecilioides* Férussac 1814 (Gastropoda) was validated from a non-binominal work. The Commission regarded the genus as feminine. This was incorrect, it should have been masculine. It is convenient to regard the gender of *Cecilioides* as having been fixed as feminine under the plenary powers.

If the generic name is a **Latin word**, you must consult a **Latin standard dictionary**. The genus takes its gender from there. There are no good online Latin dictionaries, and there are differences between Classical and Postclassical Latin. Zoologists tend(ed) to use Postclassical Latin, which reflects that like every other language, Latin evolved during the time it was used as a tool for communication.

If the author determined the gender incorrectly, the Latin dictionary's gender must invariably be taken.

If the Latin name had **common gender** the zoological name must have the gender which was chosen in the original publication (this can be seen when the name was combined with an adjective, Art. 30.1.4.2, French version). If none was selected there, the gender must be masculine. This procedure applies to more than 15,000 generic names in zoology, common gender can be recognized at the ending of the generic name:

Common gender endings: **-icola**, **-ites**, **-oides**, **-ides**, **-odes**, **-istes**

The experience with this rule is that many zoologists have difficulties if the names are feminine, and in practical life many important species do not have unique names.

Examples (Google hits from 07.2009):

Scarites Fabricius 1775 (Coleoptera) is masculine because it was originally combined with the specific names *subterraneus*, *cyaneus* and *arenarius*. The genus is currently used and treated as masculine.

Libelloides Schaeffer 1766 (Neuroptera) is masculine because it was not originally combined with an adjective or otherwise determined. The genus is currently used and treated as masculine.

Ixodes Latreille 1795 (Acari) is masculine because it was not originally combined with an adjective or otherwise determined. The genus is currently used and treated as masculine.

Melanooides Olivier 1804 (Gastropoda) is feminine because it was originally combined with the specific name *fasciolata*, a feminine Latin adjective. Two genders are used, masculine and feminine.

"melanooides-tuberculatus" 21200, "melanooides-tuberculata" 16300

Hydrooides Gunnerus 1768 (Annelida) is feminine because it was originally combined with the specific name *norvegica*, a feminine Latin adjective. Two genders are used, feminine and masculine.

"hydrooides-norvegicus" 500, "hydrooides-norvegica" 1050

Chalcides Laurenti 1768 (Squamata) is feminine because it was originally combined with the specific names *tridactyla* and *pinnata*, feminine Latin adjectives. Its use is inconsistent, sometimes feminine, sometimes masculine.

"chalcides-ocellatus" 9800, "chalcides-ocellata" 18300

"chalcides-striatus" 9700, "chalcides-striata" 0

Fruticicola Held 1838 (Gastropoda) is feminine because it was originally combined in a Latin text with an adjective "parva". The genus is currently used but not combined with adjectival species. But the name served as the base for *Metafruticicola* Ihering 1892, which should have the same gender as *Fruticicola*, but such a situation is not ruled in the ICZN Code. Only one author with significant influence treated the genus as masculine, provoking inconsistent use of involved species.

"metafruticicola-lectus" 10, "metafruticicola-lecta" 80

If it is a **Greek word**, you must consult an **Ancient Greek dictionary**. The genus takes its gender from there. Greek has also masculine, feminine and neuter genders. There are no good online Ancient Greek dictionaries. If the author determined the gender incorrectly, the Greek dictionary's gender must invariably be taken.

Greek feminine endings: **-caris, -gaster, -lepis, -opsis**

Greek neuter endings: **-ceras, -nema, -soma, -stigma, -stoma**

To read a Greek dictionary you must know the **Greek script** and the sorting of the 24 letters of the Greek alphabet.

Greek script for zoologists, with Latin equivalents transcribed from Ancient Greek (Modern Greek has the same alphabet, but other transcriptions):

A α (= a), **B** β (= b), **Γ** γ (= g), **Δ** δ (= d), **E** ε (= e), **Z** ζ (= z), **H** η (= e), **Θ** θ (= th), **I** ι (= i), **K** κ (= k), **Λ** λ (= l), **M** μ (= m), **N** ν (= n), **Ξ** ξ (= x), **O** ο (= o), **Π** π (= p), **P** ρ (= r), **Σ** σ ζ (= s), **T** τ (= t), **Y** υ (= y), **Φ** φ (= f), **X** χ (= ch), **Ψ** ψ (= ps), **Ω** ω (= o).

Diacritic marks can be ignored for these purposes.

If it is a **Greek word with latinized ending**, it takes the gender of the latinized ending.

Latinized Greek feminine endings: **-a**

Latinized Greek masculine endings: **-us, -ops**

If it is neither a Latin nor a Greek word, then look how the author treated the name.

There is a curious rule in the Code (Art. 30.2.1) that names derived from other European languages written in Latin script take the gender from there. Obviously nobody knew that genders are totally independent from language to language and do not correspond with each other. The Code does not explain what to do with words of uter gender.

If the gender treatment is not visible in the original publication (if the name was not combined with an adjective), then the ending is decisive (Art. 30.2.4):

Feminine endings: **-a**

Neuter endings: **-um, -on, -u**

Masculine endings: **all others**

To summarize: without consulting Latin and Greek dictionaries it is usually not possible to determine the gender definitely, regardless which ending it has. Ending **-a** is usually feminine, but if a Greek word it can also be neuter or masculine. Ending **-us** should usually be masculine, endings **-um** and **-on** usually neuter, but there is never a guarantee.

It is practically not possible to feed a computer program to determine automatically the gender of a generic name in zoology. It must be done manually, it must be done with good Latin and Greek dictionaries, and they are not available online.

The good news is that most genera have traditionally been treated correctly. But it occurs frequently that taxonomists discover that a genus has a different gender than hitherto believed. Proposed changes (of the involved adjectival specific names) are usually widely and quickly accepted, presumably because the Code is strict in this point and does not allow any exceptions.

If genera are not treated correctly in terms of gender agreement, this is usually not because experts would not know its correct gender. They usually do.

There are some cases of generic names of which the gender is truly disputed among various taxonomists who studied the Latin background and came to different conclusions. These cases are rare and difficult to find

(authors and database providers usually know what is "correct" and rarely admit the presence of a dispute). The most well-known disputed case is *Papilio*, historically by far the most important genus in Lepidoptera. This accounts for the fact that until today gender agreement has not been consistently applied in Lepidoptera (see below).

8.1.6.2 How to recognize a changeable Latin adjective

Specific names can be nouns (Greek words, genitives and the like are nouns in the sense of this manual) or adjectives (participles and names with adjectival endings are adjectives in the sense of this manual).

Adjectives can be changeable (variable, declinable) (*albus, alba, album*) or not (unchangeable, invariable, indeclinable) (*splendens, splendens, splendens*). We are only interested in recognizing changeable adjectives. Unchangeable adjectives behave exactly like nouns and it is not even necessary to know that they are adjectives at all.

Changeable adjectives can only have certain endings, nouns can have all endings.

The possible endings of changeable adjectives are (with their proportions of the zoological names of species, this includes the nouns with the same endings):

-a (39 %), **-us** (24 %), **-is** (13 %), **-um** (3.5 %), **-e** (3.0 %), **-er** (1.1 %), **-ior** (0.2 %)

(Source: AnimalBase, 19 Dec 2011, 47130 specific names in their original combinations, all animal groups, slightly biased towards vertebrates and molluscs)

Specific names with any other ending are unchangeable.

Our problem is that 83 % of the zoological names of species have exactly these endings, and 15 % of these are nouns.

It is not easy to distinguish a Latin adjective from a Latin noun. Not even a computer program could do this reliably, because occasionally the context of the original source is important.

To see if a name is an adjective or not, it is necessary to consult a Latin standard dictionary. And make sure that your dictionary is not too small.

You can also consult Sherborn's Index Animalium, to see if changed versions of the same name exist. But Sherborn made many mistakes, or copied incorrectly formed names from original sources, and is not reliable. The same applies to AnimalBase or other sources - many zoologists established incorrect names, which must stand. Nouns and adjectives can look very much alike.

Examples:

faber is a noun, *glaber* is an adjective. If a zoologist established a name *fabra*, this must stand, *faber* can also be an adjective.

fiber is a noun, *liber* is an adjective.

zebra is a noun, *glabra* is an adjective.

frater is a noun, *ater* is an adjective.

When nouns get adjectival endings they are converted into adjectives: **-ana, -aria, -ata, -ella, -ensis, -ina, -osa**.

Examples:

fiberata, fibulata, brasiliensis, migratoria, smithiana, victorina, victoriana, victoriensis.

Names ending in **-icola** are usually nouns (meaning "dweller"), at least in Classical Latin. But in Postclassical Latin authors used names ending in **-icolus, -icola, -iculum** as adjectives, with slightly different meaning ("dwelling in"). Despite the difference in the meaning of the word, they should be regarded as homonyms. This is neither ruled nor mentioned in the ICZN Code, but otherwise a name established as **-icolus** would become **-icola** if placed in a feminine genus and would not differ from a noun ending in **-icola**.

Example:

Ochthebius lapidicola Wollaston 1864 (Coleoptera), *Ochthebius lapidicolus* Van Dyke 1918. Should be considered as primary homonyms.

Some Latin words can be adjectives and nouns at the same time. If the author did not treat such a name as an adjective, it must be treated as a noun (Art. 31.2.2).

This concerns words ending in **-ifer/-ifera/-iferum** and **-iger/-igera/-igerum**.

For this determination it is necessary to know Latin quite well. I do not know a case where the original name was treated as an adjective. A name *nanum* is certainly an adjective, but *nana* or *nanus* could also be nouns. The same applies to *peregrinus, peregrina, peregrinum*. *monacha* and *monachus* seem to be "pure" nouns, but this might depend from the size of your dictionary.

The resulting problem is that in many cases Art. 31.2.2 is not followed because most authors are not sufficiently skilled in Latin. Consequently many taxa are known under various spellings, and often the incorrect spellings prevail (probably the appropriate statistical proportion).

Examples:

Oestrus phobifer Clark 1815 (Diptera), currently *Cephenemyia phobifer* (Clark 1815) (260 Google hits, 08.2009), not *C. phobifera* (50).

Mus laniger Molina 1782 (Mammalia), currently *Chinchilla laniger* (Molina 1815) (9000), not *C. lanigera* (17,000).

Pupa umbilicus Roth 1839 (Gastropoda), currently *Lauria umbilicus* (Roth 1839) (5), not *L. umbilica* (90). It is both an adjective (= umbilicated) and a noun (= umbilicus), the author did not specify it, so a noun.

Acanthurus velifer Bloch 1795 (Actinopterygii), currently *Zebrasoma velifer* (Bloch 1795) (360), not *Z. veliferus* (30), not *Z. velifera* (80), not *Z. veliferum* (23,000). A rare case where four endings are on the market.

Geographical names are not contained in dictionaries, for these there is no help at all. These are cases where you need a feeling for the language, which only a native speaker has. In living languages you ask a native speaker to solve such problems.

Example:

Cochlostoma parnonis Schütt 1981 (Gastropoda), currently *Cochlostoma parnonis* Schütt 1981, or is it an adjective and should be *parnone*? (Derived from Parnonas mountains, Greece, not found in dictionaries, but it seems that it is a noun).

Latin nouns are never changed to agree in gender with the genus. A feminine species is not changed to its male equivalent if combined with a masculine genus.

Examples:

Panthera leo (Linnæus 1758) (Mammalia) - *Panthera* is feminine and *leo* a masculine noun.

Gasterosteus saltatrix Linné 1766 (Actinopterygii) - *Gasterosteus* is masculine, *saltatrix* is a feminine noun (the feminine form of *saltator*).

Loxia enucleator Linnæus 1758 (Aves) - *Loxia* is feminine and *enucleator* a masculine noun.

Lamia ambulator Fabricius 1775 (Coleoptera) - *Lamia* is feminine and *ambulator* a masculine noun.

Macroglossum vidua Rothschild & Jordan 1903 (Lepidoptera) - *Macroglossum* is neuter and *vidua* is a feminine noun.

8.1.6.3 How to change the Latin adjective

In zoological Latin the three genders **feminine (58 %)**, **masculine (38 %)** and **neuter (4 %)** are not evenly distributed in the language. Neuter is very rare. In birds only 2 %.

When Latin was spread to other parts of Italy, S France, Catalonia, central Spain, Portugal, Galicia, N France and Romania, the neuter gender was lost in every region, probably because people forgot how to apply the correct declinations. Neuter merged usually with masculine. The same trend is currently observed in Albanian. In scientific zoology not many taxonomists know the correct declinations for the neuter gender.

The ending *-er* is most problematic. It is necessary to consult a standard Latin dictionary to know the form of declination of an adjective ending in *-er*. There are currently no good online Latin dictionaries where the solution could be found reliably. It is not possible to get this information automatically, to feed a computer program with such information.

Here I give some relatively frequent examples of adjectival names, only in the nominative singular. If a name was established in another case, it is necessary to consult a complete Latin grammar collection to learn which form of which of the 5 cases (singular or plural, giving 10 forms for each group) could apply for the adjective.

Example:

The name *pavidam*, established in the accusative singular in the genus *Musca* (Diptera), must be *pavida* in the nominative singular.

The sorting in such lists is always masculine - feminine - neuter.

This way of order neglects that feminine is more frequent. Masculine predominance in Europe's cultural history accounts for this interesting detail.

-us, -a, -um. Adjectives ending in *-us*. Some 55-60 % of all zoological names are adjectives in this form (differs among disciplines, 33 % in birds).

Examples:

albus, alba, album

signatus, signata, signatum

migratorius, migratoria, migratorium

pavidus, pavida, pavidum

gibberulus, gibberula, gibberulum

bicolorus, bicolora, bicolorus (but not: *bicolor*)

-is, -is, -e. Adjectives ending in *-is* with 2 endings. Some 10 % of all zoological names are adjectives in this form (birds: 19 %). This is **one of the major error sources** because zoologists usually do not know that these words must be changed when combined with genera of neuter gender. It is also very difficult to see if such a name is a noun or an adjective.

Examples:

campestris, campestris, campestre

brasiliensis, brasiliensis, brasiliense

capensis, capensis, capense

apiformis, apiformis, apiforme

mollis, mollis, molle

laevis, laevis, laeve

rudis, rudis, rude

tenuis, tenuis, tenue

More: *abdominalis, acicularis, aequinoctialis, affinis, agilis, agrestis, alpestris, angularis, annularis, aquatilis, australis, autumnalis, borealis, brevis, campestris, centralis, ciliaris, claustralis, collaris, communis, difficilis, dorsalis, edulis, -ensis, equestris, exilis, fascicularis, fenestralis, fluviatilis, fontinalis, -formis, fossilis, fragilis, glacialis, gracilis, grandis, gravis, haemorrhoidalis, hortensis,*

humeralis, imperialis, insularis, lacustris, laevis, lateralis, lenticularis, linearis, littoralis, lunaris, mammillaris, marginalis, meridionalis, militaris, mirabilis, mollis, muralis, navalis, nemoralis, nivalis, nobilis, occidentalis, officinalis, opercularis, orbicularis, orientalis, ovalis, palustris, pluviialis, pratensis, regalis, regularis, rivularis, rudis, rupestris, saxatilis, scalaris, senilis, septentrionalis, similis, stabilis, stagnalis, stellaris, sylvestris, tenuis, terrestris, transversalis, tristis, variabilis, ventralis, vermicularis, vernalis, viridis, vulgaris
 Not: *abietis, adonis, alexis, -cornis, -collis, calidris, cardinalis, dentalis, fascialis, -labris, meleagris, ocellaris, -rostris, salicis, secale, secalis, -spiralis, -ventris*

-er, -ra, -rum. Adjectives ending in *-er* with *e* not contained in the word stem. 0.5-1 % of the zoological names (birds 1.5 %, together with all following modes).

Examples:

niger, nigra, nigrum

ater, atra, atrum

pulcher, pulchra, pulchrum

More: *afer, cafer, caffer, dexter, glaber, ruber, scaber, teucer*

-er, -era, -erum. Adjectives ending in *-er* with *e* contained in the word stem. Only few names.

Examples:

asper, aspera, asperum

gibber, gibbera, gibberum

tener, tenera, tenerum

liber, libera, liberum

spinifer, spinifera, spiniferum

cordiger, cordigera, cordigerum

More with ending *-ifer* (but caution: usually these are nouns!):

anatififer, anguillifer, atomifer, bulbifer, conifer, costulifer, crucifer, dentifer, discifer, ensifer, furcifer, glandifer, globulifer, grandifer,

granifer, lamellifer, lancifer, ovifer, prolifer, punctifer, setifer, signifer, speculifer, spinifer, stellifer, tubifer, velifer

Not: *lucifer*

More with ending *-iger* (but caution: usually these are nouns!):

annulliger, armiger, claviger, corniger, disciger, flammiger, furciger, guttiger, meleager, palliger, plumiger, punctiger, scutiger,

serriger, setiger, urniger, vittiger

-er, -ris, -re. Adjectives ending in *-er* with *e* not contained in the word stem and 3 endings. Only very few names.

Examples:

acer, acris, acre

alacer, macer, procer, trinacer

-er, -eris, -ere. Adjectives ending in *-er* with *e* contained in the word stem and 3 endings. Perhaps only one name in zoology.

Examples:

celer, celeris, celere

Not: *aceris, anseris, asteris, cytheris, glycimeris, hydrochaeris, iberis, moeris, papaveris, passeris, sileris, veris*

-x and -ns. Adjectives with only one ending. These are not changed and behave like nouns. 3 % of the zoological names have these endings.

Examples (could also be nouns, does not matter, it is not necessary to know that):

atrox, biplex, carnifex, dendex, fallax, felix, praecox, senex, velox

abundans, albescens, ascendens, caeruleans, caeulescens, canescens, distans, elegans, flavescens, fulvescens, nigricans, nitens, pallens, pubescens, ringens, rufescens, sapiens, virens, volans

-ior, -ior, -ius. Adjectives in the comparative form, with two endings. Only 0.3 % of the zoological names. The most important are *maior* and *minor*, only few zoologists know that in neuter gender they must turn to *maius* and *minus*.

Examples:

major, major, majus

maior, maior, maius

minor, minor, minus

minutior, minutior, minutius

depressior, depressior, depressius

grandior, grandior, grandius

angustior, angustior, angustius

arctior, convexior, crassior, distinctior, elatior, gracilior, junior, laevior, latior, obscurior, pallidior, scabrior, solidior, tenuior

8.1.6.4 Incorrect gender application in the original description

Incorrect application of gender in the original description (adjectival name of species did not agree in gender with the genus) should be maintained for citing the original combination. This is useful for others who look for a name in an original source, perhaps in a full text electronic file, and are surprised if they do not find what they have been looking for.

But the incorrect ending is corrected if a name is actually used for a taxon in a current classification, regardless if in the same or in another genus (Art. 31.2). Art. 31.2 says that a name "must agree in gender with the generic

name". It is important to know that if not, this has no consequences. By saying "must" the Code creates the misunderstanding here that a name would be unavailable if it did not agree in gender with the genus. This is not so. Names established with incorrect endings are available, they are just corrected afterwards (Art. 34.2) by users in subsequent sources.

The contents of this chapter are basically repeated in the chapter "how to cite the original combination".

Examples:

Deroceras rhodensis Forcart 1972 (Gastropoda): *Deroceras* is neuter, should have been *rhodense*. The name is currently used as *Deroceras rhodense* Forcart 1972.

Unio manca Lamarck 1819 (Bivalvia): *Unio* is masculine and not feminine, should have been *mancus*. The name is currently used as *Unio mancus* Lamarck 1819.

Nettenchelys pygmaeus Smith & Böhlke 1981 (Actinopterygii), should have been *pygmaea* Smith & Böhlke 1981. The name is currently used as *Nettenchelys pygmaea* Smith & Böhlke 1981.

Pomatias affine Benoit, 1875 (Gastropoda): *Pomatias* is masculine and not neuter, should have been *affinis*. The name is currently used as *Cochlostoma affine* (Benoit 1875). *Cochlostoma* is neuter.

Pomatias philippianum Gredler 1853 (Gastropoda): should have been *philippianus*. Currently used as *Cochlostoma philippianum* (Gredler, 1853).

Limnaeus albolimbatus Küster 1856 (Gastropoda): The genus was originally spelled *Limnaeus* (masculine) by Küster 1856, so *albolimbatus* (masculine) was correct, but the original genus must be corrected to *Lymnaea* (feminine), the original combination can be cited as *Lymnaea albolimbatus*. The name is currently not used for a taxon.

Limnaeus pereger var. *labiatus* Rossmässler 1835 (Gastropoda): The genus was originally spelled *Limnaeus* (masculine) by Rossmässler 1835, so *labiatus* (masculine) was correct, but the original genus must be corrected to *Lymnaea* (feminine), the original combination can be cited as *Lymnaea labiatus*. The name is currently used as *Radix labiata* (Rossmässler 1835).

Pomatias tessellatus var. *achaica* Boettger 1885 (Gastropoda): should have been *achaicus*. Currently used as *Cochlostoma achaicum* (Boettger, 1885).

Some authors forced the specific names to agree in gender with the subgenus and not with the genus. This is no problem. Today the species must agree in gender with the genus. The subgenus can have a different gender. For citing the original combination, just cite genus and species, the species with the gender as given in the original source.

Examples:

Glischrus (Helix) diaphana Studer 1820 (Gastropoda), the specific name *diaphana* (feminine declination) agreed originally in gender with the subgenus *Helix* (feminine) and not with the genus *Glischrus* (masculine). The name is currently used as *Vitrea diaphana* (Studer 1820), original combination *Glischrus diaphana* Studer 1820.

Lymnaeus (Gulnaria) ampla Hartmann 1841 (Gastropoda), the specific name *ampla* (feminine declination) agreed originally in gender with the subgenus *Gulnaria* (feminine) and not with the genus which was incorrectly given as *Lymnaeus* (masculine). The name is currently used as *Radix ampla* (Hartmann 1841), original combination *Lymnaea ampla* Hartmann 1841.

8.1.6.5 When gender agreement is not applied: the Lepidoptera model

Gender agreement is not unanimously applied by all zoologists. One important group where gender agreement has traditionally been neglected or ignored is Lepidoptera.

Linnæus 1758 established only three lepidopteran genera: *Papilio* for the butterflies and *Phalaena* and *Sphinx* for the moths. The whole world of butterflies was united in one single genus, so that *Papilio* quickly contained more than 500 species.

From the beginning on the gender of *Papilio* was unclear, undecided and disputed. Some authors regarded it as masculine, others as feminine. Linnæus knew this problem and avoided any statement. All his 250 *Papilio* names were either nouns, unchangeable adjectives or adjectives ending in *-is*. He strictly did not use a single adjective ending in *-us*, *-a*, *-um*. Brown, Cramer, Fabricius, Fueßlin, Goeze, Poda and Schrank regarded *Papilio* as masculine, Ménétrés, Pontoppidan and most modern authors as feminine. This historical development had the effect that gender agreement never gained a strong position in lepidopteran nomenclature. Obviously many lepidopterists did not or refused to learn to apply gender agreement correctly. Others decided to follow the Code and to apply gender agreement.

It is interesting that although some lepidopterists apply gender agreement, incorrect genders are rarely changed in butterfly names, and that even within a species, subspecies can take other genders.

Examples:

Papilio torquatus var. *flavida* Oberthür 1879, with masculine species and feminine subspecies.

Papilio multicaudata pusillus Austin & Emmel 1998, with feminine species and masculine subspecies.

It is also interesting to see how successful this system works. Only few butterfly names were subsequently corrected and are known under more than one spelling. It seems that those lepidopterists who do apply gender agreement, respect the choice of their colleagues and do not force them to change their tradition by publishing well established lepidopteran names with other endings. Most names are only visible to the public in one ending.

Examples (Google hits 07.2009):

"*papilio-fuscus*" 7000, "*papilio-fusca*" 0

"*papilio-macilentus*" 5400, "*papilio-macilenta*" 0

"*papilio-multicaudatus*" 15500, "*papilio-multicaudata*" 4000

"*papilio-osmanus*" 0, "*papilio-osmana*" 600

"papilio-paradoxus" 80, "**papilio-paradoxa**" 1600
 "papilio-torquatus" 6800, "papilio-torquata" 0
 "**graphium-angolanus**" 4700, "graphium-angolana" 0, "graphium-angolanum" 0
 "graphium-incertus" 120, "graphium-incerta" 120, "graphium-incertum" 0
 "graphium-macleayanus" 3500, "graphium-macleayana" 0, "graphium-macleayanum" 800
 "**graphium-mandarinus**" 1000, "graphium-mandarina" 0, "graphium-mandarinum" 10
 "graphium-sandawanus" 0, "graphium-sandawana" 0, "**graphium-sandawanum**" 2400
 "**belenois-albomaculatus**" 140, "belenois-albomaculata" 0
 "belenois-rubrosignatus" 0, "**belenois-rubrosignata**" 190
 "**mylothris-arabicus**" 150, "mylothris-arabica" 0
 "mylothris-ruandanus" 0, "**mylothris-ruandana**" 160
 "delias-argentatus" 0, "**delias-argentata**" 870
 "**delias-castaneus**" 1000, "delias-castanea" 0
 "delias-clathratus" 0, "**delias-clathrata**" 3000
 "**delias-elongatus**" 600, "delias-elongata" 0
 "colias-croceus" 14000, "colias-crocea" 21000
 "colias-giganteus" 0, "**colias-gigantea**" 4900

This had also influence on the moths, which should not have had the same problems, *Phalaena* and *Sphinx* were clearly feminine. In moth genera with relatively easy and clear genders, incorrect gender application is maintained relatively stable and there are only weak trends to correct incorrect gender applications.

Examples (Google hits, 07.2009):

"xylophanes-obscurus" 200, "xylophanes-obscura" 0
 "xylophanes-columbianus" 0, "**xylophanes-columbiana**" 140
 "**xylophanes-meridianus**" 190, "xylophanes-meridiana" 0
 "xylophanes-turbatus" 0, "**xylophanes-turbata**" 700
 "manduca-bolivianus" 0, "**manduca-boliviana**" 430
 "**manduca-caribbeus**" 370, "manduca-caribbea" 10
 "**sphinx-calinigeus**" 610, "sphinx-calinigea" 280
 "sphinx-formosanus" 10, "**sphinx-formosana**" 410

Few generic names in Lepidoptera have neuter gender, these are the most problematic names because researchers are not used to the neuter forms. In some cases endings were subsequently corrected, also these are occasionally maintained.

Examples (Google hits, 07.2009):

"**macroglossum-albolineata**" 330, "macroglossum-albolineatum" 0
 "**macroglossum-buruensis**" 320, "macroglossum-buruense" 0
 "macroglossum-castanea" 0, "**macroglossum-castaneum**" 330
 "**macroglossum-marquesana**" 290, "macroglossum-marquesanum" 0
 "**macroglossum-semifasciata**" 540, "macroglossum-semifasciatum" 0
 "macroglossum-vicina" 0, "**macroglossum-vicinum**" 340

It seems that some names were used as changeable adjectives although they would probably not be declinable in Classical Latin. It is possible that trends in Postclassical Latin allowed to treat them as adjectives, and that this is not reflected in dictionaries which only cover Classical Latin. There are cases where three forms are possible. It may happen that two forms are currently used, both are grammatically incorrect, the third one would be grammatically correct in Classical Latin and is not used.

Examples (Google hits, 07.2009):

"malacosoma-alpicolus" 0, "**malacosoma-alpicola**" 3800, "malacosoma-alpicolum" 850 - grammatically correct in Classical Latin would be *Malacosoma alpicola* (original name *Malacosoma alpicolum* Staudinger 1870).
 "**graphium-monticolus**" 500, "graphium-monticola" 0, "**graphium-monticolum**" 80 - grammatically correct in Classical Latin would be *Graphium monticola* (original name *Papilio monticolus* Fruhstorfer 1896).

In such a situation it can only be recommended to maintain the names in the incorrect forms as they are, and not to change them. Some databases can handle and disambiguate names with variant endings, but most cannot.

8.2 The name of the author

In a strict application of the ICZN Code three components of a the taxon name author string ("genus", "species" and "year") can only have one combination of characters. The major problem in zoology is the author.

The Code intends to give a clear rule concerning the identity of the author, but it does not give a guide how to spell the name of the author, not even a recommendation. In the examples of the Code's text the authors of specific and generic names have consistently no first name initials. In the published Opinions of the ICZN Commission the whole currently applied variety is reflected.

8.2.1 How to determine who is the author

It is commonly agreed in most animal groups, and Art. 50.1 also intends to express this, that the author of a name is the person responsible for having made the name available. At least principally.

It is also accepted by most taxonomists that this is restricted to the person who was (made) responsible for having **written the textual scientific content of the original description**, the visibly responsible person for having written down what the publisher finally published.

The second and third editions of the Code (1963-1985-2000) had basically the same rules as the currently used 4th edition, with one exception concerning names established in works published by several co-authors. The 2nd and 3rd editions demanded that if the authorship for a name should differ from the authorship for the work, the responsible co-authors for the name must have been clearly responsible for both the name and "satisfying the criteria of availability" (this means, in most cases, for having written the description). In the 4th edition the last condition was removed if the co-authors of the name belonged to the co-authors of the work.

The **author of an image is not recognized** as co-author of a name, even if the image was the only base for the name. In such a case satisfying the criteria of availability is the action of connecting the new name with the image.

It is also accepted by most taxonomists - not by all - that the true author of the written text, if her or his name is not given anywhere in the original source, is never the author of a name. The text can actually be written by a friend, by another researcher, by the author's wife or 12-year old daughter, as we may well know from secondary sources. Some authors have copied text passages from unpublished sources without acknowledging them. In Art. 50.1.1 all these persons are excluded from the authorship of a name, if they were not explicitly mentioned in the work itself for being the responsible persons for making a name available.

Most taxonomists also accept Art. 50.1.1 that the author of a cited previously published source, from which text passages were copied, is not acknowledged as the author of a name.

I would recommend to apply Art. 50.1 and Art. 50.1.1 strictly, in most disciplines this seems to provide a quite successful model. There is no need to research who the true author was, everyone including young and relatively unexperienced researchers can verify and determine the name of the author in the work itself.

Sabrosky 1974 published an official interpretation of the Code and specified some details. He gave a general guideline that "authorship is not ordinarily such a serious matter that exceptions to the Code need be made". Zoologists have however applied some general exceptions to the Code's rules which can be addressed in the form of general frames, and which I also would recommend to acknowledge. One is the treatment of early Swedish dissertations. Another one concerns anonymously published works.

In all other cases the provisions of the Code should probably be used as a strict guideline.

The author of the new name is in most cases the author of the work. I determined a proportion of 97 % in 2400 names of European non-marine molluscs. There are only few exceptions (3 % in molluscs).

- If a work was published anonymously, see below.
- If a work was an early Swedish dissertation (with two "authors" on the title page), see below.

In all other cases the responsibilities for the new name must be given in the original source. For these cases, **external evidence must never be consulted** to determine the authorship of a name. Some disciplines or some taxonomists may deviate from this rule, but only in the case of the early Swedish dissertations this seems to go without disputes among taxonomists and disciplines.

The main rules for the **non-anonymous works** are these two:

- If a work had several co-authors and the name (or the entire chapter in which the new name was described) was attributed to one or more of these co-authors (**A & B in A, B & C**), then these have the authorship for the new name (Art. 50.1). Regardless of who was responsible for the description.
- If a name was attributed to one or more co-authors who were not (all) among the co-authors of the work (**A & D in A, B & C**), then we must look who was responsible for the description. If the (entire) description was attributed (explicitly and in the original source) to the same persons as the name, then these have the authorship for the new name (Art. 50.1.1).
- In all other cases the co-authors of the work have the authorship for the new name (even if it is clear that they had neither the responsibility for the new name nor for the description - contrasting the very first sentence of this chapter).

Guide to determine the authorship

A first step consists in determining the **authorship for the work** in the sense of Art. 50.1. In some cases the bibliographical authorship of Art. 8 (under which the book can be found in library catalogues) differs from the

"zoological" authorship which is meant in Art. 50.1. In some cases chapters or parts of a book were written by authors who were not the authors of the book.

Examples:

In 1843 **Dieffenbach** published a book on the nature of New Zealand. This book contained also a chapter on the natural history, with articles by various different authors (Gray, Richardson and others). These articles were the works in the sense of Art. 50.1, not Dieffenbach's main book.

In 1789 **Coxe** published a book on travels in Switzerland. It was explained in the work itself that the zoological part was written by Studer. Studer was the author of the work in the sense of Art. 50.1, not Coxe.

If the responsibility in a multi-authored work was subdivided among the co-authors, the authorship in the sense of Art. 50.1 must be restricted.

Examples:

In 1840 was published a new edition of Turton's "manual of the land and fresh-water shells of the British Islands", with Turton and Gray both given as co-authors on the title page. In the preface was explained that Gray was responsible for all new information. New names are all attributed to Gray.

Küster, Dunker & Clessin published a volume of a large multivolume series (Systematisches Conchylien-Cabinet), their names were given on the title page, with the date 1886. This volume appeared in various fascicles (Lieferungen), a first section between 1841 and 1850 (pp. 1-62), a second section between 1878 and 1886 (pp. 63-430). On p. 63 it was explained that Küster had been responsible for pp. 1-62, Clessin for the rest, and that Dunker only contributed his collection material. The author of the work in the sense of Art. 50.1 is Küster (p. 1-62) and Clessin (pp. 63-430).

If the responsibilities for the new name were specified more individually we must find who was made responsible for the new name.

If the new name was attributed to a co-author of the work (**A & B in A, B & C**), then it is not necessary to determine who was responsible for the description (Art. 50.1). If the new name was attributed to one or more persons who were not (all) co-authors of the work (**A & D in A, B & C**), then the responsibilities given in the original source for the name and for the description must have been the same (Art. 50.1.1). Otherwise the name is attributed to the authors of the work.

Examples:

In a work published in 1879 by **Westerlund & Blanc** several new gastropod names were established. Each one must be analysed individually.

Helix mesostena. The name was attributed to Westerlund, one part of the description was attributed to Westerlund, another part of the description was by both co-authors. The authorship for the new name is attributed to Westerlund alone.

Zonites cretensis. The name was attributed to Blanc, one part of the description was attributed to Westerlund, another part of the description was by both co-authors. The authorship for the new name is attributed to Blanc alone.

Helix piligera. The name was attributed to Blanc, the entire description was attributed to Westerlund. The authorship for the new name is attributed to Blanc alone.

Buliminus thiesseanus. The name was attributed to Mousson, the entire description was attributed to Westerlund. The authorship for the new name is attributed to Westerlund & Blanc.

In a work published in 1914 by **Sturany & Wagner** several new gastropod names were established. Each one must be analysed individually.

Chondrula lugorensis. The name was attributed to Wagner, the description was not attributed to a person. The authorship for the new name is attributed to Wagner alone.

Orcula ljubetenensis. The name was attributed to Sturany, the description was not attributed to a person, but in the same style as for *Ch. lugorensis*. The authorship for the new name is attributed to Sturany alone.

Campylaeopsis. The name was not attributed to a particular person, the description was not attributed to a person. The authorship for the new name is attributed to Sturany & Wagner.

In a paper by **Yanes et al.** (7 co-authors) published in *Zootaxa* in 2011 five new names for species in the gastropod genus *Napaeus* were established. Name 1 was attributed to co-authors 2, 6 & 7, name 2 to co-authors 3, 2 & 4, name 3 to co-authors 3, 4 & 5, name 4 to co-authors 7, 6 & 5, and name 5 to co-authors 6, 7 & 2. The responsibilities for the descriptions were not explained.

: This is a usual and correct procedure in many modern publications, the authorships can be copied as given in the original source.

In a volume of a large multivolume series (Systematisches Conchylien-Cabinet) by **Küster, Dunker & Clessin** was established a new name on p. 21 *Physa ludwigii*, its name was attributed to Krauss, but not its description.

: The name must be attributed to the author of the work, which in the sense of Art. 50.1.1 was restricted to Küster alone (who was responsible for pp. 1-62), not to Küster, Dunker & Clessin who were the three responsible co-authors for the entire volume.

If the new name was attributed to an author who was not among the co-authors of the work, then this authorship is only accepted if it matches exactly the authorship for the description (**name: A & D, description: A & D**).

The authorship for the description must be **explicitly indicated** in the original publication, either by a general statement ("all zoological descriptions in this work were written by Smith"), or by an individual statement ("the following three descriptions were provided by Jiménez", "this name shall be attributed to me and Wang because she contributed to the description").

In the 1800s it was a usual style to set an acronym of the true author immediately below the text of the description or diagnosis to indicate authorship for the description, and that this description was derived from an unpublished manuscript. In modern publications we may find verbal explanations.

Examples:

In 1846 Philippi established a new gastropod species *Bulimus cretensis* and attributed the name to "Pfr." (= Pfeiffer) in the headline. A Latin diagnosis followed, then a locality, and then a German descriptive text. Behind all this in the last line was quoted "(Pfr.)", expressing that Pfeiffer alone and not Philippi was responsible for the entire description.

: The name is attributed to Pfeiffer.

In 1983 Gittenberger established a new gastropod species *Hypnophila malagana* and explained that the name should be cited with the authorship of Gittenberger & Menkhorst because the description had been prepared by both authors.

: The name is attributed to Gittenberger & Menkhorst.

In a Serbian journal Wohlbered published an article in 1907 and established a new gastropod name *Clausilia jabucica*. The name was attributed to Böttger, the entire Serbian description was also attributed to Böttger.

: It is likely that Böttger did neither speak nor read Serbian, but since the description was attributed to him, the name is attributed to Böttger.

When the name of a different author was set behind the new name in the headline (and not repeated below the diagnosis) this indicated authorship only for the name and not for the description. These authorships for names alone do not count any more since 1905, when the international rules were fixed.

Sabrosky (1974) gave some examples to explain the limits. The expressed authorship for the text of the description must be the same as that for the name. Having provided the information does not suffice.

Prior to 1905 every discipline had its own rules. After 1905 the authorships for a large proportion of mollusc names were changed. They were so many because of a special situation. Ziegler and Parreyss were shell dealers from Vienna (Austria) and sent labelled shells with new names to researchers, who then described the new species and attributed the names to the dealers. At the end they had many hundreds of names. After 1905 the malacologists agreed that shell dealers should not be regarded as authors of names because they had in most cases not done any scientific work.

Examples:

Pfeiffer 1828 established a new gastropod name *Clausilia interrupta* and attributed the name to **Ziegler**. The description was not attributed to Ziegler.

: The name is attributed to Pfeiffer.

Rossmässler 1839 established a new gastropod name *Clausilia galeata* and attributed the name to **Parreyss** in the headline. The description was not attributed to Parreyss.

: The name is attributed to Rossmässler.

Rossmässler 1835 established a new gastropod name *Clausilia cattaroensis* and attributed the name to **Ziegler**. The description was partly by Rossmässler and partly by Ziegler who was cited in quotation marks.

: The name is attributed to Rossmässler.

The **entire description** must be attributed to the author of the name, not only a part. In the sense of the Code a descriptive statement can either be present or not, its content or correctness is not relevant. It is not possible to subdivide a compound description into an important and a less important or unnecessary part. Removing one part of the description would still keep the name available. The term "description" as used here can include other forms of making a name available.

Examples:

Hesse 1916 established a new gastropod name *Helicella spiruloides* and attributed the name to Wagner. The description was partly by Wagner (the shell) and partly by Hesse (the anatomy).

: The name is attributed to Hesse.

Caziot 1908 established a new gastropod name *Pomatias simrothi* and attributed the name to Pollonera. The description was partly by Pollonera (the main description) and partly by Caziot (who added only some descriptive remarks).

: The name is attributed to Caziot.

Forster 1840 established a new gastropod name *Pupa sterrii* and attributed the name to Voith. The description was partly by Voith (the main description) and partly by Forster (who only gave a brief summary of Voith's description in his own words).

: The name is attributed to Forster.

Locard 1882 established a new gastropod species *Helix crombezi* and attributed the name to Millière. The description was attributed to Bourguignat.

: The name is attributed to Locard.

In 1877 Fischer published a work on molluscs and attributed its authorship to the late Shuttleworth who had compiled plates of new species, equipped with names. A new species *Zonites oppressa* with Shuttleworth's indicated authorship was presented on the plate and in the text, for which Fischer inserted a description attributed to Studer.

: The name must be attributed to Shuttleworth. Even if Fischer had attributed both the name and the description to Studer, Shuttleworth would be the author because he was responsible for the arrangement of the plate, on which the printed name and the figure alone would have satisfied the criteria of availability.

External evidence must never be consulted. If we know from external evidence that the information was provided by the person to which was attributed the name, but the descriptive text was not explicitly attributed to that person in the original source, the external evidence has no influence. Two of these cases were used to explain the limits of Art. 50.1.1 by Sabrosky (1974).

Examples:

Ceriodes durani (Diptera) was first mentioned in 1925 in a work by Shannon, with some descriptive words contained in an identification key. The name was originally attributed to Davidson, with a remark that Davidson would publish the description later, and that Shannon had obtained the description from Davidson's manuscript to be used in the key.

: Although the entire information on this species was clearly and expressly derived from Davidson, the name must be attributed to Shannon 1925 alone because the text in the key was not directly attributed to Davidson. Sabrosky 1974 explained that the key was Shannon's work.

Sicyonia wheeleri (Crustacea) was first mentioned in 1943 in a work by Gurney, with an incomplete description. The name was originally attributed to Burkenroad who was acknowledged to have identified the species, with a remark that the entire description would be published by Burkenroad later. Burkenroad published a complete description in 1945.

: Sabrosky 1974 explained that the name must be attributed to Gurney 1943 because the description published there was not written by Burkenroad.

Pisidium liljeborgii (Bivalvia) was established in 1886 in an article by Esmark & Hoyer. The name was attributed to Clessin, the authorship for the description was not specified.

: Clessin was a known specialist of this group and it was likely that the students Esmark and Hoyer obtained the detailed information from Clessin. Authors of the work were both Esmark and Hoyer, there was no "clearcut" attribution of the description, so Esmark & Hoyer must be the co-authors of the new name.

Westerlund 1873 established another new bivalve name *Pisidium globulare* and attributed the name to Clessin. The description was partly not attributed to a particular person, and partly to Clessin.

: Insider knowledge suggests that Westerlund must have obtained most views about the taxonomy of this group from Clessin. This is irrelevant, the parts of the description which were not attributed to a particular person were published under Westerlund's responsibility, so the name is attributed to Westerlund.

An author can have established a **name dedicated to oneself**. This sounds unusual and rare, and it is against the unwritten conventions to dedicate a name of a species to oneself, but it is allowed. In most cases the author who made the name available was convinced only to cite a name established by a previous author. After 1905 the new convention that authorship refers to the author of the description, provoked later these unusual combinations.

Examples:

Helix krynickii **Krynicky** 1833 (Gastropoda), currently *Xeropicta krynickii* (Krynicky 1833), originally attributed to Andrzejowski who had not made the name available, description was by Krynicky.

Pupa rosmaessleri **Rossmässler** 1838 (Gastropoda), currently *Walklea rosmaessleri* (Rossmässler 1838), originally attributed to Schmidt who had not made the name available, description was by Rossmässler.

Helix bielzi **Bielz** 1860 (Gastropoda), currently *Petasina bielzi* (Bielz 1860), originally attributed to Schmidt who had not made the name available, description was by Bielz.

Zonites kobelti **Kobelt** 1898 (Gastropoda), currently *Zonites kobelti*, originally attributed to Böttger who had not made the name available, description was by Kobelt.

Unintentionally stolen names before 2000. If it is known to us from secondary sources or from traditional knowledge that the true provider of the scientific or textual content of a description was not the author of the work, this does not count if the true author was not explicitly cited (Art. 50.1.1).

In some cases a new name was mentioned with the remark that it had recently been established by another author. If that description had not appeared yet at that date, then the name was unintentionally established by the author who mentioned it. After 2000 such unintentional acts are excluded because the author must explicitly indicate a new name as intentionally new (Art. 16.1).

Examples:

Reeve 1854 established a new gastrod species *Helix kawaiensis*, with a description and a figure based on a shell from the Cuming collection. Reeve gave a reference to "Pfeiffer, Pro. Zool. Soc. 1854", which was not yet published at the time when Reeve's work appeared. The article in the Proceedings appeared shortly after. It is well known that to get a permission to publish in the famous Proceedings of the Zoological Society of London authors had to present their results at the Society's regular meetings. Reeve took the information from there and published the names prior to the dates of publication of the Proceedings. The description was not attributed to Pfeiffer by Reeve, so the name must be *Helix kawaiensis* **Reeve 1854**.

In a monograph Schütt 1993 published a self-made description of a species *Schileykula inversa* attributed to "Hausdorf 1992" in the belief that Hausdorf's publication had already appeared. Hausdorf's publication appeared several weeks after Schütt's monograph. The true dates count. The name of the species must be *Schileykula inversa* **Schütt 1993**.

The same author did the same in 2001, when citing a name *Turanena bilgini* attributed to Schütt & Şeşen, with description. But since he did not cite the name as intentionally new the name was not made available at this occasion. The name was effectively established in 2002 by the two co-authors.

Anonymous authorships

Art. 50.1 seems or intends to demand that new names established in anonymously published works (this was allowed until 1950) are "deemed to be anonymous", which could be understood as if they would have no author. Recommendation 51D contrasts this and suggests to attribute a name to the true author if known from external evidence, and to set the author in square brackets. If no true author is known the term "Anon." should be used.

The Code has obvious problems to reflect reality in this context. It is usual practice to use the term "**Anonymous**" in the English orthography to denote anonymous authorships without known true author. The **true author** is very frequently acknowledged, setting such an author in **square brackets** is usual practice. This procedure could be reflected in the legal text of the Code to obtain a more uniform standard practice, not only in a Recommendation.

Examples:

The first edition of the two volumes of "Histoire abrégée des insectes" were published anonymously in 1762. In the second edition in 1764 Geoffroy's authorship was indicated. [**Geoffroy**] is deemed to be the author of the 1762 edition.

"A catalogue of the Portland Museum" was published anonymously in 1786. Dance (1962) presented convincing evidence that Lightfoot was the anonymous author of the work. The work is attributed to [**Lightfoot**].

The square brackets are not used if the authorship was indicated in at least one volume of a multivolume work, but was not repeated in every single volume. Technically those subsequent volumes were published anonymously.

Example:

The 13th edition of "Systema Naturae" was published in 7 volumes between 1788 and 1792 by Gmelin. His authorship was indicated on the title page of the first volume in 1788, but not repeated in the other volumes. All volumes are attributed to **Gmelin**, no square brackets are used.

If a new name was attributed to an author, but not its description, then the inferred or anonymous authorship takes the authorship for the name. So the basic provision of Art. 50.1.1 (the identical responsibility for both name and description must be clearly addressed) is also applied here.

Examples:

In the journal "Correspondenzblatt des Württembergischen Landwirthschaftlichen Vereins" was published an anonymous article in 1830 with the description of a new gastropod name *Pupa columella*. This name was attributed to Benz, but not its description. It is known from external evidence that the true author of this article was G. von Martens. *Pupa columella* is attributed to **[Martens]**, not to Benz.

In the "Zoological Journal" was published an anonymous book review in 1827 about the 52nd and 53rd fascicles of Geoffroy Saint-Hilaire & Cuvier's "Histoire naturelle des mammifères", which were published in 1825. In this review a new name *Loxodonta* was validly established for a genus of African elephant, and attributed to Cuvier who had proposed the French scientific name *loxodonte* in the discussed work. The description was not attributed to a person. The name of the elephant genus is *Loxodonta* **Anonymous** 1827.

Early Swedish dissertations

In early Swedish dissertations (these had always two "authors" on the title page, the professor above and the student below) we must know off hand who wrote the text. The professor was always cited as the author, and initially it was indeed the professor who wrote the texts which the students had to explain or defend in the doctoral exam. Later the responsibilities changed and the students wrote the texts themselves.

In Uppsala the professors Linnæus and Thunberg were probably always the true authors of such dissertations, this includes all dissertations of the Amoenitates Academiae series. In Lund professor Retzius was not the true author in 1788, but the student Philipsson. At the same university professor Quensel was the true author of a 1790 dissertation. The German city of Greifswald was also Swedish, until 1815, and professor Quistorp was not the true author, but the student Rudolphi.

This procedure is common practice in all zoological disciplines. It is not covered by the Code (Art. 50.1.1 would demand to attribute authorships always to the author of the work, which was always the professor), but I would recommend to follow the usual procedure and to deviate from the Code.

Examples:

Mammalian name *Simia pygmaeus* **Linnæus** 1760, established in a dissertation of the Amoenitates Academiae series in Uppsala (Linnæus 1763). Linnæus was the professor, Hoppius the student.

Lepidopteran name *Geometra furcata* **Thunberg** 1784, established in a dissertation in Uppsala (Thunberg 1784). Thunberg was the professor, Borgström the student.

Bivalvian name *Unio crassus* **Philipsson** 1788, established in a dissertation in Lund (Retzius 1788). Retzius was the professor, Philipsson the student.

Coleopteran name *Elater quercinus* **Quensel** 1790, established in a dissertation in Lund (Quensel 1790). Quensel was the professor, Lundgård the student.

Acanthocephalan name *Haeruca erinacei* **Rudolphi** 1793, established in a dissertation in Greifswald (Quistorp 1793). Quistorp was the professor, Rudolphi the student.

Deviations from the Code

Because the Code provides so little details of how to cite authorships consistently there is a large degree of variation among authors and disciplines. For the purposes of data mobilisation it cannot be recommended to deviate from the usual procedures.

If a description or parts of it were taken from an earlier published source, the author of that source does not count for the authorship of the name and is not cited. This is usual practice.

Example:

Linnæus 1758 established the avian species *Ramphastus picatus* with a short description and two references to **Albin** 1734 and **Aldrovandi** 1646. Figures and descriptions of these two references form part of the description of the new name, and their specimens belong to the syntypes, but the author of the description in the sense of Art. 50.1 was exclusively Linnæus, the name must be *Ramphastus picatus* **Linnæus** 1758.

Constructions in the form of "Walbaum (ex Klein)" in traditional fish nomenclature indicate that the true description had been copied from a previously published source provided by Klein, a pre-Linnean author. This is not in agreement with the ICZN Code, and should not be used.

Example:

Bloch & Schneider 1801 established a new chondrichthyan fish species *Raja manatia* with a short descriptive text cited from a previously published non-nominal work by **Lacépède** (with bibliographic reference to text and figure), below this were added some additional descriptive notes by "Schn." (= **Schneider**). The description/indication consisted of Lacépède's cited text, Lacépède's uncited text in the original work, Lacépède's figure, and Schneider's text. Responsible for the textual contents of this compound description were Bloch & Schneider as the authors of the work who decided to cite Lacépède's text and to give the reference to Lacépède's publication, and who for this account they were responsible for this part of the description, and Schneider for the second part of the description.

The name of the new species must be *Raja manatia* **Bloch & Schneider** 1801.

Sherborn's Index Animalium (1922) cited the name as *Raja manatia* Schneider. In fish data sources the name is often cited as *Raja manatia* **Bloch & Schneider (ex Lacépède)** 1801 (for example in Catalog of Fishes, 07-2009). Lacépède is not a co-author of this name in the sense of Art. 50.1.

The "ex" construction was not consistently used in the meaning it had in the fish nomenclature, others used it to indicate the person who provided the name. Also this procedure is not in agreement with the Code.

Example:

Menke 1828 mentioned a name for a gastropod variant *Paludina similis* var. b *Paludina inflata*, and attributed it to "Zgl." (= Ziegler). The name was mentioned without description or indication and was not made available. It is regarded as a nomen nudum, and if cited it should be attributed to Menke's 1828 publication.

Sherborn's Index Animalium (1922) cited this name as *Paludina inflata* Menke (ex Ziegler) 1828, indicating that Menke had obtained the name from Ziegler.

Author of a nomen nudum

A new name mentioned without description, figure or other indication is a nomen nudum. A nomen nudum has no authorship and date, it is not an available name.

If it is convenient or necessary to cite such a name with author and date, then the author of the name should always be the author of the work, not the author to which the name was attributed in the original source. The Code recommends to attribute such a name to another person if cited so by the author (Recommendation 51F), but in the case of a nomen nudum this is not useful. Names were frequently and repeatedly attributed to dealers (Parreys, Ziegler) by various different authors, not always in the same sense, occasionally also to scientists and authors of other works.

Examples:

Helix contorta (Gastropoda) was mentioned by Menke 1830 without further comments in a pure list of species, and attributed to Ziegler.

Rossmässler 1838 used this name for a species from Greece, for which he provided a figure and description, and attributed the name to both Ziegler and Menke. Attributing the name to both persons seemed necessary and indicated that Ziegler had possibly labelled various different species as "*H. contorta*". It is more convenient to refer the nomen nudum to Menke 1830 than to Ziegler.

Pomatias gracilis (Gastropoda) was mentioned as a nomen nudum by Pfeiffer 1847 who attributed the name to Küster. If needed, the name should be cited as *Pomatias gracilis* Pfeiffer 1847. Küster was author of several important works in the 1840s, and a reader would helplessly look there to find this name mentioned.

8.2.2 Spelling of the author

A consistent spelling of the author has never been important when names were communicated by humans, but it has become extremely important in the electronic age. Simply said, databases can only talk with each other when they read exactly the same string, unicode character by unicode character. If variant spellings are used, the connection will provoke a need for manual confirmation, often a highly cost-intensive process.

This is one of the major problems databasers are confronted with when trying to connect information on animal species. There are strategies to overcome these problems, for example by using other identifiers. But those who use taxon name author strings as identifiers or auxiliary identifiers usually have these problems.

In plants this is much less a problem, because botany has a widely used and strongly recommended standard for their authors (IPNI Authors service, www.ipni.org, ratified in 1992 and widely regarded as a potential TDWG standard).

Zoology does not have such a standard, and this is one of the major obstacles for connecting zoological information at low costs. If two biodiversity databases try to connect their data by taxon name author strings they currently arrive at proportions of 50 % or less of the zoological names matching each other, mainly provoked by variant spellings of authors, and by the frequent use of initials.

The presence of variant spellings is not a big problem for global data aggregators such as www.globalnames.org and others. They just list all variant spellings (arriving at more than 20 million names) and ask humans to do the rest. They also establish controlled vocabularies, so that other databases who like to connect each other can use them to find names matching in case of variant spellings. It is hard to imagine that such processes can work at no workload, no costs and insignificantly low error rates.

The best solution is to avoid the presence of variant spellings.

Zoology is too complex and it has never been possible to establish a list of commonly accepted names of authors. Compiling such a standard list and rules for it would involve an enormous workload. One of the few animal groups where this has been successfully done were the fishes - certainly by far the economically most important and the best researched group of animals, but only 2 % of the currently known species. Unfortunately the ichthyologists did not seek feedback in the rest of the zoological community and in their standard partly deviated from crucial rules of the ICZN Code.

Some more or less accessible library databases exist in which standard names are recorded for known authors of monographs, but these cannot be used to determine standard for zoology, where most names of species were established in journal articles. The use of a standard name is questionable if persons changed their names and librarians and researchers who do not know this, will not find the original source any more. Zoology has many

more authors and is much more diversely structured than botany. A standardised list of zoological authors is unlikely.

But it is also possible to improve the situation without creating a central standard list and to shift to more commonly applied standards in zoology.

8.2.2.1 Obstacles provoked by inconsistent spellings of authors

One of the main objects why this manual has been compiled was to give a best practice guide for a uniform spelling of zoological authors. As said above and under the objection that controlled vocabularies can certainly improve the situation to some extent, this is one of the main problems with which electronic biodiversity related technologies are confronted when trying to connect digital information of zoological data resources, using taxon name author strings as identifiers.

For computer programs it is easy to ignore a comma between author and year, and parentheses. But everything else is not easy.

For a person it is easy to connect a name

Müller 1774 to O. Müller 1774, O. F. Müller 1774, Müller O. F. 1774, Mueller 1774, Müll. 1774 or Muller 1774,

and to infer that all these spellings refer to the same author.

The same may apply to

Adams & Adams 1855, H. Adams & A. Adams 1855, Adams H. & Adams A. 1855, H. & A. Adams 1855, Ad. & Ad. 1855, H. & A. Ad. 1855.

But not for a computer program. In a digital environment all these strings are different, and the program will produce an error alert and require a cost intensive manual input or a confirmation, or alternatively a more expensive programmer to create basic rules for the program to recognize identical authors from different spelling modes.

Controlled vocabularies can eventually do that for you, but they have to be installed, and the process does certainly not run without manual input. The efforts have to be calculated against the expected results.

A major reason for the presence of variant spellings of authors is the lack of any requirements, rulings and recommendations in Art. 50 of the ICZN Code. In many parts the Code is the result of political processes and compromises between separate currents and separately working zoological disciplines. If no uniform opinion could be detected among zoologists, because constantly different standards have been applied in various animal groups, the Code provides often only a very vague ruling or none at all, and does not serve as a helpful guide.

Incongruent spellings of authors can arise from inconsistent spellings in several publications, incorrect spellings of the name of the author, change of names due to marriage or other reasons, use of pseudonyms, and incorrect subsequent spellings.

Pseudonyms were used because authors did not like to have their name published. Zoologists usually have respected this. The true name should not be used in such cases.

Zoological databases apply basically two spelling standards in terms of names of authors. Databases either cite the author strictly as spelled on the original work (**original spelling**), or use a **preferred spelling** for each author, following a locally developed system of recorded author identities. Most databases seem to use a mixture between both systems, they partly cite as in the original work, and partly they use more or less commonly accepted preferred names.

It would be less problematic if all databases and disciplines would not use different preferred spellings. A central zoological body would be needed to decide which one should be the preferred spelling for each author for which various spellings were used. Such a central body does not exist in zoology. Many persons have had more than one legal name.

Example: **Linné** himself.

After his ennoblement in 1761 Carl Linnaeus (who spelled himself with æ) adopted the name Carl von Linné, and since then published his works under his new name. 5000 names were published under his previous name, 2000 under his new name.

The preferred name in botany is Linnaeus (abbreviated L.), in internationally used library databases usually Carl von Linné.

Wikipedia differs by language and is a good example to show the variety used in public life. The preferred name in Swedish (and French, German, Italian, Danish, Norwegian) was (in 2010) Carl von Linné (with Linnaeus given as his previous name), in English (and Portuguese, Dutch, Turkish, Indonesian, Finnish) Carl Linnaeus (with Carl von Linné given as his new name), in Romanian Carl Linné, in Spanish Carlos Linneo, in Polish Karol Linnaeus, in Chinese, Russian, Japanese, Korean and Bulgarian the name was based on Linné, in Hindi and Bengali on Linnaeus, the Arabic version transcribed Linius.

Google hits (07.2009) for the combinations "linnaeus-1758" 1.3 million, "linne-1758" 67,000, "linnaeus-1761" 40,000, "linne-1761" 3000, "linnaeus-1764" 7000, "linne-1764" 500, "linnaeus-1766" 100,000, "linne-1766" 3000, "linnaeus-1767" 60,000, "linne-1767" 6000, "linnaeus-1771" 13,000, "linne-1771" 1000.

The proportions for "linne" were 5 % (1758), 8 % (1761), 7 % (1764), 3 % (1766), 10 % (1767), 8 % (1771). The vertebrate part of the 12th edition of *Systema Naturae* was published in 1766, the non-vertebrate part in 1767. The higher proportion for 1767 suggests that some authors dealing with non-vertebrates distinguish the Linnean name and attribute names established in 1758 to Linnaeus, names established in 1767 to Linné.

It is known that for some names various disciplines seem to use different preferred names. There are cases where more than five spellings were used in the original sources. It is easy if authors have only two possible spellings.

Example: **Forsskål/Forskål**.

He himself used the spellings Forsskål and Forsskahl (in botany abbreviated Forssk.), but in his important 1775 publication with 400 new animal names the author was spelled Forskål. The two most important fish databases spell consistently Forsskål, this spelling seems to be unambiguously used in scientific fish-related contexts, slightly less in crustaceans. In other zoological fields the use is not consistent, in some animal groups the original spelling is more frequently used.

Google hits (08.2009 and (10-2010)) for "forsskal-1775" 49,000 (375), "forskal-1775" (612)

"forsskahl-1775" 2, "forskahl-1775" 6

"forsskal-1775" + actinopterygii 9000 (281), "forskal-1775" + actinopterygii 100 (152)

"forsskal-1775" + chondrichthyes (442), "forskal-1775" + chondrichthyes (265)

"forsskal-1775" + crustacea 10,000 (509), "forskal-1775" + crustacea 3000 (553)

"forsskal-1775" + cnidaria 1200 (445), "forskal-1775" + cnidaria 1200 (400)

"forsskal-1775" + mammalia 600 (431), "forskal-1775" + mammalia 800 (393)

"forsskal-1775" + aves 300 (319), "forskal-1775" + aves 500 (313)

"forsskal-1775" + mollusca 1200 (538), "forskal-1775" + mollusca 1600 (548)

"forsskal-1775" + insecta 1500 (416), "forskal-1775" + insecta 2200 (606)

"forsskal-1775" + amphibia (425), "forskal-1775" + amphibia (424)

Google Scholar (10-2010): "forsskal-1775" 1320, "forskal-1775" 2100

"forsskahl-1775" 1, "forskahl-1775" 3

"forsskal-1775" + actinopterygii 48, "forskal-1775" + actinopterygii 12

"forsskal-1775" + chondrichthyes 150, "forskal-1775" + chondrichthyes 116

"forsskal-1775" + crustacea 330, "forskal-1775" + crustacea 789

"forsskal-1775" + cnidaria 285, "forskal-1775" + cnidaria 358

"forsskal-1775" + mammalia 135, "forskal-1775" + mammalia 189

"forsskal-1775" + aves 34, "forskal-1775" + aves 85

"forsskal-1775" + mollusca 233, "forskal-1775" + mollusca 428

"forsskal-1775" + insecta 92, "forskal-1775" + insecta 461

"forsskal-1775" + amphibia 92, "forskal-1775" + amphibia 147

total: 1399 : 2585 (1 : 1.85)

This difference among zoological disciplines is also observed in Linné's case, where fish related websites have significantly lower proportions for "linne" (1 % for actinopterygii and "linne-1766", below 1 % for 1758) than those of other animal groups (18 % for "araneae" + "linne-1767", 20 % for "gastropoda", 25 % for "bivalvia", these proportions were lower in the "1758" query, only 11 % for "bivalvia"). There must be scientific sources behind these differences.

These are only some examples, but they demonstrate that it is hard to come to a common agreement in all zoological disciplines. Either the "preferred name" system is applied in all disciplines, but nobody likes to provide funds for establishing such a list outside fish nomenclature, or an arbitrary system (something similar to a "prevailing usage" model - this will unlikely lead to consistent spellings), or the original spelling is used.

Another solution is to **cite every author as spelled in the original source**.

This is currently the only way to achieve consistent spellings for authors in taxonomic names, on an objective base of published sources, in the absence of a standard list.

8.2.2.2 How to determine the original spelling of the author

Take the name from the original work, preferably from its title page. Correct genitive (or other cases) to **nominative case**, and correct **v** to **u** if the name was spelled in classical Latin. **Do not correct more**.

Examples:

Linnæi 1758 (genitive) becomes **Linnæus** 1758

Fabricii 1775 (genitive) becomes **Fabricius** 1775

Gveldenstaedt 1775 becomes **Gueldenstaedt** 1775

For the most well-known zoological author **Linnæus** it is certainly sufficient not to use the original spelling and to write simply "Linnaeus". If you intend to use the original spelling consistently in your data resource, this is "**Linnæus**" for all works prior to 1762 (e.g. the 1758 work) and Linné for the works after 1761, such as the 1766/1767 work.

If the original publication provided various spellings, select the probably mostly used variant.

If the original publication abbreviated the name or gave only a first name, feel free to spell it out and use a preferred spelling for this purpose.

Example:

Férussac 1807, complete name J. B. L. d'Audebard de Férussac, on the title page given as "**J. Daudebard fils**". D'Audebard is usually considered to form part of the set of first names. The name Férussac should be used, as in his other publications.

Use **UTF-8 character encoding** in your database.

Names of authors must be spelled with diacritic marks, ligatures, spaces and punctuation marks. The first letter is capitalised. Some French names begin with lower-case d (d'Orbigny, d'Alton), but not if they were not French citizens (D'Abbrera, was Australian).

Co-authors are separated by comma, the **last co-author should be separated by "&"**. Using "and", "et" or "y" creates unnecessary problems.

Examples:

Salvelinus alpinus (**Linnaeus** 1758) (Actinopterygii), *Dentalium aprinum* **Linné** 1767 (Scaphopoda), *Trachipterus* **Goüan** 1770 (Actinopterygii), *Chaetodon fasciatus* **Forskål** 1775 (Actinopterygii), *Ichneumon bicinctus* **Fueßlin** 1775 (Hymenoptera), *Crotalus piscivorus* **La Cépède** 1789 (Squamata), *Agouti Lacépède* 1799 (Mammalia), *Oestophora granesae* **Arrébola** 1998 (Gastropoda), *Cryptazeca spelaea* **Gómez** 1990 (Gastropoda), *Oliva Bruguière* 1789 (Gastropoda), *Alopias soosiana* **Agócsy & Pócs** 1961 (Gastropoda), *Malacolimax wiktoriae* **Alonso & Ibáñez** 1989 (Gastropoda), *Derocheras roblei* **Borredà** 2003 (Gastropoda), *Pylaemenes Stål* 1875 (Phasmatodea)
Theodoxus valentinus (**Graëlls** 1846) (Gastropoda), *Arion vejrowskyi* **Babor & Košťal** 1893 (Gastropoda), *Alopias maciana* **Bădărău & Szekeres** 2001 (Gastropoda), *Zospeum exiguum* **Kuščer** 1932 (Gastropoda), *Montenegrina minuscula* **Eröss & Szekeres** 2006 (Gastropoda), *Gyraulus stankovici* **Hadžišće** 1955 (Gastropoda), *Bithynia zeta* **Glöer & Pešić** 2007 (Gastropoda), *Oxychilus inopinatus* (**Uličný** 1887) (Gastropoda), *Orcula zilchi* **Urbański** 1960 (Gastropoda), *Sprattia aksoylari* **Yıldırım** 1997 (Gastropoda)
Agraulis Boisduval & Le Conte, 1835 (Lepidoptera), *Acanthodelphax* **Le Quesne** 1964 (Auchenorrhyncha), *Dugong dugon* (**Statius Müller** 1776) (Mammalia), *Semilimacella bonelli* (**Targioni Tozzetti** 1873) (Gastropoda), *Vitrea striata* **Norris, Paul & Riedel** 1988 (Gastropoda)
Dioctophyme Collet-Meygret 1802 (Nematoda), *Parabrosoma* **Giglio-Tos** 1910 (Phasmatodea)

Also in Chinese and Korean names only the surname is cited.

Examples:

Pipadentalium **Yoo** 1988 (Scaphopoda), *Sinentomon* **Yin** 1965 (Protura), *Belbolla huanghaiensis* **Huang & Zhang** 2005 (Nematoda)

Names originally spelled in **non-Latin script** should be transcribed using a widely used international transcription mode (avoid English or German modes of transcription for Russian or Chinese names).

If the author transcribed the name in the original work in a non-international transcription mode, you can either use that one or the international mode of transcription. This is currently under debate.

If the author did not present a Latin transcription in the original work, and spelled only in non-Latin scripts, then prefer the international mode of transcription, not one that was used by the same author at other occasions. But also this is under debate.

Examples:

Gittenbergeria **Schileyko** 1991 (Gastropoda) (Russian author, article in English, spelled with German transcription mode), *Causa* **Shilejko** 1971 (Gastropoda) (article in Russian, transcribed using an international standard)
Acarauna longirostris **Sevastianoff** 1802 (Actinopterygii) (Russian author, article in French, with French transcription mode), *Anas canagica* **Sewastianoff** 1802 (Aves) (article in French, with fantasy transcription mode)
Scarus maxillosus **Zouiew** 1781 (Actinopterygii) (Russian author, article in Latin, French transcription mode), *Muraena alba* **Zuiew** 1793 (Actinopterygii) (article in Latin, other transcription mode)
Limax fasciatus **Razoumowsky** 1789 (Gastropoda) (article in French, transcribed at other occasions Razumovskij)
Dreissena stankovici **Lvova & Starobogatov** 1982 (Russian authors, article in Russian, in the English summary spelled Lvova, not L'vova)

If an author from a Latin-script country published in non-Latin script and the name was also transcribed, spell the name as it should be in the Latin script.

Examples:

Theodoxus pallasi **Lindholm** 1924 (Gastropoda) (article in Russian, retranscribed to Latin this would give **Lindgol'm**)

Cite **Spanish names** in full as they were given on the title page. Their spellings have many variants. This is a problem in all disciplines and has partly to do with low flexibility of editors concerning their publication standards. These editors tend to force "Spanish" authors not to write their complete surnames. Some names contain "e", "y" or "i" meaning "and" in Portuguese, Spanish or Catalan, this should not be confounded with the "&" of the last co-author. Just spell as it was given in the original source.

Examples:

Iberellus pythiusensis (**Bofill i Poch & Aguilar-Amat** 1924) (Gastropoda), *Bofilliella subarcuata* (**Bofill y Poch** 1897) (Gastropoda), *Xerocrassa betulonensis* (**Bofill** 1897) (Gastropoda)
Pyrenaeaaria parva **Ortiz de Zárate** 1956 (Gastropoda), *Suboestophora* **Ortiz de Zárate López** 1962 (Gastropoda), *Microxeromagna* **Ortiz de Zárate y López** 1950 (Gastropoda), *Oestophora gasulli* **Ortiz de Zárate Rocandio & Ortiz de Zárate López** 1961 (Gastropoda)
Xerotricha gonzalezi (**Azpeitia Moros** 1925) (Gastropoda)
Suboestophora ebria **Corbella i Alonso** 2004 (Gastropoda)
Unio tumidiformis **Da Silva e Castro** 1885 (Bivalvia)
Mengoana brigantina (**Da Silva Mengo** 1867) (Gastropoda)
Iberus ortizi **García San Nicolás** 1957 (Gastropoda)
Xerocrassa edmundi **Martínez-Ortí** 2006 (Gastropoda)

"von": German names are not cited with their title of nobility "von" in the taxonomic name, this forms part of the set of first names and should not appear in authorships for taxonomic names. Graf, Gräfin, Ritter and other titles of nobility also form part of the set of first names. In citizens of English countries the "Von" of German or Austrian descendants is capitalised and part of the surname. In Austria the titles of nobility were removed from surnames in 1919, since then only Germans have carried such titles.

Examples:

Columella columella ([**Martens**] 1830) (Gastropoda) (name was Martens, C. von), *Albinaria menelaus* (**Martens** 1873) (Gastropoda) (name was Martens, E. von), *Balea heydeni* **Maltzan** 1881 (Gastropoda) (name was Maltzan, H. von)
Bithynia schwabii **Frauenfeld** 1865 (Gastropoda) (name was Frauenfeld, G. Ritter von)

Some German compound names have a particle "**von**" between independent parts of a compound surname, this is not a title of nobility and is not omitted. It is spelled in lower-case.

Examples:

Dajaca **Brunner von Wattenwyl** 1893 (Phasmatodea), *Xenophora* **Fischer von Waldheim** 1807 (Gastropoda), *Corbicula* **Megerle von Mühlfeld** 1811 (Bivalvia)

But this does not always follow the same system. It is usually the best way to follow the tradition.

Examples:

Blatta anelytra **Schrank** 1776 (Blattodea) (name was "Schrank, F. von Paula", usually not "Paula Schrank", not "Von Paula Schrank")

"**Van**" in Dutch names is not a title of nobility, and is usually capitalised and cited with the surname. In Belgian names the "Van" is always part of the surname, in these cases the "Van" is part of the taxonomic name.

In Dutch this has long been undecided and inconsistent. In alphabetically sorted Dutch registers the "van" is usually attached to the first name. On the other hand, Dutch football (soccer) players usually carry the Van with their surnames, like Belgians in public life. It would be premature to give a recommendation here, at least not one touching the heaven of Dutch football gods Van der Vaart, Van Basten, Van Nistelrooy, Van Persie, Van Bronckhorst, Van der Sar...

Examples:

Pteromeris jozinae **Aartsen** 1984 (Bivalvia) (Dutch author, alternatively: *Pteromeris jozinae* **Van Aartsen** 1984), *Marstoniopsis* **Regteren Altena** 1936 (Gastropoda) (Dutch author, or *Marstoniopsis* **Van Regteren Altena** 1936).

"**De**" can either be a title of nobility or not. If yes, then it is not cited with the surname. Most "de" in French names are titles of nobility, usually this does not form part of a taxonomic name, but there can be exceptions (in "De Gaulle" the "De" is capitalised and not a title of nobility) and special rules. In French names with d' the title of nobility is always cited with the surname and spelled lower-case (d'Orbigny), as well as in names with one syllable (de Ba).

In citizens of English countries the D' of French descendants is capitalised (D'Abrera). In Belgian, Iberian and Italian names, the particles "De", Da, "Delle" etc. are usually not titles of nobility, they part of the surname and are capitalised. In Dutch football players are known as De Cler, De Jong, De Zeeuw. The intermediate particle in "Van der" or "Uit de" is spelled in lower-case. The "De" in Dutch means "the" (De Jong = the boy).

Examples:

French: *Pagodulina pagodula* (**Des Moulins** 1830) (Gastropoda), *Rissoina inca* **d'Orbigny** 1840 (Gastropoda), *Bos javanicus* **d'Alton** 1823 (Mammalia),
Venerupis **Lamarck** 1818 (Bivalvia) (not "de Lamarck", not "Chevalier de Lamarck", complete name was Lamarck, J. B. P. A. de Monet de), *Cryptazeca* **Folin** & Bérillon 1877 (Gastropoda) (not "de Folin & Bérillon"), *Balaenoptera* **La Cepède** 1804 (Mammalia) (not "de La Cepède")
 Belgian/Dutch: *Blatta grisea* **De Geer** 1773 (Blattodea), *Vitrea inae* **De Winter** & Ripken 1991 (Gastropoda), *Vallatia* Gittenberger & **Uit de Weerd** 2006 (Gastropoda)
 Italian: *Paludinella littorina* (**Delle Chiaie** 1828) (Gastropoda), *Cecilioides jani* **De Betta** & Martinati 1855 (Gastropoda), *Viviparus ater* (**De Cristofori** & Jan 1832) (Gastropoda), *Chondrina oligodonta* (**Del Prete** 1879) (Gastropoda), *Oxychilus paulucciae* (**Di Stefani** 1883) (Gastropoda)

Some French names carry "de" in a compound surname, like the German equivalents not a title of nobility, and spelled in lower-case.

Examples:

Caucasotachea calligera (**Dubois de Montpéreux** 1840) (Gastropoda), *Crotalus adamanteus* **Palisot de Beauvois** 1799 (Squamata),
Lepadella **Bory de Saint Vincent** 1826 (Rotatoria)

Not all names of French nobles follow a well visible system, it is convenient to follow the tradition.

Examples:

Semilimax semilimax (**Férussac** 1802) (Gastropoda) (name was Férussac, J. B. L. d'Audebard de), *Arion hortensis* Férussac 1819 (Gastropoda) (name was Férussac, A. E. J. P. J. F d'Audebard de)

ä and ae, ö and oe, ü and ue, ß and ss are different letters in German names, they are not arbitrarily equivalent. Mueller and Müller are different surnames in Germany. The best recommendation is to spell exactly as in the original work.

In old German and Scandinavian works an upperscript e is occasionally printed above a, o and u, these are no extra letters in the UTF-8 character encoding and it is commonly accepted to convert these into ä, ö and ü.

The ligature æ is an independent letter and should not be converted to ä, œ should not be converted to ö. If you do not have UTF-8 encoding æ can be converted to ae, œ to oe. If you have UTF-8, cite as in the original

source. Also ö and ø are not the same letters. These characters should be copied exactly from the original work. Analyse each work independently.

For the individual name of a taxon it is not a problem if this method produces variant spellings of authorships in different taxa established by the same author in different sources. Those who are interested in the history of science usually know how to disambiguate variant spellings of author names.

Examples:

Cancer dorsipes **Linnæus** 1758, *Cancer dormia* **Linné** 1763, *Cancer dodecos* **Linné** 1767 (all Crustacea)
Perca acerina **Gueldenstaedt** 1775, *Piabucus dentatus* (**Koelreuter** 1763) (all Actinopterygii)
Buliminus exquisitus **Nägele** 1901, *Zebrina armenica* (**Naegle** 1903), *Monacha eliae* (**Nägele** 1906) (all Gastropoda)
Acrotoma semicineta (**Boettger** 1881), *Limax conemenosi* **Böttger** 1882, *Gigantomilax lederi* (**Boettger** 1883) (all Gastropoda)
Loxia atra **Brünnich** 1764 (Aves), *Cancer carinatus* **Brunnich** 1768 (Crustacea)
Claviger Preyssler 1790 (Coleoptera), *Chrysis candens* **Preyßler** 1791 (Hymenoptera)
Nesovitrea hammonis (**Ström** 1765) (Gastropoda), *Asellus longus* **Ström** 1767 (Actinopterygii)
Carabus exaratus **Næzén** 1794 (Coleoptera), *Aranea allodroma* **Walckenær** 1802 (Araneae)

Authors who published under **pseudonyms** are usually cited under the pseudonym they used in the original work, not under their (probable, if known at all) true name. These authors preferred not to be cited by their true names, otherwise they would not have published the scientific information. This is usually respected.

Examples:

Oligolimax pollonerianus (**Fra Piero** 1897) (Gastropoda) (not as Arbanasich).

Two identical surnames of co-authors should be repeated to avoid misunderstandings.

Examples:

Gastropodan genus *Elona* **Adams & Adams** 1855. Do not spell *Elona* **H. & A. Adams** 1855
 Gastropodan species *Xerosecta introducta* (**Villa & Villa** 1841). Do not spell *Xerosecta introducta* (**A. & G. B. Villa** 1841).

[] square brackets are used in zoological nomenclature if the author was not cited in the work itself but inferred from secondary sources (usually Recommendation 51D is applied). These square brackets wrap only the author, not the year. Citing the author as "Anonymous" is also done. In fishes both modes are occasionally combined.

Examples:

Perla [**Geoffroy**] 1762 (Plecoptera), *Papilio ilia* [**Denis & Schiffermüller**] 1775 (Lepidoptera), *Acronicta cinerea* ([**Hufnagel**] 1766) (Lepidoptera), *Pupa columella* [**Martens**] 1830 (Gastropoda), *Dolabella auricularia* ([**Lightfoot**] 1786) (Gastropoda), *Chlamys* [**Röding**] 1798 (Bivalvia), *Otus* [**Pennant**] 1769 (Aves)
Ignavus **Anonymous** 1759 (Mammalia)
Spherooides **Anonymous** [**Lacépède**] 1798 (Actinopterygii)

Verified original spellings of authors of important early works:

Brünnich 1764, **Brunnich** 1768, **Brünnich** 1771, 1779, 1781, 1783, 1788
Fueßlin 1775, **Füßly** 1781, **Füebly** 1783
[Geoffroy] 1762, **Geoffroy** 1767, 1785
Geoffroy Saint-Hilaire 1795, ...1818
Gueldenstaedt 1770, 1772, 1773, 1774, 1775, **Güldenstaedt** 1780, 1781
[Hufnagel] 1766 and **Hufnagel** 1766, **Hufnagel** 1767
La Cépède 1789, **La Cepède** 1798, **Lacépède** 1799, **La Cepède** 1800, 1803, 1803, 1804
Linnæus 1758, 1759, 1760, 1761, **Linné** 1762, 1764, 1766, 1767, 1768, 1769, 1771, 1775
Ström 1767, 1783, **Strøm** 1762, 1765, 1768, 1788
Svederus 1788, **Swederus** 1795
Walckenær 1802

8.2.2.3 The use of initials

Initials are problematic in that they create conflicts between taxonomists whose job is to provide unique names for animals, and other bioscientists who have to use these names and work with them in electronic environments.

Some taxonomists consider initials useful to distinguish between two authors with the same surname. Talking of an author Müller, Geoffroy, Adams, Koch, Sowerby or Verrill without initials does indeed not identify the person behind the name. From a historical point of view it can be very important to distinguish exactly between authors of important works, and not to confound authors with similar surnames. If it is necessary to identify the person, initials are usually helpful, except in the cases where different authors have the same initials. Taxonomists often work in historical literature and associate such names with persons they know well.

But for an ecologist, a nature conservation society or a legal work it is not interesting who was exactly the person who first established the name, they need a name as an identifier for an animal that can be communicated with others, often by electronic means. For these purposes it is not necessary to identify the person in a taxon name author string, but it is much more important to use as exactly as possible the same name.

A database using initials is not easily connectable to one that does not use initials. The situation in two databases both using initials is not much better because there are no commonly applied standards and

conventions. The damage caused by the presence of initials is considerably higher than its benefit it has for taxonomists.

Initials have never been a problem for human brains. Some authors used initials, some not, nobody needed to care, no standards were needed because the names were perfectly understood, with or without initials. There has never been a need to provide clear rules in the ICZN Code.

It is only very recently that initials have become a problem, since they have provided serious obstacles in electronic environments. As said in the introduction, Linnean names in the form of taxon name author strings seem to be more successful identifiers for species and genera than LSIDs and other systems, and it is possible that they stay the most important globally unique species identifier in the future.

For this purpose zoological names need to be better adapted to electronic environments than they currently are. This is much less a problem in botany, where a successful TDWG-like standard for authors was developed (IPNI Authors service, www.ipni.org).

A computer program cannot automatically see that Müller and O. F. Müller are the same authors, and that the two taxon name author strings refer to the same taxon. For a computer, O. F. Müller, O. Müller and Müller are different strings, even the differences between O. F. Müller, O.F. Müller and OF Müller are problematic. This inhibits automatic processes, provokes a feedback popup and makes cost-intensive manual input necessary to lump the identifiers. This is a serious problem and not as trivial as it is for human brains.

If database A uploads a file with a few names of species to another database B (to lump the species-specific information and use the taxon name author strings as identifiers), the recipient must recognize that all O. F. Müllers correspond to the Müllers in database B, and teach a computer program to understand this. The recipient can do this manually or use a controlled vocabulary, such as provided by www.globalnames.org or another service, but installing this, running and controlling the results cannot be done without creating workload and costs.

Neither a database provider nor a person except a skilled insider will understand taxon name author strings if they were given in the form *Elona H. & A. Adams 1855* or *Virpazaria stojaspali A., P. L. Reischütz & Subai 2009*. Which letters are initials, which ones are acronyms of surnames, how many errors are in these strings, and where exactly are they? Sorting this out can be cost intensive.

In Australia a program was created that provides a helpful tool for a non-expert databaser to decide whether two variants of presumably the same author(s) should be accepted as identical or not:

www.cmar.csiro.au/datacentre/taxamatch-tests.htm

It is not easy to work with this program, and you have to be accustomed to using it regularly. This tool does not substitute a manual process, it only helps in the manual work. Using the "compare authorities" function will yield a value between 0 (the two names do not match at all) and 1 (they match perfectly), and it is up to you to deduplicate both variant author spellings manually or not. Values below 0.4 are commonly regarded not to match, but the machine does not replace the human reader, it can only help by pre-sorting data. Sometimes good matches yield low values, in other cases bad matches may yield high values.

Examples (in **bold** incorrect matches):

0.30 - H. & A. Ad. + Adams & Adams

0.32 - A. Reischütz, P. Reischütz & P. Subai + Reischütz et al.

0.38 - A., P. L. Reischütz & Subai + Reischütz et al.

0.48 - H. & A. Ad. 1855 + Adams & Adams 1855

0.38 - A., P. L. Reischütz & Subai 2009 + Reischütz et al. 2009

0.51 - H. & A. Ad. + Adams, H. & Adams, A.

0.60 - O. F. Müller 1776 + P. L. Stadius Müller 1776

0.61 - H. & A. Adams + Adams & Adams

0.63 - A., P. L. Reischütz & Subai 2009 + Reischütz, Reischütz & Subai 2009

0.64 - Müller + Mueller

0.68 - Müller + O. F. Müller

0.68 - Müller + Muller

0.69 - O. F. Müller 1776 + P. L. S. Müller 1776

0.71 - H. & A. Adams 1855 + Adams & Adams 1855

0.73 - Müller 1776 + Stadius Müller 1776

0.75 - Sowerby 1850 + Sowerby 1875

0.78 - L. Pfeiffer 1856 + K. L. Pfeiffer 1956

0.78 - O. F. Müller 1774 + Müller 1774

0.79 - G. B. Sowerby I 1850 + G. B. Sowerby III 1875

0.81 - Müller 1774 + Müller 1776

0.83 - Pfeiffer 1856 + Pfeiffer 1956

0.83 - Pfeiffer + L. Pfeiffer

0.85 - A. Reischütz, P. Reischütz & P. Subai 2009 + Reischütz, Reischütz & Subai 2009

0.87 - O. F. Müller 1774 + O. F. Müller 1776

0.89 - Pfeiffer 1856 + L. Pfeiffer 1856

1.00 - O. F. Müller + O.F. Müller

A uniform and commonly applied practice is necessary if connecting electronic biodiversity related information should work more efficiently.

Some databases use initials, some partly, some not.

Those who use initials can quickly remove them. Those who don't use initials, cannot add them, because they don't know them. So the best solution is to remove them everywhere.

This is why the recommendation, not to use initials, is so strong in this GBIF manual.

Never use initials of first names in a taxon name author string. Neither in databases, nor in museum catalogues, nor in journal articles. If you use them, you risk to create obstacles, and you risk to provoke costs that some day others will have to pay.

Where you have them in your files, remove them. Especially when you are planning to share your data with others.

Always use exclusively the surname.

Examples:

Trichocerca tigris (Müller 1786) (Rotifera), *Gordius albopunctatus* Müller 1927 (Nematomorpha), *Strongylus equinus* Müller 1780 (Nematoda), *Centrorhynchus aluconis* (Müller 1780) (Acanthocephala), *Microplana terrestris* (Müller 1774) (Plathelminthes), *Nais elinguis* Müller 1774 (Annelida), *Podura crystallina* Müller 1776 (Collembola), *Lipaphis alliariae* Müller 1952 (Sternorrhyncha), *Ephemera danica* Müller 1764 (Ephemeroptera), *Bittacus italicus* (Müller 1766) (Mecoptera), *Ancistrocerus trifasciatus* (Müller 1776) (Hymenoptera), *Cantharis nigricans* Müller 1766 (Coleoptera), *Epirrhoe alternata* (Müller 1764) (Lepidoptera), *Physocypria kraepelini* Müller 1903 (Crustacea), *Neobisium albanicum* (Müller 1931) (Pseudoscorpiones), *Petrobia latens* (Müller 1776) (Acari), *Zelotes exiguus* (Müller & Schenkel 1895) (Araneae), *Chondrula tridens* (Müller 1774) (Gastropoda)

Also if several authors of the same surname have established names in your animal group.

Examples:

Cantharis nigricans Müller 1766 (Coleoptera), *Hylastes trifolii* Müller 1803 (Coleoptera), *Ampedus erythrogonus* (Müller 1821) (Coleoptera), *Stenichnus collaris* (Müller & Kunze 1822) (Coleoptera), *Ottiorhynchus martinensis* Müller 1858 (Coleoptera), *Haliphus dalmatinus* Müller 1900 (Coleoptera), *Anommatus matzenaueri* Müller 1913 (Coleoptera), *Ocypus kuntzeni* (Müller 1926) (Coleoptera), *Bryaxis crepsensis* (Müller 1947) (Coleoptera)
Eucypris crassa (Müller 1785) (Crustacea), *Physocypria kraepelini* Müller 1903 (Crustacea).

In those (exceptional) cases where it is necessary to explain who was the author of the description, this can be done by adding a short note.

Examples:

Cantharis nigricans Müller 1766 (established by O. F. Müller).
Conus catenatus Sowerby 1850 (established by G. B. Sowerby I), *Conus catenatus* Sowerby 1875 (established by G. B. Sowerby III).

Initials provide a few other problems. They are not used consistently, only some authors and some disciplines use initials. Zoologists are usually restricted to their disciplines and add initials only if they know another author of the same surname in the same animal group. Some use initials only in those cases where authors with the same surnames published in the same time period, others use initials in all cases, also if 200 years were between both authors.

The names are not stable, they must be updated if a new author with an already used surname begins publishing in the same field.

Example:

E. Gittenberger has published many new molluscan names since the 1960s. Those taxonomists who used initials cited the author as "Gittenberger". When his son **A. Gittenberger** published a new name more than three decades later in the 1990s, all these names suddenly needed to be changed to "E. Gittenberger" in all data resources. Of course most have remained inconsistent since then.

Initials may provide potential error sources.

Example:

Google hits (08.2009):

Semilimax semilimax (J. Férussac 1802) (109, correct), *Semilimax semilimax* (A. Férussac 1802) (8, incorrect)

Initials can provide obstacles to finding sources of mistakes in taxonomic names.

Example:

Fauna Europaea database (www.faunaeur.org) (07-2009):

Tandonia nigra (C. Pfeiffer 1849) (Gastropoda), this name must be incorrect, where was the error source? There was an author Carl Pfeiffer who had published on molluscs in the 1820s, who might either have published in 1849, or the species was established in the 1820s. Another author L. Pfeiffer published extremely much on molluscs in the 1840s and 1850s, several journal articles in 1849. A third author K. L. Pfeiffer published on molluscs in the 1950s and could have published a name in 1949. None of the three Pfeiffers published in 1894.

The true error source was not the initial, but the year 1849 - another totally unknown author with the same initial C. Pfeiffer (not Carl Pfeiffer) had published a journal article in 1894. The use of the initial "C." was correct, but led to incorrect conclusions. The correct name is *Tandonia nigra* (Pfeiffer 1894).

Initials are not used consistently, and even if yes, they are not fit for the electronic age.

I analysed the Fauna Europaea database (www.faunaeur.org, 07-2009) which contained a collection of many thousand animal names, compiled by specialists of many different animal groups.

The result was that in this mixed database the same surname occurred sometimes with and sometimes without initials, but I observed also inconsistent use of initials within a discipline.

In addition, Fauna Europaea is a typical example of a database where combined initials O.F. and O. F. are read as entirely different strings - if you try to search for all taxonomic names described by O. F. Müller you have to know (1) that the submitted data by the various data providers contained several versions (O. F. Müller, O.F. Müller, Müller and O. Müller), and (2) that the search function will not find O.F. Müller without space if you search for O. F. Müller with space or Müller.

After 2009 www.faunaeur.org lost the ability to display diacritic marks in authorships, so Müller was converted to Muller. But was only to a program bug (not fixed until at least 2012), citing "Müller" as "Muller" is not standard in zoology.

Fauna Europea (www.faunaeur.org, 07-2009) records for **Koch**

Koch: Collembola, Lepidoptera, Coleoptera, Sternorrhyncha, Crustacea, Gastropoda, Acari (n = 306)

C. L. Koch: Chilopoda, Diplopoda, Araneae, Scorpiones, Acari (n = 147 for C. L. Koch, n = 188 for C.L. Koch)

L. Koch: Chilopoda, Araneae, Pseudoscorpiones (n = 231)

Koch: *Podura striata* Koch 1840 (**Collembola**), *Aphis craccivora* Koch 1854 (**Sternorrhyncha**), *Rhopalosiphonius calthae* (Koch 1854) (Sternorrhyncha), *Lathrobium albanicum* Koch 1937 (**Coleoptera**), *Anthicus algirensis* Koch 1940 (Coleoptera), *Longitarsus echii* (Koch 1803) (Coleoptera), *Titanethes albus* (Koch 1841) (**Crustacea**), *Armadiillum albifrons* Koch 1901 (Crustacea), *Vitrina albina* Koch 1876 (**Gastropoda**), *Panonychus ulmi* Koch 1836 (**Acari**), *Tetranychus urticae* Koch 1836 (Acari), *Hyalomma dromedarii* Koch 1844 (Acari)

C. L. Koch: *Eupolybothrus grossipes* (C. L. Koch 1847) (**Chilopoda**), *Strigamia crassipes* (C. L. Koch 1835) (Chilopoda), *Julus alpinus* C. L. Koch 1838 (**Diplopoda**), *Glomeris albocincta* C. L. Koch 1847 (Diplopoda), *Polydesmus edentulus* C. L. Koch 1847 (Diplopoda), *Pardosa alacris* (C. L. Koch 1847) (**Araneae**), *Scorpius algeriacus* C. L. Koch 1838 (**Scorpiones**), *Euscortius naupliensis* C. L. Koch 1837 (Scorpiones), *Oribatella calcarata* (C. L. Koch 1836) (**Acari**), *Carabodes canaliculatus* C. L. Koch 1840 (Acari), *Holoparasiticus calcaratus* (C. L. Koch 1839) (Acari)

L. Koch: *Lithobius crassipes* L. Koch 1862 (**Chilopoda**), *Eupolybothrus litoralis* (L. Koch 1867) (Chilopoda), *Pardosa albata* L. Koch 1870 (**Araneae**), *Araniella alpica* L. Koch 1869 (Araneae), *Roncocreagriss cambridgei* (L. Koch 1873) (**Pseudoscorpiones**), *Neobisium erythroductylum* (L. Koch 1873) (Pseudoscorpiones)

Fauna Europea (www.faunaeur.org, 07-2009) records for **Müller**

Müller: Rotifera, Nematomorpha, Nematoda, Acanthocephala, Plathelminthes, Annelida, Ephemeroptera, Mecoptera, Hymenoptera, Coleoptera, Lepidoptera, Acari, Araneae (n = 351)

Muller: Plathelminthes, Diptera, Coleoptera, Acari (n = 5)

Stattus Müller: Aves (n = 3)

C. Müller: Coleoptera (n = 2)

Cl. Müller: Coleoptera (n = 1)

F.P. Müller: Sternorrhyncha (n = 14) (only F.P. Müller, not F. P. Müller)

G. Müller: Coleoptera, Pseudoscorpiones (n = 210)

Müller G.: Coleoptera (n = 5)

G. W. Müller: Crustacea (n = 18)

J. Müller: Coleoptera (n = 29)

O. Müller: Coleoptera (n = 13)

O. F. Müller: Rotifera, Annelida, Coleoptera, Hymenoptera, Crustacea, Acari, Bivalvia, Gastropoda (n = 97 for O. F. Müller, n = 83 for O.F. Müller)

Müller O. F.: Coleoptera (n = 13)

P. Müller: Coleoptera (n = 5)

P. W. Müller: Coleoptera (n = 1)

P. W. J. Müller: Coleoptera (n = 6 for P. W. J. Müller, n = 3 for P.W.J. Müller)

Müller: *Trichoerca tigris* (Müller 1786) (**Rotifera**), *Notommata aurita* (Müller 1786) (Rotifera), *Gordius albopunctatus* Müller 1927 (**Nematomorpha**), *Gordionus thuringensis* Müller 1927 (Nematomorpha), *Strongylus equinus* Müller 1780 (**Nematoda**), *Centrorhynchus aluconis* (Müller 1780) (**Acanthocephala**), *Microplana terrestris* (Müller 1774) (**Plathelminthes**), *Mesostoma tetragonum* (Müller 1773) (Plathelminthes), *Lumbriculus variegatus* (Müller 1774) (**Annelida**), *Nais elinguis* Müller 1774 (Annelida), *Ephemer danica* Müller 1764 (**Ephemeroptera**), *Bitacus italicus* (Müller 1766) (**Mecoptera**), *Ancistrocerus trifasciatus* (Müller 1776) (**Hymenoptera**), *Anthroherpon apfelbecki* (Müller 1910) (Coleoptera), *Haliphys dalmatinus* Müller 1900 (Coleoptera), *Aphaobius alphonsi* Müller 1914 (Coleoptera), *Anisoscapha klimeschi* (Müller 1917) (Coleoptera), *Orchestes testaceus* (Müller 1776) (Coleoptera), *Cantharis nigricans* Müller 1766 (Coleoptera), *Lepinus testaceus* (Müller 1817) (Coleoptera), *Stenichmus collaris* (Müller & Kunze 1822) (Coleoptera), *Bryaxis crepsensis* (Müller 1947) (Coleoptera), *Epirrhoe alternata* (Müller 1764) (**Lepidoptera**), *Coenonympha tullia* (Müller 1764) (Lepidoptera), *Petrobia latens* (Müller 1776) (**Acari**), *Zelotes exiguis* (Müller & Schenkel 1895) (**Araneae**)

Muller: *Anoura crassicornis* Muller 1859 (**Collembola**), *Podura crystallina* Muller 1776 (Collembola), *Anommatus matzenaueri* Muller 1913 (**Coleoptera**), *Hylastes trifolii* Müller 1803 (Coleoptera)

Stattus Müller: *Egretta tricolor* (Stattus Müller 1776) (**Aves**)

C. Müller: *Nebria kraatzii* C. Müller 1889 (**Coleoptera**)

Cl. Müller: *Otiorynchus martinensis* Cl. Müller 1858 (**Coleoptera**)

F. P. Müller: *Dysaphis krumbholzi* F. P. Müller 1961 (**Sternorrhyncha**), *Lipaphis alliariae* F. P. Müller 1952 (Sternorrhyncha)

G. Müller: *Orotrechus kalisi* G. Müller 1931 (**Coleoptera**), *Ceutorhynchus karamani* G. Müller 1921 (Coleoptera), *Anophthalmus alphonsi* (G. Müller 1914) (Coleoptera), *Neobisium albanicum* (G. Müller 1931) (**Pseudoscorpiones**)

Müller G.: *Oreina albanica* (Müller G. 1948) (**Coleoptera**)

G. W. Müller: *Physocypria kraepelini* G. W. Müller 1903 (**Crustacea**), *Pseudocandona hartwigi* (G. W. Müller 1900) (Crustacea)

J. Müller: *Ocypus kuntzeni* (J. Müller 1926) (**Coleoptera**), *Ocypus albanicus* (J. Müller 1943) (Coleoptera)

O. Müller: *Gyrolphus fracticornis* (O. Müller 1776) (**Coleoptera**)

O. F. Müller: *Synchaeta tremula* (O. F. Müller 1786) (**Rotifera**), *Squatinella lamellaris* (O.F. Müller 1786) (Rotifera), *Theromyzon tessulatum* (O. F. Müller 1774) (**Annelida**),

Achlypea undata (O. F. Müller 1774) (**Coleoptera**), *Noterus crassicornis* (O. F. Müller 1776) (Coleoptera), *Tenthredo bifasciata* O. F. Müller 1766 (**Hymenoptera**), *Apethymus serotinus* (O. F. Müller 1776) (Hymenoptera), *Eucypris crassa* (O. F. Müller 1785) (**Crustacea**), *Unionicola crassipes* (O. F. Müller 1776) (**Acari**), *Hydrachna cruenta* O. F. Müller 1776 (Acari), *Chondrula tridens* (O. F. Müller 1774) (**Gastropoda**), *Vallonia costata* (O. F. Müller 1774) (Gastropoda)

Müller O. F.: *Chrysolina oricalcia* (Müller O. F. 1776) (**Coleoptera**)

P. Müller: *Elaphrus aureus* P. Müller 1821 (**Coleoptera**)

P. W. Müller: *Ampedus erythronus* (P.W. Müller 1821) (**Coleoptera**)

P. W. J. Müller: *Gastrallus immarginatus* (P. W. J. Müller 1821) (**Coleoptera**)

Authors tend to have their first name initials spelled in an even broader variety than their surnames. The mode these initials are cited in zoological literature reflects this.

Examples:

O. (F.) Müller, G. (W.) Müller, P. (W. (J.)) Müller, A. (E. J. (P. J. F. (d'Audebard de))) Férussac

8.2.2.4 Best practice guide

This guide proposed here is an attempt to provide a uniform spelling of authors in taxon name author strings for mobilising biodiversity data in electronic environments.

Initials:

- Never use initials of first names in a taxon name author string. If you have them in your database, remove them.
- If you think initials are absolutely necessary, create an additional field for the initials, so that you can remove initials for data mobilising purposes.

Spelling of author:

- If you have verified the original spelling of the author, use the original spelling and add a green flag that you have confirmed it.
- If you insist in using a preferred spelling for each author or for some authors in your database, then create two fields: one for your preferred name, and one for the original spelling.
- If you do not have the original spelling, use an unconfirmed (preferred) spelling and add a red flag that you have not confirmed the original spelling.
- If you have a small database or collection of data, try to obtain consistently the original spelling.

8.3 The correct year in a name

The year must be determined following strict rules for the determination of the day of publication given by the ICZN Code (Art. 21). Zoologists of all disciplines tend to follow these very important rules widely and strictly.

The background for that is one of the most crucial rules and guiding principles of zoological nomenclature, the Principle of Priority. Almost always the name with the earliest date must be used. The year in a taxonomic name is much more important than the author.

Any name must always carry the earliest date at which it was first made available.

Caution with dates published by the ICZN Commission.

The Code (Art. 21) is usually superior to ICZN Opinions (Art. 80.6.2). The date must always be determined under the Code's provisions, also the Commission must follow this principle. If an older name has precedence and it is not desired to use it, the Commission must suppress the older name or give the younger name a specified precedence (Art. 81.1), but it has limited power to change the date. Opinions published by the Commission can be outdated and must be corrected if earlier dates are discovered. This concerns also decisions associated with these dates, such decisions can become meaningless.

Examples:

In Opinion 363 from 1955 a type species was fixed for a genus listed as "*Ancylus* Müller, 1774" (Gastropoda). The date was incorrect, *Ancylus* was established in an earlier work by Müller 1773. *Ancylus* has to be combined with the 1773 date, not with 1774 as given in the Opinion.

In Opinion 479 from 1957 a decision was taken about *Turbo smaragdus* "Gmelin 1791" (Gastropoda), the authorship was derived from Gmelin 1791: 3602. On another page Gmelin had mentioned a different new species as *Turbo smaragdus* and the Commission decided that Fleming et al. 1957 acted as First Reviser and selected the species from p. 3602 to have precedence. Later it was found that *Turbo smaragdus* in the sense of p. 3602 had already been established by [Lightfoot] 1786. This has to be corrected, the name must be *Turbo smaragdus* [Lightfoot] 1786, and the First Reviser decision became meaningless.

The date (day of publication) cited in the original publication is adopted as the correct date in absence of the contrary (Art. 21.2).

If only the month was given there, the last day of the month. If only a year was given, the date is 31 December (Art. 21.3).

If a year or month in the French Republican Calendar was given (years I-XIV, used only 1792-1806 in France, but then very strictly), the last day corresponding to that calendar (22 September). This calendar was a calendrical equivalent of the metric system of weights and measures (established in 1791), with 10 days in a week and 10 hours a day, but had 12 months. In contrast to the metric systems the calendar had no international success, the names of the months followed a well arranged system but it was overlooked that the world spoke more languages than only French.

Months of the French Republican Calendar, approximately aligned with the Gregorian Calendar:

Vendémiaire (23 Sep-22 Oct), Brumaire (23 Oct-21 Nov), Frimaire (22 Nov-21 Dec), Nivôse (22 Dec-20 Jan), Pluviôse (21 Jan-19 Feb), Ventôse (21 Feb-20 Mar), Germinal (21 Mar-20 Apr), Floréal (21 Apr-20 May), Prairial (21 May-19 Jun), Messidor (20 Jun-19 Jul), Thermidor (20 Jul-18 Aug), Fructidor (19 Aug-22 Sep).

Dates were often printed on the title page (since the 1500s this has been common standard in printed monographs and journals), or on the title page of a part or an article in a journal, or of a chapter or fascicle in a monographic work. Occasionally they were also printed on the first page of a set of pages issued simultaneously (some journals had a date printed in the footline every 16 pages). Dates can also be mentioned in the introduction, at the end of an article in a journal, or anywhere else in the text. Caution with dates if they

indicated the time at which the manuscript was finished, this was not the date of publication. Plates can also have their own dates printed on them.

If the date of the original publication turns out to have been incorrect, by evidence derived from secondary sources, published or unpublished, the date must be changed accordingly (Art. 21.2, 21.4). I would recommend to publish such information somewhere, but there is no central source of information which could be consulted. You have to know where it was published, or ask someone who may know it. Sometimes such sources are given in nomenclators or AnimalBase (www.animalbase.org).

Example:

[Denis & Schiffermüller] 1776 (Systematisches Verzeichniß der Schmetterlinge der Wienergegend)

: Title page indicated 1776, but the true date was 1775. New names are all dated to 1775. I do not know the source for that date.

Hadžišće, S. 1956. III. Beitrag zur Kenntnis der Gastropodenfauna des Ohridsees. - Beschreibungen der bis jetzt unbekanntenen Schnecken und Beispiele der Speciation bei den Gastropoden des Ohridsees. - Zbornik na Rabotite, Chidrobioloski Zavod - Ochrid [Recueil des Travaux, Station Hydrobiologique - Ohrid] 4 (1 (14)): 57-107. Ochrid.

: Title page of the volume indicated 1956. Radoman 1962: 69 published a note that the true date of publication of this issue had been April 1959. This has been accepted as the true date, names are dated to 1959. You have to know off hand that Radoman 1962 had published this note.

Caution with dates of journals.

Some **journals have not printed the true dates** of publications on their volume title pages. The true dates appeared somewhere else in the volumes, often on the title pages of separately issued parts. The true dates can deviate in both directions.

Some journals with annual volumes collected articles during the entire year and finally published all articles of the year - at the beginning of the next year. Their title pages indicated that these articles were from the last year, and they also had the last year printed on it. It is clear from such a context that the true date of publication must have been at the beginning of 1857. This is usually given as "early 1857", names will take precedence over names from Dec 1857. In other cases journals with annual cycles were in delay. So in these cases the true year was one year after the year indicated on the title of the journal volume.

Examples:

Pfeiffer, L. 1850. Descriptions of thirty new species of *Tornatellina*, *Cylindrella*, and *Clausilia*, from the collection of H. Cuming, Esq. - Proceedings of the Zoological Society of London 17 ["1849"]: 134-141.

: The title page of the journal volume indicated 1849, but this part of the journal volume appeared in 1850, so the 30 new species must carry the date 1850 and not 1849.

Pfeiffer, L. 1849. Nachträge zu L. Pfeiffer Monographia Helicearum viventium. (Fortsetzung). - Zeitschrift für Malakozoologie 5 (8) ["1848"]: 113-123.

: The title page of the journal volume indicated 1848, but a note on p. 128 indicated that the date of this part was March 1849.

Heynemann, F. D. 1863. Einige Mittheilungen der Schneckenzenzen mit besonderer Beachtung der Gattung *Limax*. - Malakozoologische Blätter 10 ["1862"]: 200-216, Taf. II-III [= 2-3].

: The title page of the journal volume indicated 1862, but on p. 209 was printed the true date October 1863.

In other cases the title page for the journal volume was issued at the beginning of the following year when all subsequently published parts of the preceding year were completed. This title page carried the date of the next year. Journals were often issued in parts, every few weeks or months 16 or 32 pages were published. So here the true year was one year prior to the year indicated on the title page of the journal volume.

Examples:

Roth, J. R. 1856. Ueber einige griechische Heliceen. - Malakozoologische Blätter 3 ["1857"]: 1-7, Taf. 1.

: The title page of the journal volume indicated 1857, but on p. 1 was printed the true date January 1856.

Some journals or multivolume works were issued in parts every few months and did not indicate dates in the content, but the parts were originally sent to the subscribers with wrappers. Wrappers were sheets in the same size, usually in cheaper low quality paper, often in a dirty colour, which indicated the contents and often also the dates. These were usually separated from the content and removed when the volumes were completed and finally bound, but occasionally they were preserved in some libraries, especially in journal volumes. These wrappers often contain important information on dates, which must be taken into account.

Example:

Sordelli, F. 1871. Anatomia del *Limax Doriae*, Bourg., nei suoi rapporti con altre specie congeneri. - Atti della Società Italiana di Scienze Naturali 13 (3) ["1870"]: 242-253, Tav. 3. Milano.

: The title page of the journal volume indicated 1870, but on the wrapper of the corresponding part was printed the date January 1871.

Sometimes reprints appeared before an article was actually published in a journal volume. It is very difficult to get to know this, since this information circulates only internally.

Example:

Sturany, R. & Wagner, A. J. 1915. Über schalentragende Landmollusken aus Albanien und Nachbargebieten. - Denkschriften der kaiserlichen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Klasse 91: 19-138, Taf. 1-18, 1 Karte. Wien.

: In the Natural History Museum in Wien members of the staff knew that reprints of this article were issued in 1914. This was subsequently recorded in some publications, usually in footnotes. All names are dated to 1914.

If no date was given in the original source, then it must be determined using secondary sources combined with the contents of the work (21.7). This information can consist in unpublished material preserved by the publisher, dates of receipt noted by librarians or other unpublished sources, or indirect evidence from cited sources in the work itself. Usually a researcher who found out the true dates of publication would publish a note and inform the community about the true dates. These dates are usually well accepted.

In some cases two alternative and equivalent proposals were published. In this case it is convenient to use the younger proposed date.

Example:

Moquin-Tandon 1855 (*Histoire naturelle des mollusques terrestres et fluviatiles de la France*, volume 2) was published in 3 parts. Falkner et al. 2002 cited two equivalent sources in which dates were determined. They differed by up to 5 months.

The year should not be given in [] square brackets. Every name has a well defined date of publication, determined by the provisions of Art. 21. Square brackets would indicate that the year was not known and is only estimated. The clear provisions in Art. 21 imply that the date is always exactly determined.

The Code's Recommendation 22A.2.3 suggests to cite a different imprint date as a second date in a form *Ctenotus alatus* Storr, 1970 ("1969") (or various other forms), but this is very rarely done and would probably create misunderstandings, especially in electronic environments. The frame in which this should be done is unclear. The term "imprint date" remains undefined in the Code, it could refer to the date printed on the title page of a work, but could also include a date printed elsewhere in a work.

I analysed 2900 European mollusc names, in 9.5 % of the names the true date differed from the imprint date. I have never seen an imprint date cited in a name in this group.

Differences between imprint dates and true dates can have various reasons.

Examples:

Dryas Hübner 1807, not *Dryas* Hübner [1807] (Lepidoptera).

In this case a date 1805 was given on the title page of the original publication, but the date 1807 was printed on the plate on which this name was established.

Zua boissii Dupuy 1850, not *Zua boissii* Dupuy [1850] (Gastropoda).

In this case the title page of the work had printed 1847-1852, but the work was issued in 6 parts, which had separate title pages without dates. The dates at which these were issued were listed on the general title page in a short note.

Clausilia munda Rossmässler 1836, not *Clausilia munda* Rossmässler [1836] (Gastropoda).

In this case the title page of the work the date had printed 1835-1837. The work was issued in 5 parts which had separate title pages with dates, the date Sep 1836 was indicated for part 4.

Clausilia idaea Pfeiffer, 1850, not *Clausilia idaea* Pfeiffer, [1850] (Gastropoda).

In this case the title page of the journal volume indicated 1849, but it is known from secondary sources that the true date of publication in this journal was always in the first weeks of the next year, here 1850.

Ohrigocea Hadžišće 1959, not *Ohrigocea* Hadžišće [1959] (Gastropoda).

In this case the title page of the journal volume had printed 1956, but it is known from secondary sources that the date was faked and that the true date was 1959.

Succinella Mabilie, 1871, not *Succinella* Mabilie, [1871] (Gastropoda).

In this case the title page contained no date, the last page of the work contained a date 1780 which was not true and inconsistent with the date printed on the wrapper.

Ascaris argentiniae Gmelin 1791, not *Ascaris argentiniae* Gmelin [1791] (Nematoda).

In this case no date was given in the original source and is only known from a secondary source published in 1907. This concerns all names established by Gmelin 1788-1791 except those for the first volume, which had the date 1788 printed on it.

Sphincterochila cariosula (Michaud, 1833), not *Sphincterochila cariosula* (Michaud, [1833]) (Gastropoda).

In this case the true date was not given anywhere in the original source and is only known from secondary sources.

9. Types, type designations, type locality

Type management is nomenclature, not taxonomy. The regulations of the ICZN Code are very useful for this chapter.

9.1 Type species of genera

If you verify the original description of a genus, it may be convenient to verify its type species, or collect information about it.

Type species are very important, and there is no general zoological database that has recorded the type species for all genera. Nomenclator Zoologicus (www.ubio.org/NZ) records most generic names, but not their type species. Except in fishes and some minor groups, type species are rarely reliably and verifiably recorded in freely accessible online databases. Information on type species is usually highly appreciated.

Try to record your information when you have found a type species of a genus and its mode of designation. In 60 % of the cases the type species can be determined in the original publication.

The Code has very strict, well elaborated and useful rules for the determination of type species of genera. The chapter on type species is one of the most solid chapters of the ICZN Code. It is also one of the best accepted parts of the Code. It is only a minor problem that the modes of designation are not completely listed and named, and that a very close view reveals some gaps in the regulations.

The type species is always the **original name of the taxon**. It is not the currently used combination.

Example:

The type species of *Locusta* Linnaeus 1758 (Caelifera) is *Gryllus migratorius* Linnaeus 1758, not *Locusta migratoria* (Linnaeus 1758).

Designation and fixation. These terms have different meanings. A designation is the proposal of the type species. It is not necessary to have spelled the name of the genus or species correctly with correct authors (Art. 67.2.1, 67.6, 67.7). The type species will always be the correctly spelled name.

If the designation is valid, the type species is fixed. A designation can also be invalid and ineffective, for example if the genus possesses a previously fixed type species, or if a type species was proposed that was not originally included.

These are the possible modes of type species designation, in order of legal importance:

(In parentheses the proportions for 366 verified European non-marine mollusc genera, perhaps a more or less representative animal group).

Superior type fixation:

- Designation by ICZN under the plenary powers (3 %)
- Designation under Art. 70.3, misidentified type species (1 %)

Type fixation in the original work:

- Original designation (31 %)
- Monotypy (28 %)
- Absolute tautonymy (2 %)
- Linnean tautonymy (0.3 %)

Subsequent methods of type fixation:

- Subsequent monotypy (2 %)
- Subsequent absolute tautonymy (0 %, I know only very few cases in zoology)
- Subsequent Linnean tautonymy (0 %, I don't know any case)
- Subsequent designation (32 %)

9.1.1 How to determine the type species.

9.1.1.1 Designation by ICZN

Several hundred genera have their type species fixed by ICZN under the plenary powers. It is possible that your genus is one of these.

A good summary of the Opinions published by the Commission until 2000 is available here, looking for the genus name usually will show its type species:

http://www.nhm.ac.uk/hosted_sites/iczn/Official_Lists_Indexes_pdfs.htm

Modes of type designations were often given incorrectly in ICZN Opinions or are outdated. The term "subsequent monotypy" was not used until 2000 and types fixed by subsequent monotypy were given to have been fixed by "monotypy" in previous Opinions.

Example:

In Opinion 335 from 1955 *Valvata cristata* Müller 1774 as type species "by monotypy" of "*Valvata* Müller 1774" (Gastropoda). The date was incorrect, *Valvata* was established by Müller 1773, without species included, type species was by subsequent monotypy by Müller 1774 who first added a species to this genus. *Valvata* has to be combined with the 1773 date. For the type species there are no consequences, we just have to write "subsequent monotypy", no measure needs to be taken.

If they were in contrast to the regular provisions of the Code, the rules of the Code must be applied and the decisions corrected (Art. 80.6.2). In the case of type species this is often undesired, so it makes sense that if the Commission took a decision that was incorrect and the mentioned type species is not tenable under the Code, to behave as if the type species was fixed under the plenary powers.

Type species designated under the plenary powers are probably always accepted in the entire community.

Example:

In Opinion 431 *Helix cartusiana* Müller 1774 was regarded as type species for *Monacha* Fitzinger 1833 (Gastropoda), "designated by Gray 1847 [09 Nov 1847]: 173". This was incorrect, the same type had previously been fixed by Herrmannsen 1847-1849 [17 Jul 1847]: 51. The statement in Opinion 431 is simply outdated, no measure needs to be taken.

In a surprisingly high number of cases the Commission took inaccurate decisions. The reason is that the Commission does not control correctness of the arguments brought up by taxonomists in such cases, the original sources are not verified. The correct way is to bring up a new case and to ask the Commission to correct it, but this is rarely done. Usual practice is to continue as if the Commission took a decision under the plenary powers.

Examples:

In Opinion 573 the Commission decided to regard *Helix vivipara* Linnaeus 1758 as the type species for *Viviparus* Montfort 1810 (Gastropoda), fixed "by original designation". This was incorrect, Montfort 1810 designated *Viviparus fluviatorum* Montfort 1810 as type. It is convenient to accept *V. fluviatorum* as type by original designation, and to interpret this name as a junior synonym of *Helix vivipara*. In the same Opinion 335 the type species for the genus *Retinella* Shuttleworth 1877 (Gastropoda) was given as *Helix olivetorum* Gmelin 1791, fixed by subsequent designation by Kobelt [1879-1881]. This was doubly incorrect, *H. olivetorum* was not originally contained and Kobelt had designated two species as type for *Retinella*. It is convenient to regard *H. olivetorum* as type, and as having been fixed as under the plenary powers.

Art. 70.3: For designation under Art. 70.3 it is necessary to understand the other modes, so this mode will be explained at the end.

Only those species which were **originally included**, can be selected as type species (Art. 67.2). Species which were included with doubts are excluded and do not count (Art. 67.2.5). For type species of new replacement names, see the special chapter on new replacement names.

If **no species** were originally included, other subsequent sources will be necessary. You have to know these. If you don't know them, you have lost the game. If you know them, the solution is listed below under the subsequent type fixation methods.

If available names of species were originally included, go on in the given way of order.

It is important that the species must have been included **at the same date** when the genus was established (Art. 67.2.1). If the genus had a short description at an early date and species were included at a later date, they were not originally included.

Example:

Müller 1773 (Vermium terrestrium et fluviatilium) gave an account of his generic classification, presenting each genus with a short description. The ciliate and rotatorian species were described in the same volume, the molluscs in another volume which appeared in 1774. The molluscan genera established in 1773 had no species originally included.

9.1.1.2 Original designation

If the author designated expressly a type species (Art. 68.2), this is the type by **original designation**. The type species must be an available name, and can also have been established as a subspecies. The author must have written something equivalent to "the type species" or "the typical species" (not implicit, and not just an example), it must have referred to a species (not to a character or structure), and there must have been no doubts (Art. 67.5). Prior to 1900, type species were only occasionally fixed by original designation, after the 1920s this has become the most widely used mode of type fixation.

Best practice is to cite the type species always in its original combination, not in a currently used combination.

Examples:

Montfort 1810 established the genus *Theodoxus* (Gastropoda) and designated *Theodoxus lutetianus* Montfort 1810 as type species. Vest 1867 established the subgenus *Clausilia* (*Isabellaria*) (Gastropoda) and designated *Clausilia isabellina* Pfeiffer 1842 as type species. Riedel 1987 established the genus *Turcozonites* (Gastropoda) and designated *Zonites wandae* Riedel 1982 as type species.

The ICZN Code has gaps concerning the requirements for considering a type designation as valid. The type species concept as we understand it today was created after the 1830s. All terms "type" used before can be interpreted as type designations, but this is a question of interpretation. Some taxonomists argue that the use of

the term "type" should be decisive, others argue that the idea behind the designation must have been in accordance with the concept of a type species as we apply it since the early 1900s.

This is undecided and it seems that several disciplines have applied different criteria. I would recommend to apply a system that strictly requires the use of the term "type" regardless of what the author might have understood under this term, with exception of those works where an author expressly disclaimed that the use of the term "type" was not meant in the sense of a unique name-bearing type (Art. 8.3).

Examples:

Montfort 1810 did not know and apply the type species concept as it was proposed after the 1840, but in his book presented many genera with a species "servant du type au genre". These are commonly interpreted and accepted as type designations.

Swainson 1840 established a new bivalve genus *Potomida* and included three species, among these was a new species *Unio corrugata*. At one occasion he used the term "the typical species *P. corrugata*", meaning that the species was typical for *Potomida*, but it was clear from the context that Swainson did not apply a type species concept as we apply it today. I would recommend to regard the expression "the typical species" as a valid type designation, but this is under dispute.

Kobelt 1904 explained in detail that he did not support the type species concept based on unique name-bearing types as explained by Dall 1903. All occasions where Kobelt 1904 employed the expression "**Typus**" should not be recognized as valid type designations.

An author who presented a group of species, named it in the form "group of the *fasciata*" and added a generic name (usually at subgeneric or infrasubgeneric rank), did not designate the type species at this occasion. These are no type designations because the type species must not be implicit, it must be explicitly designated using an expression involving the term "type" (Art. 67.5). In most cases subsequent authors regarded those species as types and coincidentally fixed them when they mentioned the term "type". But in some cases other species can be the types.

Examples:

Boettger 1877 established the gastropod infrasubgeneric name *Clausilia* (*Delima* (*Montenegrina*)) for a group of species named "**Gruppe der cattaroensis**", containing *Clausilia cattaroensis* Rossmässler & Ziegler 1835 and five other species. This species was not originally designated as type species for *Montenegrina*. The same species was fixed as type by Lindholm 1924.

Boettger 1877 also established the subgenus *Clausilia* (*Pseudalinda*), divided into two sections *Pseudalinda* (5 species) and *Mira* (1 species). For the first section Boettger used the name "**Gruppe der fallax**", based on *Clausilia fallax* Rossmässler 1836. This species was not designated as type for *Pseudalinda* at this occasion. Westerlund 1902 gave *Clausilia montana* Pfeiffer 1848 as type, which was originally contained in the section *Pseudalinda*.

Boettger 1877 also established *Clausilia* (*Euxina* (*Galeata*)) for a group named "**Gruppe der Schwerzenbachi**", based on *Clausilia schwerzenbachi* Pfeiffer 1848. The group contained 2 species, the other species was *Clausilia galeata* Rossmässler 1839. *Clausilia galeata* was designated as type at this occasion by absolute tautonymy.

An author who presented several species at once as type species for a genus, should probably be ignored in this respect. The Code gives no guide.

Examples:

Leach 1818 established *Bithynia* (Gastropoda) and designated both *Helix tentaculata* Linnæus 1758 and *Cyclostoma impurum* Draparnaud 1801 as type species. This can be ignored. Herrmannsen 1846 fixed *Helix tentaculata* as type species by subsequent designation.

9.1.1.3 Monotypy

If original designation does not apply, and if only one species was included (Art. 68.3), this is the type by **monotypy**. Synonyms do not count here. It must have been one species, and its name must have been "used as valid". Recognising monotypy is always easy. Monotypy is inferior to original designation, and superior to tautonymy.

Examples:

Anodonta Lamarck, 1799 (Bivalvia) was originally established with one included nominal species, *Mytilus cygneus* Linnæus, 1758. This is the type species fixed by monotypy.

Microcondylaea Vest 1866 (Bivalvia) was originally established with two included nominal species, *Unio bonellii* Férussac, 1827 and with doubts *Anodonta lata* Rafinesque, 1820. Doubtfully included species do not count, type species is *Unio bonellii* fixed by monotypy.

Margaritifera Schumacher 1815 (Bivalvia) was originally established with one included nominal species, *Margaritifera fluviatilis* Schumacher 1815. Schumacher 1815 cited *Mya margaritifera* Linnæus 1758 as a synonym. Monotypy is superior to absolute tautonymy (Art. 68.1), so the type species is *M. fluviatilis* fixed by monotypy (Art. 68.3).

9.1.1.4 Absolute tautonymy

If original designation and monotypy do not apply, and if among the names a specific name was identical with the new (sub)generic name (Art. 68.4), this is the type by **absolute tautonymy**. Synonyms do count here, but they must be available. The names must be exactly identical. If the specific name is an adjective, it is forced to agree with the gender of the new (sub)generic name for this purpose.

Examples:

Kobelt 1871 established the gastropod infrasubgeneric name *Helix* (*Xerophila* (*Candidula*)) and included 23 species. Among these was *Glischrus candidula* Studer 1820. *Glischrus candidula* is type species by absolute tautonymy.

Draparnaud 1801 established the gastropod genus *Succinea* and included two species, *Succinea amphibia* Draparnaud 1801 and *Succinea oblonga* Draparnaud 1801. Among the synonyms of *S. amphibia*, Draparnaud listed a name *Helix succinea* Müller 1774. *Helix succinea* is type species by absolute tautonymy.

Kobelt 1904 established the gastropod subgenus *Iberus* (*Balearica*) and included 10 species. Among these was *Helix balearica* Rossmässler 1838, which Kobelt cited as *Iberus* (*Balearica*) *balearicus*. *Helix balearica* is type species by absolute tautonymy.

Euxinolauria Lindholm 1924 (Gastropoda: Lauriidae) was established as a new replacement name for *Caucasica* Caziot & Margier 1909 (not *Caucasica* Boettger 1877 (Gastropoda: Clausiliidae)). *Caucasica* Caziot & Margier 1909 contained originally 4 species, among

which was *Pupa caucasica* Pfeiffer 1857. This is the type species for *Caucasica* Caziot & Margier 1909 fixed by absolute tautonymy, and also for *Euxinolauria*.

Very similar names do not produce absolute tautonymy, even if they have absolutely identical meanings. There is no term "virtual tautonymy" in the ICZN Code.

Examples:

Scomber scombrus Linnæus 1758 (Actinopterygii), *Babyrousa babyrussa* (Linnæus 1758) (Mammalia), *Suricata suricatta* (Schreber 1776) (Mammalia), *Merlangius merlangus* (Linnæus 1758) (Actinopterygii), *Isabellaria isabellina* (Pfeiffer 1842) (Gastropoda), *Rupestrrella rupestris* (Philippi 1836) (Gastropoda).

If the specific name was implicit but not cited, this is not absolute tautonymy. This occurs frequently. In early works, authors often avoided tautonymy and used substitute names for the species when they borrowed specific names for the generic rank.

Examples:

Laurenti 1768 established the squamatan genus *Natrix* and included 10 species. Among these was a new species named *Natrix vulgaris*, obviously a substitute name for the not mentioned name *Coluber natrix* Linnæus 1758 to avoid tautonymy *Natrix natrix*. *Coluber natrix* is not type species by absolute tautonymy.

Müller 1773 established the gastropod genus *Planorbis* with a short description. Müller 1774 included 13 species, among these was *Planorbis carinatus* Müller 1774, a name obviously established to avoid tautonymy with the not mentioned name *Helix planorbis* Linnæus 1758. In Opinion 335 the ICZN Commission regarded *Helix planorbis* as type species by absolute tautonymy. The interpretation in Op. 335 from 1955 was not in accordance with our rules today, because in 1773 no species were included and in 1774 the specific name *H. planorbis* was not mentioned.

9.1.1.5 Linnean tautonymy

If a word identical with the new generic name was cited as a pre-1758 name in the synonymy of one of the originally included species (Art. 68.5), this nominal species is type species by **Linnean tautonymy**. This is a rare case and occurred primarily in vertebrates, but here in some very important genera, for which Linnæus often cited such pre-Linnean names. In invertebrate genera Linnean tautonymy is extremely rare. It is convenient to allow some tolerance.

Examples:

Linnæus 1758 established *Castor* (Mammalia) and included two species, *C. fiber* and *C. moschatus*. Among the synonyms of *C. fiber* was cited the one-word name **Castor** with references to six pre-Linnean works (Gesner 1598, Rondelet 1554, Jonston 1650, Dodart 1676, Ray 1693 and Aldrovandi 1649). *Castor fiber* Linnæus 1758 is type species by Linnean tautonymy.

Linnæus 1758 established *Cuculus* (Aves) and included *C. canorus* and 7 other species. Among the synonyms of *C. canorus* was cited the one-word name **Cuculus** with references to several pre-Linnean works. *Cuculus canorus* Linnæus 1758 is type species by Linnean tautonymy.

Müller 1781 established the gastropod genus *Bulinus* and included four species, three with references to Müller 1774 and a new species *B. senegalensis* with a reference to Adanson 1757: p. 5. In the description Müller 1781 explained that he adopted Adanson's name **Bulinus** for the new genus. Adanson 1757: 5 had used the name only for the species which Müller 1781 named *B. senegalensis*. *B. senegalensis* should be regarded as type by Linnean tautonymy although Müller 1781 had not cited this name *Bulinus* explicitly in the synonymy of this species.

In all other occasions the type species is not fixed in the original work. In genera established after 1930 the following methods of subsequent type fixations are not allowed any more.

9.1.1.6 Subsequent modes of type fixation

If several species were originally included and none was fixed there, or if none was included, the type species can only be fixed by a subsequent mode.

If no species were originally included, it is necessary to find the next publication where species were included to this genus. Only these can be selected as type species.

If only one species was contained, the type species was designated by **subsequent monotypy** (Art. 69.3).

Examples:

Müller 1773 established the gastropod genus *Valvata* with a short description and without species. Müller 1774 included one species, *Valvata cristata* Müller 1774. *Valvata cristata* is type species by subsequent monotypy.

Férussac 1821 established the gastropod subgenus *Helix* (*Helicodonta*) with a short description and without included species. Risso 1826 was the first author who included species, he included only one species *Helix obvoluta* Müller 1774. *Helix obvoluta* is type species by subsequent monotypy.

9.1.1.7 Subsequent absolute tautonymy

If among the names first included to a (sub)genus a specific name was identical with the new (sub)generic name, this is the type by **subsequent absolute tautonymy**. The ICZN Code does not know this expression, but it is a logical consequence of the concept of subsequent monotypy. Subsequent monotypy had formerly been called monotypy, and when they created the new expression "subsequent monotypy", they forgot to provide the expressions for subsequent tautonymies.

Examples:

Alosa Garsault 1764 (Actinopterygii) was established without included species. As first author, Cuvier 1829 included two species: *Clupea alosa* and *Clupea fincta*. Type species is *Clupea alosa* Linnæus 1758 by subsequent absolute tautonymy.

Rupicapra Garsault 1764 (Mammalia) was established without included species. As first author, Blainville 1816 included 3 species: *Capra rupicapra*, *pudu* and *americana*. Type species is *Capra rupicapra* Linnæus 1758 by subsequent absolute tautonymy.

Erythrinus Scopoli 1777 (Actinopterygii) was established without included species. We do not know who was the first author to include species, but this was presumably after 1801. Currently *Salmo erythrinus* Bloch & Schneider 1801 is recognized as type species. We have to assume that the unrecorded first author included this species in *Erythrinus*. If so, this would be type species by absolute subsequent monotypy and regardless of eventually other included species.

9.1.1.8 Subsequent Linnean tautonymy

The same should also be effective for subsequent Linnean tautonymy, but it is possible that no such case exists. However, 340,000 genera have been established, so there is a theoretical chance.

9.1.1.9 Subsequent designation

If no type species was fixed in the original or first subsequent publications, the first author who cited a type species for the genus, fixed the type species by **subsequent designation** (Art. 69.1).

The type species must have been originally included, or first-subsequently included if the generic name was established without species (Art. 69.2). Synonyms do count here (Art. 67.2).

It is not necessary that the name of the species was spelled correctly (Art. 67.6, 69.2.1) and attributed to its correct author (Art. 67.7), it is not necessary that the genus was attributed to its correct author (Art. 67.7). A species must not have originally been included with doubts (Art. 67.2.5). If a new replacement name was cited instead of the originally contained species, the originally contained species is the type species (Art. 67.8).

Examples:

Aplexa Fleming 1820 (Gastropoda) was established with two species, *Bulla hypnorum* Linnæus 1758 and *Bulla rivalis* Turton 1807. Herrmannsen 1846 fixed *Bulla hypnorum* as type by subsequent designation.

Pseudanodonta Bourguignat 1877 (Bivalvia) was established with 7 species, *Anodonta complanata* Rossmässler 1835 and 6 others. Westerlund 1902 designated *Anodonta complanata* as type species.

Neostyriaca Wagner 1920 (Gastropoda) was established with two species, *Clausilia corynodes* Held 1836 and *Clausilia styriaca*. Kennard & Woodward 1923 designated *Clausilia corynodes* as type species.

If a synonym of an originally included species (and which was not mentioned in the original source) was given as type, with both names being explicitly mentioned and classified as synonyms, then the originally included species is the type species (Art. 69.2.2). This is a case in which the cited type species did not need to have been originally included.

Example:

Truncatella Risso 1826 (Gastropoda) was established with several species, one of which was *T. costulata* Risso 1826. Lowe 1855 designated *Cyclostoma truncatulum* Draparnaud, 1801 as type and listed *T. costulata* as a synonym of this species. Lowe fixed *T. costulata* as type species by subsequent designation.

If a type species was designated that was not originally included, the act is usually not valid and can usually be ignored.

Like in the case of original designations, the standards to be applied for valid subsequent designations have also been disputed, and the exact conditions are unclear. It is clear that a term "type" must have been mentioned, and that this term must have referred to the species itself (represented by its name) and not to a typical structure of an animal. It is unclear if the type species concept must have been understood and applied by the author.

Examples:

Cypraea Linnæus 1758 (Gastropoda) was established with several included species. Montfort 1810 designated *Cypraea tigris* as species "servant de type au genre". This is commonly interpreted as a valid subsequent type species designation, although Montfort used the term "type" in a different sense as we use it today.

9.1.1.10 Designation under Art. 70.3, misidentified type species

If the author misidentified the species when designating a type species, the cited species and not the "true" species is the type species. But it is possible to change the type species and to designate the misidentified "true" species as the type species, with a reference to Art. 70.3. Also the "wrong" type species can be fixed under Art. 70.3. Nobody can change such a type fixation under Art. 70.3 afterwards.

The usual way to solve the problem is to simply accept the "true" species as type species, without fixing it correctly under Art. 70.3. Many taxonomists tend to ignore the rule that for such an act Art. 70.3 must be cited. But I would not recommend to ignore this.

Example:

Forcart 1940 established the gastropod genus *Bollingeria*, type species by original designation was *Chondrus pupoides* Krynicki 1833 from Caucasus. Shilejko 1978 established the genus *Improvisa*, type species by original designation was also *Chondrus pupoides*. Bank & Hovestadt 1991 provided evidence that Forcart 1940 misidentified the type species and in reality meant *Bulimus lamelliferus* Rossmässler 1858. In the past decades *Bollingeria* was not used. In practical life the misidentified type species *B. lamelliferus* has widely been accepted as type for *Bollingeria*, and not *C. pupoides*.

Now a statement in the following form is necessary: "Under Art. 70.3 of the ICZN Code shall now be fixed *Bulimus lamelliferus* Rossmässler 1858 as type species for *Bollingeria* Forcart 1940, misidentified as *Chondrus pupoides* in the original designation by Forcart 1940."

This is a real case but not a valid nomenclatural act, because this manual is not a paper-based publication, and as such not published work (Art. 8.1.3, 9.8).

9.2 Types of species, subspecies and subordinate variants

The Code's chapter on type specimens for species is commonly very well accepted in the community. It is slightly overloaded with some meaningless provisions and terms, but in the public reception this has no impact on the effective components of the chapter.

While a name for a genus can hardly be used if no type species has been fixed, names of species and subspecies are often based on common acceptance and used without fixed types. For the primary purposes of this manual (mobilising biodiversity data in electronic environments) it is not necessary to know the exact provisions for type specimens, so this subchapter is only included for completeness.

Prior to 2000, types of species, subspecies and subordinate variants did not need to have been mentioned in the original publications. Taxonomists are required to play detectives (Art. 72.4.1.1) and to look in old collections for specimens which might possibly be the type specimens. Only after 1999, holotype or syntypes must be mentioned and fixed in the original publication (Art. 72.3).

Types are always the real specimens on which the published illustrations were based, never the illustrations as such (Art. 72.5.6, 74.4).

Subordinate variants do not need to have names (they can also have letters or numbers), but they have their own types. If a species was established with distinct subspecies or subordinate variants, the types of those are not the types of the species (Art. 72.4.1). The species itself does not need to have its own description (Art. 12.1, the combined descriptions for the subordinate taxa suffice), but it should have its own types (and there is a gap in the Code, these types are not defined).

Example:

Helix lenticula Férussac 1821 (currently *Caracollina lenticula*) was established with a description that referred only to a subordinate variant α , but with none for the main form (the nominal species *H. lenticula*). Since the taxon *H. lenticula* was equipped with a description for its subordinate variant α , the name *H. lenticula* was made available at this occasion. The types are either those in Férussac's collection which were labelled "*lenticula*", or those labelled "var. α ", the Code has no exact provision.

Name-bearing types are holotypes, syntypes, lectotypes and neotypes (Art. 72.1.2). All other types (paratypes and others) can be neglected, they have names but no function in the Code. Hapantotypes for protists are holotypes (Art. 73.3). In the Code the term "type series" is defined, the term is meaningless for the purposes of this manual, but occasionally used in this context.

Holotype

If the original description was based on a single type (Art. 73.1). A holotype was either expressly fixed as such, or only one single specimen is known to have ever existed when the name was established.

Syntypes

If the name was originally based on several specimens (Art. 73.2) and no holotype or lectotype was fixed. Syntypes are all specimens which the author had seen prior to publication, except those which were doubtfully included or expressly excluded (Art. 72.1.1, 72.4.1). If an author referred bibliographically to a previous publication, including pre-Linnean works, also the specimens of those authors are syntypes for the new name (Art. 72.4.1, 72.4.4).

Lectotype

A lectotype can be designated if several syntypes are known to exist (Art. 74). If validly fixed, a lectotype has a name-bearing function like a holotype.

This rule has been abused by taxonomists who intended to facilitate the process and by museum curators who designated lectotypes not for taxonomic reasons but simply because other museums also had syntypes of the same taxon, to avoid that one of those would some day become lectotypes (by quicker museum curators). This is why lectotypes must not be designated collectively by general statements (Art. 74.3), this must be done individually and only for taxonomic reasons.

After 1999, the term "lectotype" (or an exact translation) must have been employed (Art. 74.7), but before 2000 not necessarily. Art. 74.5 rules that the author could have used a term "the type", but must unambiguously have made clear that one of several syntypes was selected to act as the unique name-bearing type. Just figuring a specimen and writing "type" in the figure caption is not enough (Art. 72.4.7). Just calling a syntype "holotype" is not sufficient either, the awareness of the act of selecting is important.

Art. 74.6 gives an exception of this rule, for special cases where it was unambiguously assumed that a taxon was based on a single type, and this specimen was called holotype or "the type". The first author who published this assumption before 2000 selected this specimen as lectotype.

Neotype

If no name-bearing types are known to exist, because all were lost, a neotype can be selected, but only if this is necessary (Art. 75). Neotype designations have strict conditions, much stricter than for holotypes or lectotypes. It must be stated explicitly that and why there is a need to designate a neotype. **If the identity of the taxon has**

not been disputed, there is no exceptional need and a neotype cannot be designated (Art. 75.3), or the neotype can afterwards be disputed. Also the measures taken to find the original types must be explained (Art. 75.3.4), and a published statement is required which institution possesses the neotype and makes it accessible for study (Art. 75.3.7).

Paratypes, paralectotypes

The Code talks about paratypes and paralectotypes (Art. 72.1.3, 72.4.5, 73.2.2), but they have no name-bearing function and are meaningless for nomenclatural purposes. Some authors state that certain specimens shall be or shall not be paratypes of a new name, following various recommendations of the Code. But using the term "type" for these specimens is not necessary, such statements are nomenclaturally ineffective (Art. 72.1.3). If the holotype is lost, the paratypes do not become syntypes (Art. 72.4.5).

An author may designate a **lectotype** out of several syntypes (Art. 74.1) - the others become paralectotypes and lose their name-bearing status (Art. 74.1.3). If the lectotype is lost, the paralectotypes do not become syntypes again.

Types of names first published in synonymy and made available under Art. 11.6

Types of names made available under Art. 11.6.1 are either those "cited" (types must be expressly mentioned) with that name in the published synonymy, and if none was cited there, "denoted" by that name when it was adopted as a name of a taxon (no explicit mentioning of types is needed there).

The term "cited" has been disputed. In the only example given in the Code for this case an author talked of some specimens he obtained from another person. Recent authors have regarded a general reference to a museum collection as "cited specimens" (because in the corresponding museum some specimens would presumably be found under that name). Others have argued that in pure lists of species the names of the species would indicate that the author must previously have seen some specimens, and accepted these specimens as types.

Objective synonymy

Two taxa are objective synonyms if they have the same name-bearing type (lectotype, holotype or neotype).

This does not work if two names have exactly the same syntypes (because syntype 1 could some day be selected as lectotype for the one name, and syntype 2 for the other name, and the two syntypes could belong to different species).

Other classes of types

In the course of zoological history many terms attributed to special type specimens have been employed for shorter or longer periods, in few or many disciplines, but only the terms cited above survived in the Code. It is occasionally recommended not to use the other terms any more (cotype, genotype and all derivatives like allogenotype etc.). Others are tolerated and well defined (allotype = a designated specimen of the opposite sex as the holotype), again others are badly defined (topotype = a specimen from the type locality, not necessarily designated, not necessarily part of the type series, so not a type specimen in the sense of this chapter). Once again others are rarely used and not even mentioned in the Code's Glossary, which means that they have not a fixed definition (iconotype = a specimen only known by a picture).

9.3 Type locality

The type locality is the locality from which the name-bearing type specimens (holotype, lectotype, neotype, syntypes) originally came from.

The type locality cannot be fixed. It can only be cited. The name-bearing type can be fixed. If captured animals were described, the localities where they originally came from. It is no problem if the types do not exist any more today.

How to cite the type locality?

It is important to note that the type locality is **not** necessarily the locality mentioned in the original publication. If an incorrect locality was given, this is not the type locality. If the author believed the animal came from Brazil and called it *brasiliensis*, and later is found that it came from Ghana, then Ghana is the type locality of the species with the name *brasiliensis*.

For the type locality, reasearch in secondary and unpublished sources can be necessary. Museum labels, other published information.

Host plants are no type localities. "Ocean" is not a type locality.

The type locality can consist of several localities, if the name is based on more than one type specimen. All mentioned references must be included. If an author referred to five previous works, all the specimens of those works are also syntypes, possibly all with their own localities. All these are "the type locality".

How to cite the type locality?

Give the type locality in a modern form and language, if you understand the original information properly. It is not necessary (and often not convenient) to give the type locality in the original language. Nobody knows what "Carniolia" or "Galicia" should mean today. Give the locality as exact as possible.

You can give the name of the country in English or Spanish, but avoid translating names of lower administrative regions or cities into English. Zoologists will have problems to understand what Lower Saxony means, or they might not know the English expressions for Genova (Italy) or Genève (Switzerland). And they will not find these geographic terms in English-Russian dictionaries. If you use the official language of the country for its lower administrative regions, lakes or mountains, you will be best understood.

Examples:

Italy: Lago Maggiore and Lago di Garda

Mexico: between Sierra Madre Oriental and Baja California del Norte

Austria: Osttirol and Kärnten

France: Nice and Avignon

Squalus maximus Gunnerus 1765 (Chondrichthyes): type locality Atlantic Ocean near Nordland, northern Norway. No types are known. The type locality is taken from Gunnerus 1765.

Cimex abietis Linnæus 1758 (Heteroptera): type locality given as "in Pinu Abiete". This is not a type locality, but a host plant. Type locality should be northern Europe, but in the Linnean collections in Stockholm, Copenhagen or London there may be type specimens with labels indicating a more exact locality.

Papilio aesta Linnæus 1758 (Lepidoptera): type locality given as "in Indiis". This was a contemporary expression usually used for the Caribbean. In your database, if you have no other source, write "Caribbean ("in Indiis")". If you do not know what "in Indiis" means, then copy the original expression. Occasionally the term referred also to India.

Fringilla hyemalis Linnæus 1758 (Aves): type locality given as "in America". This should be translated "in the Americas". Linnæus gave a short description and a reference to Catesby 1731. If no lectotype was designated, type locality is where the specimen(s) in the Linnean collection came from, and where Catesby's specimen(s) came from, "possibly from USA: North Carolina or South Carolina".

In modern publications type localities are usually given much more accurately.

10. Current status and mechanisms for the online registration of names and nomenclatural acts

In the 4th edition of the ICZN Code (2000, Art. 79) an unsuccessful concept for a **List of Available names in Zoology** was proposed. The idea was to compile and establish lists of officially accepted names in zoology, by specialists of each animal group. 10 years later not a single list has been compiled.

Not all taxonomists agreed with the main idea behind this concept. Some taxonomists consider "almost forgotten names" as useful - contrasting the idea that only useful or currently used names and not forgotten names would appear on the List of Available Names. "Resurrecting" an old and almost forgotten name is sometimes used as a tool to disambiguate uses of names before and after a major revision that threatened the meaning of a well-known name (see the example of *Radix balthica* above).

Other problems were the lack of any financial background (nobody was paid to do the work) and the extremely diverse structure of the zoological community consisting of colleagues with different opinions who would not necessarily accept dictations by their competitors. Names established for genera may have impact on homonymous names in other animal groups, which makes it difficult to establish such a list for a small and separate group. If the selected group is too small, it will be unclear what to do with neighbouring species.

Zoology has currently no automatic registration system for nomenclatural acts (new names of taxa, type designations). **ZooBank** (www.zoobank.org) is currently being developed and there are plans to establish it as an Official Register with online registration of names. The main issues and scope of this database are (2009/2011) still under discussion. The database is already online, but only in English (2011). ZooBank is based in the United States and there are limited skills and resources for establishing a multilingual portal.

Feeding the database with the OCR extract of the more than 4000 names published by Linnæus (1758) resulted in numerous incorrectly spelled and unavailable names being submitted or registered (names for which the originally printed Linnean spelling was corrected afterwards). Some important journals collaborate closely with ZooBank and a good proportion of the currently 20,000 new names established each year are registered semi-manually. The financial future of ZooBank is still unclear, but this might change once the system will be working. There are still some important steps necessary until it will be able to become mandatory for online registration of the complex patterns of nomenclatural acts, publications and name-bearing types. The ICZN website (www.iczn.org) informs on the current state.

Acknowledgements

I have to thank Richard Pyle (ZooBank) and many members of the [iczn-list] and [Taxacom] mailing lists for having explained many technological terms, for having brought my attention to many examples used here, and for extended discussions on many topics raised in this manual. Statements about presence of disputes in the Code interpretation were also mostly derived from these contributions.

This guide was mainly written in 2009 and since then has been used by the AnimalBase team as a basic guide. I am grateful to my team for having tested this guide, they helped to improve it and expanded it with more examples. Finally I would like to acknowledge the financial support for this manual by GBIF.

References

Most references given in the examples are listed at www.animalbase.org, usually with links to digitized online versions.

Berendsohn, W. G. 1995. The concept of "potential taxa" in databases. - *Taxon* 22: 207-212.

Bouchet, P. & Rocroi, J.-P. 2005. Classification and nomenclator of gastropod families. - *Malacologia* 47 (1-2): 1-397.

Brandon-Jones, D., Duckworth, J. W., Jenkins, P. D., Rylands, A. B. & Sarmiento, E. E. 2007. The genitive of species-group scientific names formed from personal names. - *Zootaxa* 1541: 41-48.

Dubois, A. 2007. Genitives of species and subspecies nomina derived from personal names should not be emended. - *Zootaxa* 1550: 49-68.

Franz, N. M. 2005. On the lack of good scientific reasons for the growing phylogeny/classification gap. - *Cladistics* 21: 495-500.

Franz, N. M. & Peet, R. K. 2009. Towards a language for mapping relationships among taxonomic concepts. - *Systematics and Biodiversity* 7 (1): 5-20.

Franz, N. M., Peet, R. K. & Weakley, A. S. 2008. On the use of taxonomic concepts in support of biodiversity research and taxonomy. - pp. 63-86, in: Wheeler, Q. D.: *The new taxonomy*. (CRC Press).

Kennedy, J., Hyam, R., Kukla, R. & Paterson, T. 2006. Standard data model representation for taxonomic information. - *OMICS* 10 (2): 220-230.

Mallet, J. 2001. Subspecies, semispecies, superspecies. - pp. 523-526, in: Levin, S. A.: *Encyclopedia of biodiversity*. Volume 5. R-Z. -- pp. i-xxxix [= 1-31], 1-1103. Amsterdam. (Elsevier).

Sabrosky, C. W. 1974. Article 50 and questions of authorship. *Z.N.(S.)* 1925. - *Bulletin of Zoological Nomenclature* 31 (4): 206-208.