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Nomenclatural and taxonomic problems related to the electronic publication of new nomina and nomenclatural acts in zoology, with brief comments on optical discs and on the situation in botany

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Abstract

In zoological nomenclature, to be potentially valid, nomenclatural novelties (i.e., new nomina and nomenclatural acts) need first to be made available, that is, published in works qualifying as publications as defined by the *International Code of zoological Nomenclature* ("the *Code*"). In September 2012, the *Code* was amended in order to allow the recognition of works electronically published online after 2011 as publications available for the purpose of zoological nomenclature, provided they meet several conditions, notably a preregistration of the work in *ZooBank*. Despite these new Rules, several of the long-discussed problems concerning the electronic publication of new nomina and nomenclatural acts have not been resolved. The publication of this amendment provides an opportunity to discuss some of these in detail. It is

important to note that: (1) all works published only online before 2012 are nomenclaturally unavailable; (2) printed copies of the PDFs of works which do not have their own ISSN or ISBN, and which are not obtainable free of charge or by purchase, do not qualify as publications but must be seen as facsimiles of unavailable works and are unable to provide nomenclatural availability to any nomenclatural novelties they may contain; (3) prepublications online of later released online publications are unavailable, i.e., they do not advance the date of publication; (4) the publication dates of works for which online prepublications had been released are not those of these prepublications and it is critical that the real release date of such works appear on the actual final electronic publication, but this is not currently the case in electronic periodicals that distribute such online prepublications and which still indicate on their websites and PDFs the date of release of prepublication as that of publication of the work; (5) supplementary online materials and subsequent formal corrections of either paper or electronic publications distributed only online are nomenclaturally unavailable; (6) nomenclatural information provided on online websites that do not have a fixed content and format, with ISSN or ISBN, is unavailable. We give precise examples of many of these nomenclatural problems. Several of them, when they arise, are due to the fact that the availability of nomenclatural novelties now depends on information that will have to be sought not from the work itself but from extrinsic evidence. As shown by several examples discussed here, an electronic document can be modified while keeping the same DOI and publication date, which is not compatible with the requirements of zoological nomenclature. Therefore, another system of registration of electronic documents as permanent and inalterable will have to be devised. *ZooBank* also clearly needs to be improved in several respects. Mention in a work of its registration number (LSID) in *ZooBank* would seem to be possible only if this registration has occurred previously, but some works that have purportedly been registered in *ZooBank* are in fact missing on this web application. In conclusion, we offer recommendations to authors, referees, editors, publishers, libraries and the International Commission on Zoological Nomenclature, in the hope that such problems can be limited along with the potential chaos in zoological nomenclature that could result, if careful attention is not paid to the problems we highlight here, from a somewhat misplaced, and perhaps now widespread, understanding that electronic publication of nomenclatural novelties is now allowed and straightforward. We suggest that, as long as the problematic points linked to the new amendment and to electronic publication as a whole are not resolved, nomenclatural novelties continue to be published in paper-printed journals that have so far shown editorial competence regarding taxonomy and nomenclature, which is not the case of several recent electronic-only published journals.

Key words: *International Code of zoological Nomenclature*; amendment; nomenclatural novelty; new nomen; nomenclatural act; availability; paper publication; electronic publication; optical disc; *ZooBank*; preregistration; prepublication; facsimile; unedited proofs; publication date; authors; editors; publishers; libraries; International Commission on Zoological Nomenclature.

Introduction

Although often ignored or belittled, the role of taxonomy in biological research and in other fields like ecology and biodiversity management is central. To paraphrase a famous sentence, nothing makes sense in biology if the organisms studied are not identified and named, as their taxonomic placement in special units, the taxa, provides irreplaceable information on their characters, relationships and evolution. Misidentification or misnaming of organisms may have unfortunate consequences not only on the accuracy of biological works and on their repeatability, but also in domains like medicine, pharmacology, breeding, agriculture, conservation biology, ecosystem management and climatology. In order to be able to communicate about the classifications it produces, taxonomy uses a specific language: biological nomenclature. The status of scientific names (*nomina*) of taxa is regulated by distinct sets of Rules for different groups of organisms: (1) animals; (2) algae, fungi and plants; (3) cultivated plants; (4) prokaryotes; and (5) viruses. For simplicity, and because the Rules differ in these different groups, this discussion is limited here to the first of them, animals, but the general problems raised here also exist in the other ones. A few comments regarding the situation in botanical nomenclature are provided in Appendix 3.

The process by which a nomen becomes the "official" one for an animal taxon is rather complex. Dubois (2005) showed it to consist of three successive steps: *availability*, *allocation* and *validity* (for details see Dubois 2011*a*).

The first step is that of nomenclatural availability. Clear and stringent Rules are necessary to avoid confusion between modern scientific nomina of taxa and other kinds of names such as vernacular names of animals in various languages or "pre-scientific" zoological names used by classical authors like Aristotle, Pliny the Elder or Al-Jahiz —as well as the names of "morphs", "phases" or "strains", etc. In order to be available in zoological nomenclature, and therefore potentially valid to designate a taxon in a way compliant with the *International Code of zoological Nomenclature* (Anonymous 1999; hereafter, "the *Code*"[1]), a new nomen must comply with a number of Rules. First, it must have been duly "*published*", after the year 1757. This condition flows from the fact that 1758, the year

of publication of the tenth edition of Linnaeus's *Systema Naturae* (and also considered to be that of Clerck's 1757 *Aranei Svecici*), has been fixed as the arbitrary starting date of scientific zoological nomenclature.

Although this is not mentioned in the *Code*, a basic feature of zoological nomenclature, called the *Principle of Nomenclatural Foundation* by Dubois (2011*a*: 96), is that the original nomenclatural status of a nomen (regarding availability and allocation) is usually fixed in the original publication where it is introduced, and cannot be modified subsequently by individual zoologists. In a few special cases, an ambiguity may exist in the original publication, and must be removed by a subsequent *nomenclatural act*, such as a *first-reviser action* or *airesy* (Dubois 2013*a*): e.g., a lectotype designation, a selection between two or more original spellings, or a choice of precedence between synonymous or homonymous nomina apparently published on the same date. Below, we use the term *nomenclatural novelty* to cover both new nomina and new nomenclatural acts.

To be nomenclaturally available, such novelties must first be "*published*". However, this term is to be taken in a special technical sense, not in a trivial one. For a publication to qualify as available, it must comply with the definition of "*available work*" in the *Code*. In its successive editions since the beginning of the 20th century (see Melville 1995), the *Code* has defined "*publication*" as a work produced by a method that assures numerous identical and durable physical copies, i.e., printed on paper using ink or toner. This was still the case in the so-called[2] "third edition" of the *Code* (Anonymous 1985), which was in force until the end of 1999. Until that date, nomenclatural novelties published by other means than printed on paper using ink or toner were unavailable, i.e., denied any "official existence" in zoological nomenclature.

For more clarity, we distinguish below four kinds of publications: *p-publications*, printed on paper; *e-publications*, distributed electronically online; *d-publications*, released on optical discs; and *m-publications*, released in a mixed manner in parallel, under two or three of these formats. We also use in some cases other similarly derived terms such as *e-publisher*, *e-periodical* or *e-journal*.

The global cultural revolution which followed the development of computer science and of electronic communication in the last few decades has had important consequences on scientific publication and on exchanges between researchers worldwide, including taxonomists. There can be no doubt that the number of exclusively electronic publications or e-publications—i.e., publications that do not exist in paper or optical disc form—will grow in the coming decades. The principal reasons include, among other advantages, that: (1) once the review process is completed, the time lapse before e-publication is very short, (2) the distribution of work is immediate and almost instantly global, and (3) the costs of publishing and distribution are minimal. We fully recognise that publishers of taxonomic works must take this into account, and that increasing numbers will take appropriate steps to embrace e-publication. However, this must be done with great care, in order to avoid creating new problems. The implementation of new nomenclatural Rules without very precise understanding too easily brings with it a variety of problems.

In this respect, it is important to note that the recent decision, discussed below, of the International Commission of Zoological Nomenclature (hereafter, "the Commission") to allow the publication of nomenclatural novelties in electronic form, was strongly influenced, if not "imposed", by pressure from both the international biological community of non-taxonomists, and of non-scientists, e.g. Internet and Google "candid users" (e.g., Beck 2012). This question must be discussed here, despite the widespread belief that science develops in a pure, abstract world, and that social issues should not be tackled in scientific papers. Some readers of an early manuscript of this paper have expressed the opinion that this paper should only tackle "technical issues", excluding matters that belong in "scientific policy". Thus, one referee of this paper, although stating "*I found myself nodding in agreement with the sentiments expressed*" in some sections below, suggested considerably reducing them as irrelevant in a paper dealing with nomenclature. In fact, we are sure that many real practicing taxonomists agree with our statements about the current downplaying the importance of taxonomy and nomenclature by non-taxonomists and by "big journals", especially in the current epoch of the taxonomic urgency (see below). However, apart from rare exceptions (e.g., Dubois 2003*a*; Wheeler 2004; Wheeler *et al.* 2004; Boero 2010; de Carvalho *et al.* 2013), what is striking is that these important concerns are very rarely expressed in the scientific literature. Why is

1. We do not use the abbreviation "ICZN" here, because it is equivocal, being used by some to designate the *Code*, and by others to designate the Commission.
2. We use this formula because this numbering of the editions is misleading, as it ignores the early editions under the title of *Règles* (see Melville 1995), and intermediate amendments between official "editions" which in fact resulted in different Rules and could be considered also as partial "new editions".

it so? Would it be because of censorship, or of self-censorship? The fact is that the career, funding and research projects of taxonomists, who are a small minority in the academic world (Wilson 2004), is largely under the "control" of colleagues from other disciplines, charged with the so-called "evaluation" of their work, although they sometimes lack the subject-specific competence required for such evaluation. The implication seems to be that taxonomists should follow the "mainstream ideology" regarding the scientific priorities of our times, and keep silent when their discipline is attacked or devalued. But nomenclature, like all scientific domains, is a part of a context which includes social issues, and it is important to discuss this context. To suppress that part of this paper to focus on "facts" or "rules", as if they came from nowhere, would not help anyone to understand the issues at stake or to take appropriate decisions regarding the evolution of the *Code*.

In 1999, the so-called "fourth edition" of the *Code* was published, taking effect on 1 January 2000. For the first time, it stated that a work "*produced after 1999 by a method that does not employ printing on paper*" could, under certain conditions, be acceptable as a publication available for the purposes of zoological nomenclature. But the Rules provided in this respect were brief and, as we will see below, somewhat unclear and controversial or difficult to interpret. Anyway, the 1999 text made it quite clear in its Article 9.8 that "electronic signals" (e-publications) did not constitute published works under the meaning of the *Code*, so that only works produced in *durable physical form* could be nomenclaturally available.

In 2008, the Commission published a "*proposed amendment*" of the *Code* "*to expand and refine methods of publication*". The primary aim of this proposal was to provide Rules allowing electronic publication of nomenclatural novelties under certain conditions. The Commission encouraged taxonomists to debate these proposals. A number of arguments were published in their favour (Anonymous 2008*a*, 2012*c*; Krell 2009, 2012; Michel *et al.* 2009*a–c*, 2010*a–b*; Allcock & Polaszek 2010; Polaszek 2010; Knapp *et al.* 2011; Moylan 2011; Zhang 2012), but also against this proposal or with reservations about it (Dubois 2008*a,d*, 2010*a*, 2011*a*; Carlos & Voisin 2009; Welter-Schultes *et al.* 2009; Löbl 2009; Michel *et al.* 2010*a*; Namba 2011[3]). During this period, this proposed amendment, which had only been submitted for discussion and not adopted by the Commission, was thus not in force for zoological nomenclature—but, as we will see below, some taxonomists and publishers apparently believed it was, and followed its proposed prescriptions as if they had been adopted as Rules.

This changed, at least for a while[4], with the publication on 4 September 2012 of an amendment, effective on 1 January 2012[5], relating to five Articles of the *Code* (Anonymous 2012*a–b*,*d*). It set out and brought into forces Rules, which differed from the 2008 proposal, and introduced a new procedure for electronic publication, requiring registration of the works containing nomenclatural novelties in the database *ZooBank*[6]. For all zoologists who follow the *Code* in their taxonomic works, i.e., the vast majority of world zootaxonomists, this decision had immediate binding effects and it must now be followed, whatever their feelings and opinions about it.

For a better understanding of all these changes and of their consequences, it is useful to compare the key Articles of the *Code* in the three texts of 1999, 2008 and 2012 (see Table 1), and to do so in the context of three kinds of publications (printed paper, optical discs and online only distribution).

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3. Among the main arguments against online availability of publications and electronic registration, was that no one knows how long the digital age, as we now know it, will last, that electronic systems are technique-dependent, fragile and vulnerable, particularly in case of conflicts, and that the permanency of an electronic system of registration like *ZooBank* will depend on the permanent availability of important financial resources that cannot be guaranteed for the future. None of these problems exists for paper publications, which have largely succeeded in passing the test of time over centuries and millennia (see Appendix 2).
4. Precedents exist in which the Commission has suppressed a new Rule after having promulgated it, sometimes very soon, as in the cases of "page priority" (see Dubois 2010*b*: 14) or of availability of works published on CD-ROMs or DVDs (see below).
5. For reasons explained in Anonymous (2012*d*: 167). The choice of 1 January 2013 would have been much more logical, avoiding the new Rule to be retroactive, which always is a source of problems (Dubois 2010*b*).
6. In this work we use the CamelCase writing *ZooBank*, although several authors of this paper think that the use of capital letters within words is improper and that there is no linguistic reason to write differently "*Zootaxa*", "*Zoosystema*", "*ZooKeys*" and "*ZooBank*". CamelCase citation became fashionable recently following the success of wiki and Apple products. However its use in proper nouns is unjustified grammatically, with a few exceptions like some surnames (McAngus, MacLean, FitzGerald, etc.) or trademarks (TKMax, PepsiCo, etc.). Sometimes this fashion leads to direct mistakes such as in case of the name of Major John Eaton Le Conte, who invariably wrote his own name as two separated terms (Le Conte 1824, 1825, 1828, 1830, 1854, 1855, 1860) but is quoted as "LeConte" by many authors (e.g., Duellman 1977; Frost 1985; Frost *et al.* 2006) although not all (e.g., Martof 1973; Bour 2003). See also in this respect Dubois (2011*b*: 46, note 1). Ironically, one anonymous referee to whom the manuscript of the present paper was submitted consistently used in his/her comments the writing "DuBois", which is improper (and quite funny indeed) in French!

TABLE 1. Some Rules concerning the nomenclatural availability of works in the 1999 *Code* (Anonymous 1999: 6–8, 22–23), in the 2008 proposed amendment (Anonymous 2008*a*: 58–62) and the 2012 amendment (Anonymous 2012*a–b,d*).

1999 *Code*	2008 proposed amendment	2012 amendment
Article 8. What constitutes published work. A work is to be regarded as published for the purposes of zoological nomenclature if it complies with the requirements of this Article and is not excluded by the provisions of Article 9.	**Article 8. What constitutes published work.** [UNCHANGED].	**Article 8. What constitutes published work.** [UNCHANGED].
8.1. **Criteria to be met.** A work must satisfy the following criteria: 8.1.1. it must be issued for the purpose of providing a public and permanent scientific record, 8.1.2. it must be obtainable, when first issued, free of charge or by purchase, and 8.1.3. it must have been produced in an edition containing simultaneously obtainable copies by a method that assures numerous identical and durable copies.	8.1. **Criteria to be met.** A work must satisfy the following criteria: 8.1.1. it must be issued for the purpose of providing a public and permanent scientific record, 8.1.2. it must be obtainable, when first issued, free of charge or by purchase, and 8.1.3. it must have been produced in an edition containing simultaneously obtainable copies by a method that assures 8.1.3.1. numerous identical and durable copies (see Article 8.4), or 8.1.3.2. widely accessible electronic copies with fixed content and format (e.g. PDF/A, ISO Standard 19005-1:2005) (see Article 8.5).	8.1. **Criteria to be met.** A work must satisfy the following criteria: 8.1.1. it must be issued for the purpose of providing a public and permanent scientific record, 8.1.2. it must be obtainable, when first issued, free of charge or by purchase, and 8.1.3. it must have been produced in an edition containing simultaneously obtainable copies by a method that assures 8.1.3.1. numerous identical and durable copies (see Article 8.4) or 8.1.3.2. widely accessible electronic copies with fixed content and layout. **Example:** PDF/A (Portable Document Format Archive), described by ISO Standard 19005-1:2005, is a file format that allows content and layout to be preserved unchanged.
8.4. **Works produced before 1986.** To be published, a work produced before 1986 must have been produced on paper, by a printing method then conventional (such as letterpress, offset printing) or by hectographing or mimeographing.	8.4. **Works issued as physical copies.** Works issued as physical copies are subject to the following criteria: 8.4.1. **Works printed on paper.** After 2009**,** the only acceptable means of producing physical copies is by printing on paper using ink or toner. 8.4.2. **Works on CD-ROM or DVD.** To be considered published, a work on CD-ROM or DVD 8.4.2.1. must have been issued after 1999 and before 2010, and 8.4.2.2. must contain a statement naming at least 5 major publicly accessible libraries in which copies of the CD-ROM or DVD were to have been deposited.	8.4. **Works issued as physical copies.** Printing on paper and optical disc are the only recognized formats for works issued as physical copies. In addition to fulfilling the requirements of Article 8.1 while not being excluded by Article 9, works issued as physical copies are subject to the following criteria: 8.4.1. Works printed on paper. Before 1986 and after 2012, the only acceptable means of producing physical copies is by printing on paper using ink or toner. 8.4.2. Works on optical disc. To be considered published, a work on optical disc must be issued, in read-only memory form, after 1985 and before 2013, and 8.4.2.1. if issued before 2000, must contain a statement that any new name or nomenclatural act within it is intended for public and permanent scientific record and that the work is produced in an edition containing simultaneously obtainable copies, or 8.4.2.2. if issued after 1999, must contain a statement naming at least five major publicly accessible libraries in which copies of the optical disc were to have been deposited.
8.5. **Works produced after 1985 and before 2000.** A work produced between 1985 and 2000 by a method other than conventional printing may be accepted as published within the meaning of the Code if 8.5.1. it meets the other requirements of this Article and is not excluded by the provisions of Article 9, and 8.5.2. contains a statement by the author that any new name or	8.5. **Works issued and distributed electronically**. To be considered published, a work issued and distributed electronically must 8.5.1. have been issued after 2009, 8.5.2. state the date of publication in the work itself, and 8.5.3. be archived with an organization other than the publisher in a manner compliant with ISO standard 14721:2003 for an Open	8.5. **Works issued and distributed electronically.** To be considered published, a work issued and distributed electronically must 8.5.1. have been issued after 2011, 8.5.2. state the date of publication in the work itself, and 8.5.3. be registered in the *Official Register of Zoological Nomenclature* (ZooBank) (see Article 78.2.4) and contain evidence in the work

nomenclatural act within it is intended for public and permanent scientific record, and 8.5.3. contains a statement in words in the work itself that it is produced in an edition containing simultaneously obtainable copies.	Archive Information System (OAIS), or the successors to that standard. (For documentation of the location of the archive, see Article 10.9.2.1.) 8.5.3.1. The archiving organization's website must provide a means to determine which works are contained in the archive. 8.5.3.2. The archiving organization must have permanent or irrevocable license to make the work accessible should the publisher no longer do so. 8.5.3.3. If it is found that the work was not deposited in an archive within one year after the work's stated date of publication, or that after the publisher or its successor no longer supports distribution of a work it cannot be recovered from an archive, the case must be referred to the Commission for a ruling on the availability of any names and nomenclatural acts contained in the work.	itself that such registration has occurred. **Examples.** Evidence of registration is given by stating information that would be known only if the registration has occurred, such as the exact date of registration or the registration number assigned to the work or to a new name or nomenclatural act introduced in the work. A work issued as a PDF may contain the registration number as an embedded hyperlink. Even if the registration number is not visible in the normal viewing mode of the file or when the work is printed from the file, it is deemed to be cited in the work itself because the text of the hyperlink can easily be revealed using standard software for viewing PDFs. 8.5.3.1. The entry in the *Official Register of Zoological Nomenclature* must give the name and Internet address of an organization other than the publisher that is intended to permanently archive the work in a manner that preserves the content and layout, and is capable of doing so. This information is not required to appear in the work itself. 8.5.3.2. The entry in the *Official Register of Zoological Nomenclature* must give an ISBN for the work or an ISSN for the journal containing the work. The number is not required to appear in the work itself. 8.5.3.3. An error in stating the evidence of registration does not make a work unavailable, provided that the work can be unambiguously associated with a record created in the *Official Register of Zoological Nomenclature* before the work was published. **Examples.** The following are examples of admissible errors: In preparing a manuscript an author accidentally deletes the final digit of the registration number. An author states the wrong date of registration forgetting that ZooBank uses Coordinated Universal Time rather than local time. An author registers two works that are in review for publication and accidentally uses the same ZooBank number in both published versions. The following are examples of inadmissible errors: An author, in preparing a manuscript for publication, states that day's date for the registration date, intending to register it later that day but forgetting to do so. The author discovers the omission after the work is published and immediately registers it; because registration occurred after publication, the work is not available. A publisher discovers errors in a work and reissues it to correct those errors, but instead of registering the new edition, uses the original ZooBank number; the revised edition is not available because it was not separately registered.
8.6. **Works produced after 1999 by a method that does not employ printing on paper.** For a work produced after 1999 by a method other than printing on paper to be accepted as published within the meaning of the Code, it must contain a statement that copies (in the form in which it is published) have been deposited in at least 5 major publicly accessible libraries which are identified by name in the work itself.	8.6. **New methods of publication and archiving.** The Commission may issue Declarations to clarify whether new or unconventional methods of production, distribution, formatting, or archiving can produce works that are published in the meaning of the Code.	8.6. **New methods of publication and archiving.** The Commission may issue Declarations to clarify whether new or unconventional methods of production, distribution, formatting or archiving can produce works that are published in the meaning of the Code.
Recommendation 8A. Wide dissemination. Authors have a responsibility to ensure that new scientific names, nomenclatural acts, and information likely to affect nomenclature are made widely known. This responsibility is most easily discharged by publication in appropriate scientific journals or well-known monographic series and by ensuring that new names proposed by them are entered into the *Zoological Record*. This is most easily achieved by sending a copy of the work to the *Zoological Record*, published by Biosis U.K. **Recommendation 8B. Desirability of works on paper.** Authors and publishers are strongly urged to ensure that a new scientific name or nomenclatural act is first published in a work printed on paper.	**Recommendation 8A. Wide dissemination.** Authors have a responsibility to ensure that new scientific names, nomenclatural acts, and information likely to affect nomenclature are made widely known. Authors can accomplish this by publishing in appropriate scientific journals or well-known monographic series, by entering new names and nomenclatural acts into the *Official Register of Zoological Nomenclature* (ZooBank), and by sending copies of their works to the *Zoological Record*. **Recommendation 8B. Minimum edition of printed works.** A work on paper should be issued in a minimum edition of 25 copies, printed before any are distributed. **Recommendation 8C. Electronic works.** Ideally names and nomenclatural acts	**Recommendation 8A. Wide dissemination.** Authors have a responsibility to ensure that new scientific names, nomenclatural acts, and information likely to affect nomenclature are made widely known. Authors can accomplish this by publishing in appropriate scientific journals or well-known monographic series, by entering new names and nomenclatural acts into the *Official Register of Zoological Nomenclature* (ZooBank), and by sending copies of their works to the *Zoological Record*. **Recommendation 8B. Minimum edition of printed works.** A work on paper should be issued in a minimum edition of 25 copies, printed before any is distributed. **Recommendation 8C. Electronic works.** Electronic works should be structured

Recommendation 8C. Public accessibility of published works. Copies of published works which contain a new scientific name or nomenclatural act should be permanently conserved in libraries whose works are publicly accessible (but for the deposition of works produced after 1999 by a method other than printing on paper see Article 8.6). **Recommendation 8D. Responsibilities of authors, editors and publishers.** Authors, editors and publishers have a responsibility to ensure that works containing new names, nomenclatural acts, or information likely to affect nomenclature are self-evidently published within the meaning of the Code. Editors and publishers should ensure that works contain the date of publication, and information about where they may be obtained. **Recommendation 8E. Inclusion of disclaimers.** Editors and publishers should avoid including new names and the information that might appear to make the names available, or new nomenclatural acts, in works that are not issued for public and permanent scientific record (such as pre-symposium abstracts, or notices of papers to be delivered at a meeting). They should ensure that such documents contain a disclaimer (see Article 8.2), so that new names published for the first time therein do not enter zoological nomenclature unintentionally and pre-empt intended publication in another work.	published in electronic works should also be published simultaneously on paper. Electronic works should be structured to allow automated indexing and data extraction. **Recommendation 8D. Content immutable.** The content of a work is immutable once it is published. Publishers should not allow any changes to a work after its publication, even to correct typographical errors. Such changes automatically create a new work in the sense of the Code. Corrections should instead be made through notices of errata or other separate publications. This is particularly true for electronic works and works produced by print-on-demand. Second or other additional printings of a work should be clearly labeled as such, with date of publication stated in the work, whether or not any changes have been introduced. **Recommendation 8E. Public accessibility of published works.** Copies of published works that contain new scientific names or nomenclatural acts, or information likely to affect nomenclature, should be permanently conserved in or by libraries that make their holdings publicly accessible.	to allow automated indexing and data extraction and should include actionable links to external resources (such as embedded hyperlinks to records in the *Official Register of Zoological Nomenclature*), where appropriate. **Recommendation 8D. Content immutable.** The content of a work is immutable once it is published. Corrections should be made through notices of errata or other separate publications. Second or other additional printings of a work should be clearly labelled as such, with date of publication stated in the work, even if no changes have been introduced. **Recommendation 8E. Public accessibility of published works.** Copies of published works that contain new scientific names or nomenclatural acts, or information likely to affect nomenclature, should be permanently conserved in or by libraries that make their holdings publicly accessible. **Recommendation 8H** [*sic*]. **Archiving encouraged.** Authors are encouraged to ensure that their electronic works are archived with more than one archiving organization. Archiving organizations utilized for registered works should have permanent or irrevocable license to make a work accessible should the publisher no longer do so.
Article 9. What does not constitute published work. Notwithstanding the provisions of Article 8, none of the following constitutes published work within the meaning of the Code: 9.1. after 1930 handwriting reproduced in facsimile by any process; 9.2. photographs as such; 9.3. proof sheets; 9.4. microfilms; 9.5. acoustic records as such made by any method; 9.6. labels of specimens; 9.7. copies obtained on demand of an unpublished work [Art. 8], even if previously deposited in a library or other archive; 9.8. text or illustrations distributed by means of electronic signals (e.g. by means of the World Wide Web); or 9.9. abstracts of articles, papers, posters, texts of lectures, and similar material when issued primarily to participants at meetings, symposia, colloquia or congresses. **Recommendation 9A. Authors to avoid unintentional publication in abstracts.** Authors submitting abstracts of conference papers primarily for issue to participants, should ensure that names and acts affecting zoological nomenclature in such works are not liable to unintended publication. They should ensure that volumes of abstracts contain appropriate disclaimers [Art. 8.2].	**Article 9. What does not constitute published work.** Notwithstanding the provisions of Article 8, none of the following constitutes published work within the meaning of the Code: 9.1. after 1930, handwriting reproduced in facsimile by any process; 9.2. after 1985, works produced by hectographing or mimeographing; 9.3. before 2000 and after 2009, works issued on laser disks such as CD-ROM and DVD; 9.4. photographs as such; 9.5. proof sheets; 9.6. microfilms; 9.7. acoustic records made by any method; 9.8. labels of specimens; 9.9. copies obtained on demand of an unpublished work [Art. 8], even if previously deposited in a library or other archive; 9.10. materials issued primarily to participants at meetings (e.g. symposia, colloquia, congresses, or workshops), including abstracts and texts of presentations or posters; 9.11. text or illustrations distributed by means of electronic signals (e.g. via the Internet), except those fulfilling the requirements of Articles 8.1 and 8.5. **Recommendation 9A. Authors to avoid unintentional publication in abstracts.** Authors should not include names and acts affecting zoological nomenclature in abstracts of papers or posters to be presented at meetings. (For disclaimer of abstracts volumes, see Recommendation 8G).	**Article 9. What does not constitute published work.** Notwithstanding the provisions of Article 8, none of the following constitutes published work within the meaning of the Code: 9.1. after 1930 handwriting reproduced in facsimile by any process; 9.2. after 1985, works produced by hectographing or mimeographing; 9.3. before 1986 and after 2012, works issued on optical discs; 9.4. photographs as such; 9.5. proof sheets; 9.6. microfilms; 9.7. acoustic records made by any method; 9.8. labels of specimens; 9.9. preliminary versions of works accessible electronically in advance of publication (see Article 21.8.3); 9.10. materials issued primarily to participants at meetings (e.g. symposia, colloquia, congresses, or workshops), including abstracts and texts of presentations or posters; 9.11. text or illustrations distributed by means of electronic signals (e.g. via the Internet), except those fulfilling the requirements of Articles 8.1 and 8.5[;] 9.12. facsimiles or reproductions obtained on demand of an unpublished work [Art. 8], even if previously deposited in a library or other archive. **Example:** A Ph.D. thesis that was distributed only to members of the student's thesis committee is listed for sale in the catalogue of a print-on-demand publisher. The print-on-demand work is a reproduction of the thesis. Because the thesis was an unpublished work in its original form, it remains unpublished. If an editorial process was evident in converting the work to print-on-demand form (e.g., change to single spacing, repagination, addition of running headers), it might be considered published. **Recommendation 9A. Avoidance of new names and acts in meeting abstracts.**

		Authors should not include new names and nomenclatural acts in abstracts of papers or posters to be presented at meetings. This avoids the appearance that they are published and prevents inadvertent publication if the abstracts are widely distributed. (For disclaimer of abstracts volumes, see Recommendation 8G).
10.8–9. [ABSENT].	10.8. **Availability of names and nomenclatural acts in electronic works.** New names and nomenclatural acts cannot be made available in electronic works issued before 2010 (Article 8.5.1; see Article 10.9 for other requirements). 10.8.1. Where stability of nomenclature would be promoted thereby, a name or nomenclatural act appearing in such a work may be referred to the Commission for a ruling under the plenary power on its availability, if the work otherwise fulfils the requirements of Article 8.5. 10.9. **Registration of names and nomenclatural acts.** Registration in the *Official Register of Zoological Nomenclature* (Article 78.2.4) is required for a new scientific name published in an electronic work (Article 8.5) to be available. Additional requirements for availability of such names are: 10.9.1. the registration number assigned in the *Official Register* must be cited in the work itself, and 10.9.2. at least the following information must be recorded in the *Official Register*: 10.9.2.1. for the name of a taxon at any rank, sufficient bibliographic information to identify the work in which the name is proposed, and the name and Internet address of the archiving organization, and 10.9.2.2. for a species-group name, the depository for the name-bearing type and the location of that depository; 10.9.2.3. for a genus-group name, the type species; 10.9.2.4. for a family-group name, the type genus. 10.9.3. Registration of nomenclatural acts other than the proposal of new names in an electronic work is voluntary. 10.9.4. Names and nomenclatural acts published on paper may be registered voluntarily and retrospectively; such registration does not affect their availability. 10.9.5. Registration without publication in conformity with Articles 8 and 9 does not confer availability. **Recommendation 10B. Registration encouraged.** Authors are encouraged to include registration numbers from the *Official Register of Zoological Nomenclature* for new names and nomenclatural acts that they introduce in paper-based publications, particularly if there is also an electronic edition.	10.8–9. [DELETED]. **Recommendation 10B. Registration of names encouraged.** Authors are encouraged to include registration numbers from the *Official Register of Zoological Nomenclature* for new names and nomenclatural acts introduced in their publications, and to register names and acts that have been previously published.
Article 21. Determination of date. 21.1. **Date to be adopted.** Except as provided in Article 3, the date to be adopted as the date of publication of a work and of a contained name or nomenclatural act is to be determined in accordance with the following provisions. 21.2. **Date specified.** The date of publication specified in a work is to be	**Article 21. Determination of date.** 21.1–21.7. [UNCHANGED]. 21.8. **Advance distribution of separates and preprints.** Advance distribution of separates or preprints affects date of publication as specified by the following criteria:	**Article 21. Determination of date.** 21.1–21.6. [UNCHANGED]. 21.7. **Date not specified.** If the date of publication is not specified in a work, the earliest day on which the work, or a part of it, is demonstrated to be in existence as a published work is to be adopted as the date of publication of the work or of that part.

adopted as correct in the absence of evidence to the contrary. 21.3. **Date incompletely specified.** If the day of publication is not specified in a work, the earliest day on which the work is demonstrated to be in existence as a published work is to be adopted as the date of publication, but in the absence of such evidence the date to be adopted is 21.3.1. the last day of the month, when month and year, but not day, are specified or demonstrated, or 21.3.2. the last day of the year when only the year is specified or demonstrated. (…) 21.7. **Date not specified.** If the date of publication is not specified in a work, the earliest day on which the work, or a part of it, is demonstrated to be in existence as a published work is to be adopted as the date of publication of the work or of that part. In the absence of evidence as to day, the provisions of Article 21.3 apply. 21.8. **Advance distribution of separates and preprints.** Before 2000, an author who distributed separates in advance of the specified date of publication of the work in which the material is published thereby advanced the date of publication. The advance issue of separates after 1999 does not do so, whereas preprints, clearly imprinted with their own date of publication, may be published works from the date of their issue (…).	21.8.1. Before 2000, an author who distributed separates in advance of the specified date of publication of the work in which the material was published thereby advanced the date of publication. 21.8.2. The advance issue of separates after 1999 does not advance the date of publication, whereas preprints on paper, unambiguously imprinted with their own date of publication, are published works from the date of their issue, if they fulfil the criteria for publication in Article 8 and are not excluded by Article 9 (see Glossary: "separate", "preprint"). 21.8.3. Some works are accessible online in preliminary versions before their final publication date. Advance electronic access does not advance the date of publication of a work. 21.9. **Works issued on paper and electronically.** A name or nomenclatural act published in a work issued in both print and electronic editions is available from the one that first fulfils the relevant criteria of availability	21.7.1. In the absence of evidence as to day, the provisions of Article 21.3 apply. 21.7.2. Works issued as electronic copies are required to state a date of publication (Article 8.5.2), even if incompletely specified (Article 21.3). 21.8. **Advance distribution of separates and preprints.** Advance distribution of separates or preprints affects date of publication as specified by the following criteria: 21.8.1. Before 2000, an author who distributed separates in advance of the specified date of publication of the work in which the material was published thereby advanced the date of publication. 21.8.2. The advance issue of separates after 1999 does not advance the date of publication, whereas preprints on paper, unambiguously imprinted with their own date of publication, are published works from the date of their issue, if they fulfil the criteria for publication in Article 8 and are not excluded by Article 9 (…). 21.8.3. Some works are accessible online in preliminary versions before the publication date of the final version. Such advance electronic access does not advance the date of publication of a work, as preliminary versions are not published (Article 9.9). 21.9. **Works issued on paper and electronically.** A name or nomenclatural act published in a work issued in both print and electronic editions takes its date of publication from the edition that first fulfilled the criteria of publication of Article 8 and is not excluded by Article 9.
Article 78. Powers and duties of the Commission. (…) 78.2.4. [ABSENT].	**Article 78. Powers and duties of the Commission.** (…) 78.2.4. The Commission may establish and maintain an *Official Register of Zoological Nomenclature*, to record essential information about names and nomenclatural acts. The *Official Register* may be maintained in electronic or paper form. The *Official Lists* and *Official Indexes* may be maintained in the *Official Register*.	**Article 78. Powers and duties of the Commission.** (…) 78.2.4. The Commission may establish and maintain an *Official Register of Zoological Nomenclature* (ZooBank), to record essential information about works, names and nomenclatural acts. The *Official Register of Zoological Nomenclature* may be maintained in electronic or paper form. The *Official Lists* and *Official Indexes* may be maintained in the *Official Register*.

As regards the availability of electronic publications, the transition from 2011 to 2012 must be seen as a crucial milestone in the history of zoological nomenclature. The definition of "*available publication*" (publication acceptable for the purposes of zoological nomenclature) changed then drastically, and the importance of that change should not be underestimated. However, the proposed amendment of 2008 unfortunately played an unsettling role during this period, because, as mentioned above, some publishers followed it as if it had been implemented in the *Code*. We provide detailed examples of this in Appendix 1. For example, in 2008 the journal *PLoS One* registered in *ZooBank* some nomina published electronically with the intent to make them available, in line with suggestions in the 2008 proposal. However, as the final 2012 amendment requires registration in *ZooBank* of "works" instead of "nomina" (or names), and as this acceptable only starting on 1 January 2012, these nomina remain unavailable. Separately, and from 1 January 2000, the apparent possibility to publish works on a physical support other than paper (Art. 8.5 and 8.6 of the 1999 *Code*) was sometimes misinterpreted as allowing works published only in electronic format to be made available by depositing a few paper facsimiles of these works in a few selected libraries. As we will discuss below, these works are not available, and many nomina published in such electronic-only publications during just over a decade are not available, in spite of such deposits.

This paper discusses the nomenclatural status of non-paper publications such as optical discs and online publications. Although different from electronic publications, optical discs are also discussed here because, as we will see, after publication of the 1999 *Code*, some authors have apparently believed that the terms "*a method that does not employ printing on paper*" applied to e-publications, not just to optical discs. Thus, the scope of this paper is not limited to a discussion of the Articles of the *Code* dealing with these matters; it also includes side issues related to e-publication, d-publication and nomenclatural availability, such as the role and practices of publishers, editors, referees, authors and libraries regarding these questions.

Optical discs

Articles 8.5 and 8.6 of the 1999 *Code* (Table 1) allowed recognition of availability for works produced after 1985 by "*a method that does not employ printing on paper*", subject to certain conditions, including that such works are "*not excluded by the provisions of Article 9*", a statement that has been often overlooked as we will see below. This statement was not precise enough to ensure an unambiguous interpretation of these Articles[7]. If one stays strictly with the discussions in the subsequent 2008 text and formulation of the 2012 amendment (Table 1), the only method that does not employ printing on paper which has subsequently been considered to be covered by these Articles is publication on optical discs (CD-ROMs and DVDs). This restriction appears to be based on hindsight rather than any clear limitation actually imposed in Article 8.6 in the 1999 *Code*. For example, it might well be argued that this Article initially also applied to microfiche cards with printed introductory texts, which were not explicitly excluded by Article 9—unlike microfilms or online electronic publication ("*distributed by means of electronic signals*"). However, what does seem clear is that from the start this Article only applied to *physical* documents such as optical discs, and not to *virtual* documents such as online PDFs or other publications on the World Wide Web. This point will be discussed at more length below.

In the 2008 text, the Commission itself considered that the conditions, in the 1999 *Code*, of Articles 8.5.2 and 8.5.3 dealing with nomenclatural availability of works issued on optical discs (d-publications) between 1985 and 2000 were probably never met, so these Articles appeared to be irrelevant, but, for complete security, as regards such potential works, the Commission added: "*If such exist, they should be brought to the attention of the Commission*" (Anonymous 2008*a*: 64). These conditions therefore were not repeated in the text proposed in 2008. In 2012, the Commission noted: "*A few such works have now been brought to the Commission's attention, so the 'after 1985' time frame was restored*" (Anonymous 2012*d*: 168). Thus these conditions reappeared in Article 8.4.2.1 of the 2012 amendment, but only for works issued between 1985 and 2000, and apparently apply to just "*a few*" works. For a d-publication issued after 1999 and before 2013, the new Article 8.4.2.2 states that the conditions of Article 8.6 of the 1999 *Code* apply: "*it must contain a statement naming at least five major publicly accessible*

7. As a matter of fact, "ambiguity" is a growing cancer that has been eating away at the whole *Code* for quite some time now (see e.g. Dubois 2011*a*).

libraries in which copies of the optical disc were to have been deposited". This condition is minimal (the number of five copies being very low), but the explicit identification of five libraries *in the work itself* was probably rarely met, especially concerning optical discs (here also the 2012*d* text mentions only "*some works*"), so that the relevance of these Articles in terms of the availability of nomenclatural novelties in d-publications is no doubt a matter of very limited concern, taking into account the huge body of taxonomic publications.

An example supporting our interpretation is the Dutch "webzine" *Podarcis*[8], which, according to its colophon, is published only online. The following statement appears in this colophon [http://www.podarcis.nl]: "*New names and nomenclatural acts within this publication are intended to serve as a permanent, public scientific record as laid out in the International Code of Zoological Nomenclature. Identical copies on cd/dvd have been deposited in the libraries of* (...)." (colophon of issue 1–2 of volume **8**, dated 12 February 2008). This statement is present only on the colophon, not in any of the "works" (articles) composing the periodical. Therefore, according to Article 8.4.2.2 of the 2012 amendment, which requires that this statement appears in the "work" itself, nomenclatural novelties in these issues, such as Donaire Barroso & Bogaerts's (2003) new nomen *Salamandra algira tingitana*, are unpublished and unavailable. Note that this is not a consequence of the 2012 amendment: this nomen was already unavailable when first published as the requirement to identify the five libraries in the work itself was already present in the 1999 *Code*.

The incursion of the *Code* into optical discs thus appears to have been a premature, unedifying and confusing adventure, perhaps motivated by requests from publishers and by the tendency of the Commission "*to be eager to stick to 'modern techniques' and to follow the emergence of new processes of publication and archiving of data and documents*" (Dubois 2010*a*: 22)—an example of the "*fascination by the tool*" which is common in current science (Dubois 2008*b*: 38).

CD-ROMs and DVDs are not only technology-dependent. Worse, they are dependent on technologies that will soon probably have become obsolete, as have so many audio and audiovisual publication and storage technologies in recent decades[9]. So the content of the few optical discs that comply with the requirements of Article 8.4.2 of the 2012 amendment should certainly be copied and saved in other formats compliant with the *Code* (including preferably printing on paper) before access to this content becomes exceedingly difficult or even technically impossible. In addition, the longevity of such optical discs (i.e., containing data that are readable), although advertised up to 100 years, has proved as low as two years or less for the cheapest ones (LaBarca 2010). Most of currently used CD-ROMs and DVDs have longevities ranging from five to little more than 10 years (Hourcade *et al.* 2010). Hence, their permanence and durability are not comparable with that of paper printed materials.

The situation regarding the nomenclatural availability of d-publications can be summarised as follows:

[S1] Works included on optical discs issued before 1986 or after 2012 are not available publications for the purpose of zoological nomenclature. Optical discs issued in read-only memory form between 1985 and 2013 may contain available publications, if, and only if, they complied with the following conditions (Article 8.4.2 of the 2012 amendment of the *Code*): (1) before 2000, presence in the work itself of an explicit statement that any nomenclatural novelty it contained was intended for public and permanent scientific record and that the work was produced in an edition providing simultaneously obtainable copies; (2) after 1999, presence in the work itself of a statement naming at least five major publicly accessible libraries in which copies of the optical disc were to have been deposited.

As explained above, these elements of the Rules will probably have a very limited impact on zoological nomenclature, as they only apply to a few works published over a period of less than 30 years. The situation will be very different for online electronic publications, which are likely to soon concern thousands and later millions of works.

8. The title of this journal is written "*POD@RCIS*" in the journal itself, but in this case we think it is better to transfer it into normal typographic style. Given the current tendency to use unusual typographic styles in titles of publications, it cannot be excluded that in the near future some use very particular symbols that will not be available to some printers and publishers, so that citing them under their original form may be become difficult or impossible. In order to avoid this, we advocate the use of simple fonts and typographic conventions in the titles of journals. See also footnote 6 above (p. 6).
9. Such as 33, 45 and especially 78 rpm records, magnetic tapes, audio and video cassettes, floppy discs, zips, etc.

Electronic publications

The 1999 Code

Articles 8.5 and 8.6 of the 1999 *Code* allowed for a work produced after 1999 by a method that does not employ printing on paper to be nomenclaturally available, provided that some conditions were fulfilled. These conditions differ according to the period involved (Table 1).

After 1985 and before 2000, three conditions were required by Articles 8 and 8.5 for the availability of such works: (Co1) the work must not have been excluded by the provisions of Article 9 (Articles 8 and 8.5.1—which are redundant in this respect); (Co2) it must have contained a statement *by the author* that any nomenclatural novelty it included was intended for public and permanent scientific record (Article 8.5.2); (Co3) it must have contained a statement in words that it was produced in an edition containing simultaneously obtainable copies (Article 8.5.3). As we have seen above, these three conditions have been respected in some publications on optical discs, but, as Article 9.8 expressly excludes "*text or illustrations distributed by electronic signal*", electronic-only publications containing nomenclatural novelties produced before 2000 (if they exist) are clearly not available. However, we are not aware of any such work published only online before 2000 (see Appendix 1).

After 1999, two conditions were required by Articles 8 and 8.6 for the availability of such works: (Co1) the work must not have been excluded by the provisions of Article 9 (Article 8); (Co4) it must have contained a statement that copies "*in the form in which it is published*" had been deposited in at least five major publicly accessible libraries which were identified by name in the work itself (Article 8.6). Because of Article 9.8, in this case also availability is possible only for optical discs, and not for electronic-only publications.

Under the 1999 *Code*, only works complying with all these conditions could be considered available, and non-compliance with a single one of them would have made a work unavailable. But several interpretations of condition (Co4) have been or could be given. In fact, this last condition suffers seriously from a lack of precision, perhaps due to limited foresight, so that it was and still is the cause of much confusion and of misunderstandings and mistakes in zoological nomenclature. The issue is whether Article 8.6 of the 1999 *Code* does apply to electronic-only publications, such as PDFs made available on the World Wide Web, as well as to physical optical discs (discussed above)—or only to the latter. As we will see in detail in Appendix 1, some authors and publishers (e.g., Zauner 2009, Sands & Moylan 2012) have considered that this Article also applied to online electronic publications and therefore that a work published electronically could be available provided it satisfied condition (Co4). We consider that here there is no ambiguity and that, because of Article 9.8, electronic-only publications could not be made available by the 1999 *Code*, even if such copies had been deposited in five libraries.

Let us first consider several possible interpretations of Article 8.6 of the 1999 *Code*.

(I1) The first, most straightforward interpretation (I1a), is to stress that Article 9.8 of the 1999 *Code* explicitly stated that "*text or illustrations distributed by means of electronic signals (e.g. by means of the World Wide Web)*" were not available publications. Article 9 applied "*Notwithstanding the provisions of Article 8*", which means that it took precedence over these provisions and therefore cancelled them whenever they were contradictory. Strangely enough, this linkage does not seem to have been pointed out by anyone until now. A very awkward and questionable interpretation (I1b) of this situation would be to consider that Article 9.8 does not apply to "*works*" as defined in Article 8, i.e. scientific articles, but only to "isolated" texts or illustrations appearing e.g. on the Internet in a website, a forum, a blog, an online database, etc. Whereas some might see this as a way to try to "nullify" Article 9.8 in relation to online PDFs, it is quite clear that this would be extremely controversial and not likely to resolve this uncomfortable situation. It can be argued quite reasonably that, if the Commission had had this purpose in mind, Article 9.8 would have been written differently in order to make this clear. However, the reference to Article 9.8 in Article 8.5, but not in Article 8.6, seems curious and unjustified.

(I2) A second interpretation relies on the words "*in the form in which it is published*" in (Co4) to deny availability to online publications produced after 1999. The word "*form*" is not easily interpreted in this phrase. Its most straightforward understanding (I2a) is that it applies to a *physical object* such as an optical disc (or, of course, a printed document): the sentence would then mean that the copy of a physical object must itself be an identical physical object, i.e., that of a p-publication an identical p-publication, that of a DVD an identical DVD, etc. Under this reading, online distributed PDFs could not qualify as publications, as the form in which a PDF is published is through its electronic upload from a website where it can be distributed electronically and received, downloaded

and possibly subsequently printed, by any user who decides to do so. Such prints can therefore be very numerous, but these are not copies that have been "*deposited*", they result from local printing of a document just transferred electronically from a server to a local computer. Strictly speaking, a PDF, which is not a physical document in the traditional sense of the term (although of course it also has a physical basis, in the form of magnetically or electronically coded information), cannot be deposited as a physical object in any library, but only as an electronic copy on a server or other hardrive, so this alone would deny nomenclatural availability to such documents under the 1999 *Code*. A second possible interpretation (I2b) of the term "*form*" would be that it refers merely to the *content and format* of the document (text, layout, font, figures, colours, etc.), but not to its, physical or electronic, *support*: in such a case, a paper print of a PDF could be considered as having the same "*form*" as the latter. We do not think this interpretation (I2b) can be correct however, because then, instead of the imprecise term "*form*", the terms "*content and format*" or equivalent ones would have been used in this Article. "*Lex, si aliud voluisset, expressisset*", i.e., if it was intended, it would have been expressly stated in the law.

Now, if both these interpretations (I1) and (I2) are rejected and one insists on considering the deposition of paper printed copies of a PDF in five libraries as complying with Article 8.6 of the 1999 *Code*, three interpretations of this situation need to be considered.

(I3) This interpretation relies on the mention in Article 8.5.2 of the purposefulness of the printing and deposition of these copies to provide a "*public and permanent scientific record*" (Article 8.1.1). It is quite questionable whether such copies comply with the conditions of Article 8.1.2, i.e., if they qualify as available paper publications in the sense of the *Code*, as they do not seem to be "*obtainable*" from the publisher "*by purchase or free of charge*". In Appendix 1, we cite a letter from a publisher of an electronic journal who, when questioned about the possibility to purchase print copies of papers published online, stated that his company does not provide such copies and invites customers to download them from the website and to print them as this would be "*cheaper*". We also mention another publisher who never replied to a request for a printed copy of an electronically published work. In such cases at least, it seems that only these five copies intended for libraries selected *a priori* were or would be printed by the publisher, and that no other copy is "*obtainable*" by any other users, including libraries, even by purchase. Such paper documents therefore qualify as privately distributed documents (like letters or internal unpublished reports, often called "grey literature"), not as "*public and permanent*" scientific documents, despite the clear "intention" of their publishers. The fact that a document was made with the clear purpose of providing availability to a nomenclatural novelty is not enough *by itself* to allow this, if other conditions are not met. Thus, many authors in the past have published what are actually *nomina nuda* or other unavailable nomina, and many continue to do so—although their purpose was or is to publish available nomina for long-term use! An intention alone does not suffice! If the *Code* were nothing more than a set of vague recommendations, which one were free to follow or not according to one's tastes, its usefulness would indeed be debatable. So in this case the *intention* of the publishers, editors and/or authors to make these works nomenclaturally available by depositing copies in libraries does not by itself make them available, and the *Code* should not encourage the perception that it might.

(I4) The next interpretation relies on the recognition that such printed copies were mere *facsimiles* or *reproductions* of printed copies of the PDFs of the online publications[10], and did not qualify as distinct, independent publications. Based on several examples analysed in detail below in Appendix 1, this interpretation is supported by an array of evidence: (a) these copies bear the same ISSN/ISBN as the online documents; (b) in some of the cases for which we have reliable data, they were printed *ad hoc* in a limited number (usually five) and distributed *after* the electronic publication, sometimes several months later[11]; (c) in all cases, including those where the copy was apparently deposited (or mailed) on the very day when the PDF was made available online, there is no evidence that they were "*obtainable, when first issued, free of charge or by purchase*", as required by Article 8.1.2, by any customer beside the few libraries where they were deposited; (d) they are of variable quality, some being faithfully

10. The "Glossary" of the *Code* does not provide definitions for the term "*copies*" used in its Article 9.7, and which was replaced by the terms "*facsimiles or reproductions*" in Article 9.12 of the 2012 amendment. The usual meaning of the term "*facsimile*" is "*an exact copy, especially of written or printed material*" (Pearsall 2001: 656). Such a definition does not require that the copy be identical to the original in terms of material (e.g., that the facsimile of a PDF be another PDF), but only in terms of content and format: for example a photocopy is not produced by the same technique as the handwritten or printed original, but nevertheless qualifies as a facsimile. However, it has been argued in law that a photocopy is unreliable because of the ease with which it can be changed. This is similar to the use of Photoshop on photographs.

printed on both sides of the pages and on good paper, like a "real" periodical publication, others having clearly been directly printed from the online PDF using desk printers and standard office paper, sometimes on one side of the sheet only, or being mere photocopies of such prints, sometimes after size reduction (two pages on one) and even printed upside down on even and uneven pages (see Appendix 1). Not being independent publications, such prints, "*even if previously deposited in a library or other archive*", are in fact "*copies obtained on demand of an unpublished work*" and were clearly rejected as unpublished works by Article 9.7 of the 1999 *Code* (see Table 1). This interpretation is adopted here and the printed copies of works originally published electronically and subsequently reproduced, under the same ISSN/ISBN (or without ISSN/ISBN), from the online PDF, are here considered to have been unpublished facsimiles or reproductions, and their nomenclatural novelties unavailable, under the 1999 *Code*. The only possibly acceptable reason to reject this interpretation would be to argue somehow that a copy printed for deposit was not "*obtained on demand*" (demand from whom?) and is thus not a facsimile. As both situations would be absolutely indistinguishable this must surely be rejected.

(I5) One more possible interpretation of this tangled situation relies on the fact that the famous[12] five copies were supposed to provide nomenclatural availability *jointly with* the electronic publication. What would confer availability would be neither the electronic publication as such, nor the meagre set of five copies as such, which do not qualify as a publication for reasons explained under (I3) and (I4), but both together (Alessandro Minelli, personal communication to AD). Availability would result from an indissoluble set of two distinct actions, which would be reminiscent of the situation of first-reviser actions. It is true that first-reviser actions depend on two temporally separate conditions, both of which are necessary, but neither of which is sufficient. However there is a basic difference between both situations. Until a first-reviser action is taken, a nomenclatural situation may remain *ambiguous* (e.g., there is a lack of precedence between two synchronous synonyms, or of type-species designated where two or more nominal species were originally included in a nominal genus; for more examples see Dubois 2013*a*), but this has no bearing on the *availability* of the first, incomplete, nomenclatural act (the introduction of a new nomen or of new nomina), only on their status regarding *allocation* and *validity*—whereas in the present case the first act, if that is electronic publication, does not by itself provide *availability*, so that under this interpretation availability would depend on the second act (deposition of five copies in five libraries). Anyway, should this interpretation be adopted, the date of availability of the work would be the date when *both* documents have been distributed or deposited, independent of the respective chronology of these two actions.

Of the seven interpretations presented above, four, (I1a), (I2a), (I3) and (I4), clearly conclude that, under the 1999 *Code*, deposition in five libraries of hard copies of works published in electronic-only periodicals did not provide nomenclatural availability to these works, whereas three, (I1b), (I2b) and (I5) seem to allow some potential that they did provide or might have provided such availability. The least that can be said about this Article 8.6 which covered just a few lines but allowed so many interpretations is that it was… confused and confusing…

Our preferred interpretation of this Article, for several independent reasons, is that, under the 1999 *Code*, it did not provide availability to nomenclatural novelties published online as PDFs (because this would have contradicted Article 9.8), even if accompanied by the deposition of paper printed facsimiles in five selected libraries (because this would have contradicted Articles 8.1–2 and 9.7). Although this is not quite clearly stated in the 1999 *Code*, we think that the Commission did not intend, when it introduced the new Articles 8.5 and 8.6, to permit online publication, but only *durable physical publications* on optical discs such as CD-ROMs and DVDs, or possibly other durable media not involving printing on paper.

Our conclusion is that neither e-publications issued before 2012, even if accompanied by deposition of five or more copies in libraries, nor the distributed copies themselves, constitute published works in the sense of the *Code*. This interpretation seems to be supported by the 2008 proposed amendment. Even if that text has no status regarding nomenclatural rules, it can be reasonably argued that it conveys the thinking of the commissioners, at least in 2008.

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11. In fact, Article 8.6 of the 1999 *Code*, by requiring that the publication contains a statement that copies "have *been deposited*", clearly can only mean that this occurred *before* despatch of the work itself! Deposit or despatch for deposit should always precede despatch for distribution, which is unlikely to have been or to be a common practice of publishers. This Article was for this reason flawed from the beginning. This may appear as a pedantic issue but it is a very real one and on this basis alone no work or very few works can possibly have qualified.
12. We qualify these five copies as "famous" because, as amply illustrated in Appendix 1, many publishers, editors and authors have so far considered these five copies as a kind of "magic" solution to the problem of availability of online works, and some still continue to believe so.

We must stress however that, in the end, all this is of little practical importance regarding the *current* status concerning availability of all electronic works published before 2012, whether or not accompanied by deposition of facsimiles in a few libraries, as these clauses of the 1999 *Code* were retrospectively cancelled in the 2012 amendment, as we will see below.

The 2008 proposed amendment

In 2008, less than ten years after publication of the 1999 *Code*, the Commission published a *proposed* amendment to the *Code* which included significant *proposed* changes in the Rules of availability of electronic publications (see Table 1). These proposals included: (1) the precision that Article 8.6, about the copies deposited in five libraries, applied only to optical discs (Article 8.4.2.2) and not to electronic publications or other systems; (2) the fixation of "after 2009" as the starting date for potential availability of e-publications (Article 8.5.1)—therefore *de facto* making unavailable all nomenclatural novelties published online before 2010, whether or not five copies were deposited in libraries; (3) a series of conditions to be met for the availability of works published electronically, including deposition of the work in an electronic archive (Articles 8.5.2–8.5.3); (4) a series of conditions required for the availability of new nomina published electronically, including their registration in *ZooBank* (Articles 10.8–9), with the voluntary, not compulsory, registration being possible for new nomenclatural acts other than introduction of a new nomen, for which it was to be compulsory.

In introducing the proposed amendment, it was stated that it had been discussed in August 2008 and the following statement was included: "*The Commissioners voted to start the process required to amend the* International Code of Zoological Nomenclature *to allow electronic publication of new scientific names and other nomenclatural acts.*" This statement makes absolutely clear that, for the members of the Commission, e-publication was not allowed by the 1999 *Code* and that Articles 8.5 and 8.6 of the 1999 *Code* only pertained to d-publications (works on optical discs).

These *proposed* changes were submitted to the international community of zootaxonomists for appraisal and discussion, but they were not formally adopted by the Commission for incorporation into the *Code* (which furthermore would have required the approval of the International Union for Biological Sciences). However, some publishers, editors and authors seemed to believe that they were already part of the *Code* or that their future inclusion in the *Code* was certain, and they began to follow some of them (e.g., Article 10.9; see Table 1) in their e-publications, wrongly believing that this would make their nomenclatural novelties available. Various examples of this situation are given and analysed in detail in Appendix 1. More examples will no doubt be easily found by looking at many other periodicals than those few discussed in this Appendix.

The 2012 amendment

Contrary to the 2008 text, the text published in September 2012 was the result of formal adoption by the Commission and therefore became, on the very day of its publication, the official text of the *Code*, replacing the 1999 text (not the 2008 text, which had never been in force). This new text differs from both the 1999 and the 2008 texts.

According to this amendment, works published only electronically *can* now be available, but only under seven very precise conditions (see Table 1): (C1) the work must have been issued after 2011 (*vs*. 2009 in the 2008 text); (C2) its date of publication must appear in the document itself; (C3) it must exist as "*widely accessible electronic copies with fixed content and layout*" (e.g., a PDF/A or "Portable Document Format Archive" as defined by ISO standard 19005); (C4) it must have been registered *before* publication in *ZooBank* and contain evidence, in the work itself, that such registration has indeed occurred[13]; (C5) this document must be, or be "*intended*"[14] to be, permanently archived by "*an organization other than the publisher* (…) *and* (…) *capable of doing so*"[15]; (C6) the *ZooBank* entry must provide the name and Internet address of this organisation; (C7) this entry must provide the ISBN/ISSN of this work, i.e., of the *electronic* publication.

Conditions of availability bring with them implicit conditions of unavailability. Therefore, any nomenclatural novelty published only in electronic form before 2012, or after 2011 but without prior registration of the work in

ZooBank or without complying with the other conditions above, remains unavailable, i.e., irrelevant or "devoid of existence" in zoological nomenclature.

Concerning e-publications, the new Article 8.5 makes therefore no distinction between works published during different periods. In other words, it is retroactive and applies to all electronic works published before 2012: they are all unavailable, whether five printed copies were deposited in libraries or not. This supports our interpretation above that, in the mind of the authors of the 1999 *Code*, Article 8.6 could not apply to e-publications, but only to d-publications (optical discs). As a result, our discussion above about the seven possible interpretations of this Article, although necessary to illustrate the point, becomes obsolete. Whatever the situation regarding the availability of some e-publications *between 1999 and September 2012*, the new amendment now applies to these works and *now* they are all rendered unavailable. This is not a trivial fact, as shown below in Table 3 of Appendix 1: 77 of the 79 new nomina published online in several BioMed Central periodicals between 2006 and September 2012 turn out to be unavailable, and many more will be revealed in other periodicals.

Thus, whether one agrees with our understanding of the 1999 edition of the *Code* or not, the 2012 amendment now unambiguously excludes from availability all works issued and distributed electronically only before 2012. Except for the exceptional case of works made available by the Commission through use of its Plenary Powers, the only way nomina and nomenclatural acts published electronically only before 2012 could be seen as available would be to consider that the deposition in a few libraries of paper copies resulting from printing of PDF files constitutes publication of these nomina or nomenclatural acts. According to Article 9.12 of the 2012 amendment, deposition in selected libraries of five or more printed copies of an e-publication not registered in *ZooBank* cannot make them available after 2011, and cannot have made them available before 2012, even if the work or the nomenclatural novelties it contains had been registered in *ZooBank*. As this point is a controversial one, it requires a special discussion.

The opinion that the deposition of five copies in selected libraries constitutes, by itself, an available p-publication, was clearly shared by a number of publishers of electronic-only periodicals, and by some members of the Commission (e.g., Krell 2009), as shown in detail below in Appendix 1. It seems also to have been, at least in 2008, the opinion of some other members of the Commission, if not of its majority, although this is more difficult to ascertain because, as is too often the case, the Commission offered no explicit majority opinion or details of its votes, at least as far as we are aware. The following sentence appears in the discussion of the 2008 proposed amendment: "*Some authors of electronic works currently use print publication of a small number of copies to satisfy requirements of availability, but it has been controversial whether such works should be considered 'obtainable' (Article 8.1.2) if sent only to a few colleagues*." (Anonymous 2008*a*: 65). In view of the fact that the Commission had mentioned this controversial point in 2008, it is surprising and disappointing that no clarification of its final position in this respect, if it exists, was made in the 2012 paper. Although this is not fully clear in the 2008 text, it would seem that what the Commission was questioning then was not the fact that a few copies could provide availability (as Article 8.1.3 of the *Code* does not fix a minimum required number of copies, the term "*numerous*" not being defined; see Table 1), but the fact that these copies were distributed "*only to a few colleagues*". Actually, there is no basic difference between "*only a few colleagues*" and "*only a few libraries*". In our opinion, and as discussed above under (I3), the only difference that makes sense in the context of Article 8.1.2 is between *closed* distribution to a few *a priori* selected addressees and *open* potential distribution to colleagues and libraries expressing interest in "*obtaining*" the publication. As we will now see, this latter interpretation is

13. It is important to note that this registration concerns the publication, not merely the nomen or nomenclatural act as it had been envisioned in the 2008 text. Registration of a nomen in *ZooBank*, if not accompanied by registration of the work where it was proposed as new, does not provide nomenclatural availability to a nomen published online only. Even if it had occurred after 2011, registration in *ZooBank* of the nomen *Heliconius timareta florencia* by Giraldo *et al.* (2008) would not by itself have provided availability to this nomen (see Appendix 1). Furthermore, although the registration of this nomen is announced in this publication, this nomen and its LSID are currently (13 September 2013) absent in this database.
14. Note that, strictly speaking, Article 8.5.3.1 does not require that this archiving be actually implemented, even after a given period of time. Therefore, a nomenclatural novelty published electronically with the mention of such an "intention" would not become unavailable if this "intention" went unheeded. We do not wish to develop more this point here, but this writing clearly deserves to be reconsidered, (1) either by adding a statement according to which, if after a certain time has elapsed no archiving has occurred, availability of the work is nullified, or that (2) the original publication only provides "pre-availability", but availability proper is pending until archiving has indeed occurred.
15. Problems of long-term preservation of electronic publication, open access and copyright deserve special consideration and are largely out of scope of the current work (but see Appendix 2).

supported by the 2012 amendment, which does not mention at all the possibility to have rendered an electronic publication available by depositing paper-printed copies in at least five libraries.

Secondly, and most importantly, under Article 9.12 of the 2012 amendment, we interpret these paper printed copies of PDFs deposited in libraries as mere *facsimiles* or *reproductions* of the online publications, which as such do not qualify as distinct, independent publications. This important point is discussed in depth below.

It is important to stress that denying nomenclatural availability to online publications despite the deposition of these famous five copies has another, not inconsequential, advantage: it avoids having to carry out long, fastidious and often fruitless enquiries in libraries to ascertain that these copies have indeed been deposited there and that their "*form*" (content and layout) is identical to that of the online document. Although Article 8.6 of the 1999 *Code* only requires a "*statement that copies* (…) *have been deposited*", and not that this was indeed the case, simple consistency would require, should these documents be considered available p-publications, that such enquiries be carried out, as experience shows that some of these documents are missing in some of the libraries where they are supposed to have been deposited and probably never reached them, whereas some may be present in libraries which were not specified as depositories, and finally some, although bearing the same ISSN/ISBN and the same DOI (Digital Object Identifier), are slightly or largely different from the original online distributed documents, as documented in detail in Appendix 1.

Another important question relating to the publication date as defined by this amendment is that it is the date of availability online of the *final*, edited, version of the work, not that of a prepublication of a provisional version of it, a distinction which so far has not been made by some publishers of electronic periodicals. This point is discussed further below.

The current situation regarding the nomenclatural availability of electronic publications, after implementation of the 2012 amendment, can therefore be summarised as follows:

[S2] Any work published only electronically before 2012 is permanently unavailable in zoological nomenclature (Article 8.5.1 of the 2012 amendment of the *Code*). Any work published electronically after 2011 may be available for the publication of nomenclatural novelties, if it complies with *all* the requirements of Articles 8.1, 8.5.2 and 8.5.3 of the 2012 amendment of the *Code*. It must therefore: (1) be issued for the purpose of providing a public and permanent scientific record; (2) be obtainable, when first issued, free of charge or by purchase; (3) have been produced in an edition containing simultaneously obtainable copies by a method that assures widely accessible electronic copies with fixed content and format (e.g. PDF/A, ISO Standard 19005-1:2005); (4) include the actual date of publication in the meaning of the *Code* in its final format (not that of a provisional unformatted document); (5) have been registered *before* publication in *ZooBank*; (6) be archived, or intended to be so, by an appropriate organisation unambiguously identified in the *ZooBank* entry, which must also give the ISBN or ISSN of this work. Its publication date is that of its actual first release under its "final format" on the website of its electronic publisher.

Several of the nomenclatural problems discussed above are due to the fact that some pieces of information needed to ascertain the availability of nomenclatural novelties in electronic publications will have to be sought from extrinsic evidence, not being provided in the work itself as it was generally the case for paper publications. This includes the pieces of information that according to the 2012 amendment do not need to be given in the publication itself but that must appear in the *ZooBank* entry.

In this respect, *ZooBank* clearly needs to be improved. It currently provides the basic information of the date of its registration of works, nomina and nomenclatural acts in a very "hidden" way: this date is not shown on the page itself, but appears on the screen by passing the mouse slowly above its registration number (LSID). This may be difficult to discover for some users of *ZooBank*. This is however an important information, necessary in order to be able to check on this application whether this registration was indeed made prior to the e-publication of a new work, as now required by the *Code* for nomenclatural availability. It is to be hoped that this date, attached to each LSID provided in *ZooBank*, is a permanent and stable information that is not liable to be subsequently modified. Of course, mention in a work of its LSID in *ZooBank* would seem to be possible only if this registration has occurred previously, but this would require that all pieces of information once entered in *ZooBank* be permanently stored and available on this website, but so far this is not the case.

As a matter of fact, a particular and unexpected fact that we discovered, and analysed in detail in Appendix 1,

is that some works that have purportedly been registered in *ZooBank* are in fact missing on this web application, for reasons unknown to us. This is a genuine nomenclatural problem because Articles 8.5.3.1 and 8.5.3.2 require that some information be provided in the entry of the work in *ZooBank*, so if this entry is missing the nomenclatural novelty is unavailable. Whatever its causes are, this problem clearly needs fixing, and this is the duty of the Commission, which currently bears the responsibility for this web application.

A related problem concerns the mention of the ISSN of any work published in a periodical registered in *ZooBank*. This number does not appear in the individual entry of the publication itself, but in the general entry of the periodical at stake (see footnote 40 below, p. 77). This absence of correspondence between the requirements of the 2012 amendment and the real application *ZooBank* may be confusing and should be corrected.

The status of the famous "paper-printed copies deposited in five libraries": publications or facsimiles?

Before discussing this point, we wish to stress that determining what constitute a published work on paper based on the current wording of the *Code* is far from straightforward. A complete discussion of this problem is beyond the scope of the present paper but will be the subject of a forthcoming work.

As we have seen, although Article 9 explicitly excluded this possibility, between 1999 and 2012 some authors, editors and publishers considered that the deposition of paper-printed copies of PDFs published online in five libraries would make the nomenclatural novelties they contained available. Following this misinterpretation of Article 8.6 of the 1999 *Code*, some online-only periodicals decided to deposit printed copies of some of their papers in five major libraries (see Appendix 1). As explained above, we reject this interpretation, but as this has important consequences, certainly concerning hundreds of new nomina and nomenclatural acts, we come back again to this problem.

A very important fact, which has apparently been discussed nowhere so far, is that no mention is made in the 2012 amendment of these famous five paper-printed copies. This is unlike the situation regarding optical discs described above, for which Article 5.4.2 of the 2012 text provides different Rules of availability according to their publication date (before 2000 or after 1999). When writing the 2012 amendment, the Commission had the possibility to include in it a statement clarifying whether works published online between 1999 and 2012, of which printed paper copies had been then deposited in five major libraries, were then and are now to remain available, but it did not and as a consequence it provides no basis for "rescuing" those works from unavailability.

Thus the current situation regarding these paper-printed copies can be summarised as follows:

[S3] Facsimiles or reproductions as paper-printed copies of unavailable electronic publications (i.e., those published before 2012 or after 2011 but not complying with the requirements of Articles 8.1, 8.5.2 and 8.5.3 of the 2012 amendment of the *Code*), do not qualify as available publications for the purpose of zoological nomenclature (Article 9.12 of the 2012 amendment of the *Code*), and the nomenclatural novelties they contain are nomenclaturally unavailable.

In our opinion, Article 9.12 of the 2012 amendment of the *Code* defining "*facsimiles or reproductions*" of unavailable works (see Table 1) is not clear and specific enough and should provide more precise criteria to distinguish a facsimile from an independent p-publication. We think three such criteria could be used to make this distinction clear. They could be added in Article 8.4.1 of the *Code*.

The first one, (Cr1), stresses that, unlike available publications, facsimiles do not comply with Article 8.1.2, which requires that the work "*must be obtainable, when first issued, free of charge or by purchase*", at least by some interested customers (until exhaustion of the originally printed stock), and not only by a few libraries selected *a priori* by the publisher.

The second one, (Cr2a), stresses that, unlike available publications, facsimiles do not bear their own ISSN/ISBN, but bear the same number as that of the PDF or other original from which they were printed, or no ISSN/ISBN at all. This condition regarding the ISSN/ISBN does not concern paper-printed publications in the 2012 amendment, but it appears in Article 8.5.3.2 for e-publications. The reasons given by the Commission for this requirement are consistency with the botanical *Code* for e-publications, and "*likelihood that works with ISSN and ISBN would be deposited in national archives, as deposition is required in some countries*" (Anonymous 2012*d*:

268). We suggest this condition should be added to the general conditions of availability of paper-printed publications for the purpose of zoological nomenclature given in Article 8.4.1 of the 2012 amendment. This would not only clarify definitely the distinction between p-publications and facsimiles, but also some other situations that are sometimes controversial, such as the availability of academic theses, of some reports, volumes containing abstracts of meetings and other "grey" publications of various kinds. We agree "*that ISSN and ISBN give no assurance of quality while increasing costs and that some outlets for taxonomic monographs have not traditionally used ISBN*" (Anonymous 2012*d*: 168), but we think these drawbacks are less important than the benefit this change would provide[16].

Regarding some paper-printed monographs and periodicals devoid of ISSN/ISBN, we think a third criterion, alternative to criterion (Cr2a), could be used to provide nomenclatural availability to these works. This criterion could be similar to those of Article 8.5.3 for e-publications, but without mention of ISSN/ISBN: (Cr2b) nomenclatural availability can be provided to a paper-printed publication devoid of ISSN/ISBN through preregistration of this work in *ZooBank* and its appropriate archiving as defined in Article 8.5.3.1, with mention of evidence of this preregistration in the work itself. Contrary to obtaining an ISSN/ISBN, such a registration has little or no cost.

Of course these proposed changes to the *Code* should not be retroactive, as otherwise it would deprive some paper-printed works of their current availability, but we suggest they could start as soon as this change would be implemented into the *Code*.

In conclusion, we suggest that Articles 8.4.1 and 9.12 of the *Code* should provide a precise, operational definition of facsimile *vs*. publication, as follows:

[S4] Paper-printed facsimiles or reproductions of unavailable electronic publications differ from genuine available paper publications through (1) not being clearly obtainable, when first issued, free of charge or by purchase, even if deposited in five major libraries or other archives; (2a) having been directly printed from the PDF as provided on a publisher's website, bearing the same ISSN/ISBN as the latter or no such identifiers, but lacking their own ISSN/ISBN; and/or (2b) after 2012, not having been preregistered in *ZooBank* and appropriately archived (as defined in Article 8.5.3.1) and/or missing evidence that this preregistration and archiving has occurred.

Based on the discussion above and on the information given in Appendix 1 below, providing a detailed analysis of several examples in several journals, we propose the following guidelines to establish whether a work first published electronically after 1999 and before September 2012 was rendered nomenclaturally available through the production of printed copies:

(1) After 1999 and before September 2012, the production of printed copies of a work made the latter unambiguously available in each of the following cases: (a) when they bear an ISSN/ISBN different from that of the electronic document; *or/and* (b) when they are *clearly* and *publicly* (e.g., as announced in the work itself or at least on a website) obtainable by some interested customers at least, *when first issued* (and not as copies printed subsequently on demand), free of charge or by purchase. In conformity with Recommendation 8B of the 2012 amendment (see Table 1), which in our opinion should become a binding Rule, we suggest that "*a minimum edition of 25 copies, printed before any is distributed*", should apply in this case.

(2) After 1999 and before September 2012, the production of printed copies of a work does not make the latter available (a) when these copies do not bear an ISSN/ISBN different from that of the electronic document; *and* (b) when they are not *clearly* and *publicly* (e.g., as announced in the work itself or at least on a website) obtainable by some interested customers at least, *when first issued*, free of charge or by purchase. Such printed copies qualify as unavailable facsimiles or reproductions of unavailable online works, even if they have been deposited in or sent to libraries or other archives (Article 9.12).

For the nomenclatural novelties first published in online publications that are permanently unavailable in nomenclature, despite deposition of facsimiles in five libraries, the only possibility that remains is to make them

16. Our suggestion is consistent with the Note 2 of Article 3 of the Melbourne botanical *Code* of 2012 (Knapp *et al.* 2011: 2): "*The presence of an International Standard Book Number (ISBN) or a statement of the name of the printer, publisher, or distributor in the original printed version is regarded as internal evidence that the work was intended to be effectively published*".

available subsequently and independently, through a new publication respecting the Rules of the current *Code* for nomenclatural availability of publications, i.e., either as a p-publication or as an e-publication respecting the requirements of [S2]. This point is discussed further below.

Simultaneous paper and electronic publication of nomenclatural novelties after 2012

After 1999, some journals published "simultaneously" (i.e., on the same day) two versions of each of their issues, one traditionally printed on paper and one accessible electronically online (m-publications). In zoological taxonomy, the best example of such a publishing policy has so far been that of the journal *Zootaxa*, published in New Zealand by Magnolia Press, which from May 2001 to the end of 2012 published 3,598 issues including thousands of papers and hundreds of thousands of pages: in 2010, this journal published about 20 % of the new zoological taxa published worlwide (Zhang 2011*a–b*). The following information appeared in November 2012 on the website of *Zootaxa* [http://www.mapress.com/zootaxa/index.html]: "*Printed and online editions are published on the same day and both are available to subscribers*". The same policy had then been followed by this publisher for the other four periodicals it publishes: *Molluscan Research* (since 2002), *Zoosymposia* (since 2008), *Phytotaxa* (since 2009) and *Bionomina* (since 2010)[17]. It was also subsequently adopted by the publishers of other zootaxonomic journals, such as *ZooKeys* (since 2008).

In our opinion, for each of these journals, the two versions must be considered as two distinct publications. This basic fact was stated in full words in 2008 by the Commission: "*An electronic publication is not the same work as the printed edition of that publication, and each edition has its own criteria of availability*" (Anonymous 2008*a*: 66)[18]. This was confirmed by Article 21.9 of the 2012 amendment (see Table 1), although this Article does not repeat the statement that the two *editions* are different *works*. The printed and online versions of these periodicals bear different ISSNs, for example for *Zootaxa* ISSN 1175-5326 (print edition) and ISSN 1175-5334 (online edition), or for *ZooKeys* ISSN 1313-2989 (print edition) and ISSN 1313-2970 (online edition)[19]. This is true despite the fact that both versions of each paper may have identical content and format. This also applies to paper-printed works[20]. This is a fact, and it would be so even if the *Code* stated the contrary (which is actually not the case): no "international *Code*" could deny that two documents that bear different identification numbers are different kinds of "objects". Their texts, even if identical, are "carried" by different "vehicles". This is similar to the situation, discussed below, concerning preprint *vs*. "final version" of a paper-printed work.

This is made even more clear by the fact that, from the nomenclatural point of view, the two versions, paper-printed and electronically distributed, of an m-publication have distinct statutes according to the date: before 2012, the electronic version is for ever unavailable in zoological nomenclature, whereas the paper version may be available if all other conditions of availability are met; after 2012, both versions may be available if their respective conditions are met. After 2012, as stressed by Minelli (2013), "*With printed and online editions published at the same time, there is no ambiguity in fixing the date of publication of a paper.*" This is not true if the two versions are published on different dates.

Although the periodicals mentioned above state that they publish both versions of each of their issues on the same day, some other periodicals (or the same in different periods: see footnote 17 below) do not follow this practice and publish the two issues at different dates. This may also occur for the periodicals above, if for some

17. Magnolia Press decided to change this publication policy at the beginning of 2013, which will raise the problems of priority between both publications discussed below.
18. The same statement appears in the Melbourne botanical *Code* (McNeill *et al.* 2012: Article 31.2 and its example 5).
19. Several other zootaxonomic periodicals have adopted the same publishing policy. Whenever it is stated that two distinct versions, with different ISSNs, are published, the nomenclatural availability of the print version (if it indeed exists) is clear. Thus, the periodical *Taxonomy Online*, published by the Naturkundliche Gesellschaft (Salzburg, Austria) is stated to exist in two versions, an online edition (ISSN 2071-873X) and a print edition (ISSN 2079-1380), for which its website [http://www.nkis.info/taxon/] writes: "*Each print edition has been produced simultaneously in at least 25 copies. A copy of each print edition has been sent to and stored at least in the following libraries and has been available at least in one of these libraries at the indicated publication date:* (…)*. Further copies have been distributed to selected members of the 'Naturkundliche Gesellschaft' and are also available at a price of Euro 1.– per page (+ postage).*" In such a case, the availability of these paper printed works is clear. The print edition, which has been produced simultaneously in at least 25 copies and which has its own ISSN, is available "by itself" and distinct from the electronic one, and distribution and deposition of these printed documents does not make the electronic version, but the print version, nomenclaturally available. The availability results from these criteria, not from the deposition of copies in libraries.

unexpected material or other reason the publication of one of the two versions is delayed relative to the other one. In such cases, the new Article 21.9 applies:

[S5] A nomenclatural novelty published in a work issued in both print and electronic editions takes its date of publication from the edition that first fulfilled the criteria of Articles 8 of the 2012 amendment of the *Code* and was not excluded by its Article 9.

In other cases, when the paper and electronic versions bear the same ISSN/ISBN (or no ISSN/ISBN at all), and when the paper version was not clearly obtainable, when first issued, free of charge or by purchase, we are in the situation addressed above of deposition in libraries of a few printed facsimiles, which do not qualify as distinct publications and therefore do not provide nomenclatural availability. This is the case for example of some issues of the BMC and PLoS periodicals, of *Palaeontologica electronica* and of the *European Journal of Taxonomy*, as discussed in detail below in Appendix 1.

Electronic-only publication of nomenclatural novelties before 2012

In recent decades, the rapid development of facilities for online dissemination of documents, and the economic profit resulting from such publications, have resulted in a surge in the production of online "periodicals" and "books" by local organisations or individuals, without printed copies. As we have seen, nomenclatural novelties published before 2012 under such a format are permanently unavailable, even when a few facsimiles or printed copies of their original PDFs were deposited in libraries. They can be made available by any subsequent author (including, but not only, the original one) through paper publication (if the latter contains a statement of intention of an author to introduce a nomenclatural novelty) but, unless or until this has occurred, the nomenclatural novelty does not "exist" in zoological nomenclature and cannot be the basis of a valid nomen for use for a zoological taxon.

It is not yet certain when electronic-only taxonomic papers having nomenclatural implications started to be published. Krell (2009: 273) wrote in this respect: "*starting probably in 2005, articles containing nomenclatural content were published entirely in electronic form*". However, one much earlier case was already pointed out by Dubois *et al.* (2005: 50): the salamander nomen *Pseudoeurycea amuzga*, first published online by Perez-Ramos & Saldana de la Riva (2000), which became nomenclaturally available only with its publication in a printed periodical (Perez-Ramos & Saldana de la Riva 2003). More famous is the case of the moth *Hyposmocona molluscivora*, first introduced by Rubinoff & Haines (2005) in the "Supporting Online Material" of a paper published in *Science*, and which became available only with the publication of the printed version of a second paper in the same journal (Rubinoff & Haines 2006).

Following Gee (2000), Polly (2013: 1) claimed that the journal *Palaeontologia electronica* had been "*the first digital journal to publish new taxonomic names*", but their presentation of the situation was misleading when they stated that the 1999 *Code* "*made allowances for electronic publishing*" (Polly 2013: 2), provided that "*copies have been deposited in at least five named libraries*" (Gee 2000)—which as we have seen is true only for a given period and only for CD-ROMs, not for paper facsimiles. We discuss at the end of Appendix 1 the availability of the new nomina published in this e-journal.

Recently, several important and well-known publishing companies have launched periodicals that exist only, or seem to exist only, in electronic format, without the existence of an independent paper printed version (with a different ISSN), even if only distributed as a few copies.

20. Books published under two different editions, e.g., with hard cover and with paperback cover, bear different ISBNs and are different publications. Although in many cases these two editions are published on the same date, and although they usually have identical contents, layout, page numbers, etc., this is not always the case: they sometimes also have different publication dates and slightly different contents. In case of distinct dates, the second version may include additions (e.g., a preface) and "corrections" for misprints found in the first version, and such corrections (e.g., in spelling of nomina) may have nomenclatural consequences. The same also applies to "reprint editions" or "facsimiles" of older texts: despite any possible claim that both editions are "identical", they may show tiny differences which are nomenclaturally significant (for an analysis of such a situation, see David & Dubois 2011). Different ISSNs or ISBNs do not necessarily mean different contents, but they are different kinds of physical documents and, if published on different dates, priority will apply between them. The same will apply between electronic and paper editions of "the same" work if published on different days, or between the first edition of a book and its subsequent re-editions, even if no change has been brought to its content and format.

In fact, and as noted by Krell (2009), the information whether or not printed copies do exist may not be as easy to obtain as it might seem. As we have seen, some publishers clearly indicate on their website that they publish their periodicals both on paper and electronically, and at the same date. However, the websites of other online periodicals merely insist on their rapid publication, on their "open access" and other advantages linked to their online availability, but they fail to provide the basic information whether or not they also produce independent printed versions of their periodicals on the same day and distribute or deposit them. This information can be sought from other sources, such as institutional libraries, but is often difficult to obtain.

Unless clear and public evidence exists, and is easy to find, that an independent paper version, with its own ISSN, has been printed, and that it was obtainable, when first issued, free of charge or by purchase, the work will qualify merely as facsimile, as defined in the new Article 9.12, and the nomenclatural novelties in such works are not to be considered nomenclaturally available. This point deserves to be explored in more detail, and we chose to do it in Appendix 1 with the periodicals published by BioMed Central (BMC), and more briefly with a few other periodicals. We refer to this Appendix for details.

Electronic-only publications not complying with the new Rules

As discussed above, nomenclatural novelties published only in electronic form before 2012, or after 2011 but without prior registration of the publication in *ZooBank* or with missing information, remain unavailable and cannot be valid in zoological nomenclature. Consequently, problems of availability of zoological nomenclatural novelties can occur in many distinct cases, in particular whenever the conditions (C1) to (C7) listed above are not fulfilled:

(Pa1) any original publication before 2012 in a periodical or book existing only in an electronic version, without simultaneous publication of an independent paper edition (bearing a distinct ISSN/ISBN if both editions have one);

(Pa2) original publication after 2011 in a periodical or book existing only in an electronic version, without any paper edition, the electronic edition failing to meet some of the compulsory conditions listed above in (C2) to (C7);

(Pa3) "advanced online publication" of a paper or electronic publication;

(Pa4) original publication in the "online supporting information" or electronic-only "supplementary material" of a paper publication;

(Pa5) original online publication of new nomenclatural novelties on websites, online forums or blogs, i.e., not in an electronic periodical or book having an ISSN/ISBN.

These different situations will be considered separately below.

The new Rules allowing availability of nomenclatural novelties published online after 2011 are quite complex, and the risk for error in their interpretation and implementation is considerable. It may therefore be useful to provide a (non exhaustive) list of potential errors that may be due to an incomplete understanding of the new Rules or to the complete absence of considerations for them, now that the word has been widely and loudly spread that, at last, new nomina and nomenclatural acts can be published online only.

Let us consider first the various situations grouped above under (Pa2). Some of the reasons for nomenclatural unavailability concern the original online publication, e.g. when: (C2) the date of its publication is missing in the work itself; (C3) the work does not comply with the requirement concerning acceptable format (e.g., as PDF/A); (C4) it has not been registered in *ZooBank* before electronic publication or does not contain evidence that such registration has indeed occurred. Other faulty cases concern the *ZooBank* entry itself, whenever it fails to provide evidence that it has been properly archived or is intended to be so: (C5) the name and Internet address of the archiving organisation are missing; (C6) the ISSN/ISBN of this work is missing. Of course, when a work has been stated to have been registered in *ZooBank* but when, for whatever reason, its entry is missing on this website, the last two conditions cannot be fulfilled and the nomenclatural novelty is unavailable.

Because there are a number of reasons why mistakes may occur in the registration process devised by the Commission, the latter has tried to incorporate in the *Code* itself the possibility to "correct" these mistakes. Article 8.5.3.3 of the new amendment (Table 1) provides examples of both "*admissible*" and "*inadmissible*" errors. Such a system is quite strange indeed in an official Code and should be avoided. A Highway Code that would tolerate "admissible errors" would certainly be quite dangerous for both drivers and pedestrians, and it may be feared that this system of "admissible errors" tends to encourage careless nomenclatural work.

Any nomenclatural novelty published only in electronic form before 2012, or after 2011 but failing on just one

criterion of (Pa2), remains unavailable, i.e., "non-existent" in zoological nomenclature, and cannot be used as valid in biology. We see no special drama in this situation, and we do not think the Commission should rush to the rescue of the authors, editors and publishers who have not paid enough attention to the Rules before publishing new nomina or nomenclatural acts. The history of zoological taxonomy is full of *nomina nuda* and other unavailable nomina, and the best way to avoid this nuisance is to train biologists in nomenclature and to ensure that practising taxonomists, editors and publishers study, understand and respect the Rules of the *Code* rather than always struggling hard to correct their mistakes, as has been too often the case in the last decades—in particular to salvage incorrect "usage" although in many cases this faulty usage could only develop because of repeated errors or indiscipline (see Dubois 2010*d*).

An anonymous reviewer of the present paper's manuscript raised a question relating to the situation where only some of the criteria of (Pa2) are complied with in the original *ZooBank* registration (which results in the work being unavailable), but where the missing information is later added to the *ZooBank* entry. This referee wrote: "*Is the work then available? If not, why not? If so, then what date is considered the date of publication? The date on which all requirements were fulfilled? The answers to these sorts of questions are not included within the* Code *itself, but are real, solid relevant questions of the sort that the Authors should be focused on.*" Although of course we cannot reply in the place of the Commission, we see no special difficulty in this situation. As Article 8.5.3 of the 2012 amendment expressly requires that registration be made *before* the online release of the work, *ZooBank* entries that are incomplete should in our opinion result in definitive, irreversible unavailability of the work, which cannot be corrected later on. If one indulged, not only to correct (as in the case of the "*admissible errors*" of Article 8.5.3.3), but also to complete *ZooBank* entries after the electronic release of the work, this would open the door to endless problems and manipulations, and to nomenclatural instability. To avoid this, we think the *Code* should respect in all cases the Principle of Nomenclatural Foundation (see p. 5 above): at the moment of its release, a work should be either available or unavailable, and this status should not be liable to change later on (except of course through possible use by the Commission of its Plenary Powers). We consider it is the role of the *Code* to provide unambiguous and stringent Rules, and the role of the Commission to care for the *Code* to be fully clear in this respect.

Works containing nomenclatural novelties published exclusively online *before* 1 January 2012, date of implementation of the 2012 amendment, and without *ZooBank* preregistration, are simply unavailable under the 1999 *Code*, even if accompanied by deposit of five facsimiles in libraries. This is in fact a common situation. Such works are numerous and concern probably hundreds of new nomina and nomenclatural acts. Inserra *et al.* (2013) highlighted one of them, in which they had personal interest[21], but many other cases do exist: dozens of them are listed in Appendix 1 below. These will require publication of new papers making these nomenclatural novelties available.

Concerning works failing to follow these conditions published *after* 1 January 2012, we mentioned 19 of them in Table 2 of this Appendix, but it is doubtless that a number of others will be, or have already been, published. Whether this will continue for a long time, or whether the international community will react rapidly and impose respect of the new Rules to all (or most) zootaxonomists, will largely depend on the reaction of the Commission to the mistakes like those listed in our Appendix 1. It can be quite safely predicted that if the Commission indulges in validating, under its Plenary Powers, the 101 nomenclatural novelties listed as unavailable in Table 3 and other similar cases, the "transitional" situation risks to last for a long time. If publishing mistakes has no "cost" for the concerned authors, as has been too often the case in the recent decades (Dubois 2010*d*), there will be no real motivation for hurried authors to care for the requirements of the *Code* regarding online publications, especially as these are quite demanding indeed. For this reason, we here plea for a strict respect of the new Rules of the 2012 amendment by all zootaxonomists, and for the Commission refraining to "validate", through the use of its Plenary Powers, mistakes due to their neglect. We will return to this question in our discussion and in our conclusion below.

Prepublication: preprints, separates, proof sheets, advance sheets and advanced online publication

The "Glossary" of the 1999 *Code* defined "preprints" and "separates" as follows:

> "***preprint***, n. *A work published, with its own specified date of publication (imprint date), in advance of its later reissue as part of a collective or cumulative work. Preprints may be published works for the purposes of zoological nomenclature.*"

21. Note that the title of their paper is misleading, which has apparently escaped the attention of the editors of *ZooKeys*. The paper at stake (Zeng *et al.* 2012) was published in June 2012, i.e., *before* publication of the 2012 amendment of the *Code*. It could therefore not "*disregard*" a Rule that did not yet exist! It is nevertheless unavailable in nomenclature indeed, but simply for having ignored Article 9.8 of the 1999 *Code*. See also p. 6 above our footnote 5.

"***separate***, n. *A copy (reprint or offprint) of a work contained in a periodical, book or other larger work, intended for distribution (usually privately by the author(s)) detached from the larger work which contains it but without its own specified date of publication (imprint date). The advance distribution of separates after 1999 does not constitute publication for the purposes of zoological nomenclature.*"

According to Article 21.8 of the *Code*, slightly modified in the 2012 amendment (see Table 1), the nomenclatural status of such documents depends on the date. Before 2000, any advanced distribution of a document, either as preprint or as separate, thereby advanced the publication date. After 1999, the advance issue of *separates* does not advance the date of publication, whereas *preprints* on paper, unambiguously imprinted *with their own date of publication*, may be published works from the date of their issue, if they fulfil the other criteria of availability of works.

Therefore, since 1999, only preprints (resulting from what can be called "*paper prepublication*") have an independent nomenclatural status. Provided it includes an unambiguous mention of its publication date, a preprint is available, whether or not it is followed by a subsequent "re-publication" of the work, as both documents will then qualify as distinct publications.

Both preprints and separates are fully edited and formatted documents duly printed and intended for distribution for permanent scientific use. As such they are different from *proof sheets*, which are temporary documents that are not supposed to be distributed publicly. Even if they include no misprints or other mistakes and are in fact identical to the subsequent final document, proof sheets are explicitly excluded from nomenclatural availability by Article 9.5 of the 2012 amendment (see Table 1). However, in some cases it may be difficult to ascertain in which situation a document belongs: proof sheets including the final pagination and (expected) publication date of a paper may not be distinguishable from a preprint or separate. This would have no nomenclatural consequence in most cases, but it could have some if the proof sheets were distributed, and registered in libraries, long before the actual publication and distribution of a preprint or of the final work, if this publication was delayed for an unexpected reason, or if it finally happened not to have ever been printed and distributed.

A distinct issue, of little relevance for recent publications but historically significant, is that of "*advance sheets*", which are distinct from proof sheets and preprints although not recognised as such in the *Code*, and for which we refer to the work of Dickinson *et al.* (2011: 15–16, 19–20, 285).

What is now the nomenclatural status of online documents resulting from "*electronic prepublication*"? In the situation designated above as (Pa3), the publication of a new paper is preceded by an "advanced online publication". Articles 9.9 and 21.8.3 state that such "*preliminary versions of works accessible electronically in advance of publication*" are not nomenclaturally available, but they fail to define precisely where the difference between the two kinds of documents lies.

An advanced online publication is often a provisional document (see Appendix 1: Figure 6), directly issued from an author(s)' manuscript with the content (including illustrations) and under the original format where it was accepted by an editor, before its final editing, formatting and publishing—therefore clearly distinguishable from the "final publication". But this is not always so. In other cases of electronic prepublication, the original manuscript has already been edited and formatted, but its "provisional" status is indicated as such, either explicitly or implicitly (e.g., through the absence of a volume and fascicle number and/or of the final pagination) (see Figure 1). The "final publication", which occurs later (e.g., when all the articles composing a fascicle are ready), may be published both electronically and on paper, or only electronically. In the latter case, its availability is submitted to the new Rules. In both cases, the nomenclatural situation is quite clear: according to the new Article 21.8.3, the advanced online publication is considered as a "preliminary version", so to say a draft, and does not provide nomenclatural availability. The latter is provided only at the date of publication of the "final version". This is true before 2012 for papers finally published on paper, and after 2011 whether the "final publication" is printed on paper or both on paper and electronically, if it complies with the Rules for availability in both cases.

An additional problem is posed by the requirement of Article 8.5.2 of the 2012 amendment that the date of publication of the work be provided in the work itself. But then this should be the date of the "final publication" of the work, not that of the online prepublication which is nomenclaturally unavailable. However, in Appendix 1 we provide examples where the date that appears on the "final publication" is that when the online prepublication was distributed electronically! In such cases, it is quite clear that the publication date, although duly printed in the "final publication", is misleading, and as the second date may be much later than the first one, this may have nomenclatural consequences whenever problems of priority (between synonyms, homonyms or nomenclatural acts) are at stake.

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Naming taxa from cladograms: some confusions, misleading statements, and necessary clarifications

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Abstract

Hillis (2006) recently published a rebuttal of my analysis (Dubois, 2006c) of a paper by Hillis and Wilcox (2005) on the taxonomy and nomenclature of American ranid frogs. His paper consists not only in a reply to my paper, as it contains in fact three distinct kinds of statements: (1) an attempt to "save" the new generic nomina proposed by Hillis and Wilcox (2005) from being considered *nomina nuda* under the *Code*; (2) another plea for the superiority of the *Phylocode* over the *Code*, especially as regards the absence of a Rule of Coordination and the substitution of "phylogenetic definition" of nomina to the use of onomatophores for the allocation of nomina to taxa; (3) a plea for "taxonomic stability" in order not to upset the traditional use of nomina and to please users of electronic data bases. These three points are here commented, as follows: (1) even with the best goodwill, under the rules of the *Code* it is possible to "save" only three or four of the seven new nomina of Hillis and Wilcox (2005), the others being indeed *nomina nuda*; furthermore, three of these seven nomina are definitively useless and redundant, being junior objective synonyms of other generic nomina; (2) the well-known arguments against the *Phylocode* do not need to be repeated in detail once again, the most important one being that replacement of a secular nomenclatural system by another one, whose theoretical and practical superiority is highly questionable, would cause considerable chaos and detract taxonomists from their urgent task of accelerating the collection, study and description of the living species of our planet; (3) the claim for taxonomic and nomenclatural stability ignores the importance of the taxonomic impediment and sends a misleading message to the scientific community and to society as a whole: in the present situation of our knowledge, taxonomic stability is ignorance, and the science of taxonomy would have much to lose to adapt its concepts and practices to the needs of databases at the expense of scientific quality. It is once again stressed that, for the quality and accuracy of communication between evolutionary biologists, and above all with other biologists and non-biologists, it is urgent that scientific periodicals impose the use of different systems of notation of nomina following distinct nomenclatural systems, such as the *Code* and the *Phylocode*.

We are now at the beginning of the "century of extinctions", and the "biodiversity crisis" poses major challenges to all biologists (Dubois, 2003). At this stage of the history of science, the existence of several nomenclatural codes, based on different philosophies of biological nomenclature, is a source of confusion and chaos, and is not doing a service to the study of biodiversity and to actions aiming at understanding and conserving it (Sluys et al., 2004). Even more damaging for the image of taxonomy outside the specialized milieu of taxonomists and phylogeneticists, is the confusion caused by the use in some publications of a "double nomenclature", supposed to be valid under two distinct nomenclatural systems, the *Code* (Anonymous, 1999) and the *Phylocode* (http://www.ohiou.edu/phylocode/), but ignoring some of the basic rules of one of them. This had prompted me to propose (Dubois, 2006c) a detailed analysis of the nomenclatural problems raised by a recent publication (Hillis and Wilcox, 2005), which provides a very enlightening example of such problems. As clearly stated in the

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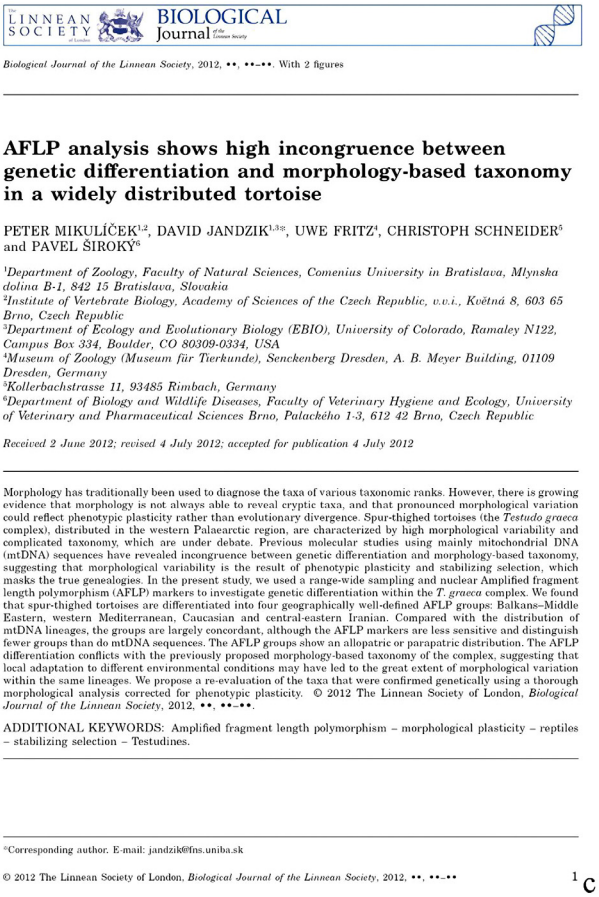

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AFLP analysis shows high incongruence between genetic differentiation and morphology-based taxonomy in a widely distributed tortoise

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Morphology has traditionally been used to diagnose the taxa of various taxonomic ranks. However, there is growing evidence that morphology is not always able to reveal cryptic taxa, and that pronounced morphological variation could reflect phenotypic plasticity rather than evolutionary divergence. Spur-thighed tortoises (the *Testudo graeca* complex), distributed in the western Palaearctic region, are characterized by high morphological variability and complicated taxonomy, which are under debate. Previous molecular studies using mainly mitochondrial DNA (mtDNA) sequences have revealed incongruence between genetic differentiation and morphology-based taxonomy, suggesting that morphological variability is the result of phenotypic plasticity and stabilizing selection, which masks the true genealogies. In the present study, we used a range-wide sampling and nuclear Amplified fragment length polymorphism (AFLP) markers to investigate genetic differentiation within the *T. graeca* complex. We found that spur-thighed tortoises are differentiated into four geographically well-defined AFLP groups: Balkans–Middle Eastern, western Mediterranean, Caucasian and central-eastern Iranian. Compared with the distribution of mtDNA lineages, the groups are largely concordant, although the AFLP markers are less sensitive and distinguish fewer groups than do mtDNA sequences. The AFLP groups show an allopatric or parapatric distribution. The AFLP differentiation conflicts with the previously proposed morphology-based taxonomy of the complex, suggesting that local adaptation to different environmental conditions may have led to the great extent of morphological variation within the same lineages. We propose a re-evaluation of the taxa that were confirmed genetically using a thorough morphological analysis corrected for phenotypic plasticity. © 2012 The Linnean Society of London, *Biological Journal of the Linnean Society*, 2012, ••, ••–••.

ADDITIONAL KEYWORDS: Amplified fragment length polymorphism – morphological plasticity – reptiles – stabilizing selection – Testudines.

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AFLP analysis shows high incongruence between genetic differentiation and morphology-based taxonomy in a widely distributed tortoise

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FIGURE 1. First pages of PDFs of two papers on two different versions: (a–b) work of Dubois (2007) as downloaded from the *Cladistics* website on: (a) 16 May 2007 (online prepublication); (b) 6 September 2007 (final publication); (c–d) work of Mikulíček *et al.* (2013) as downloaded from the *Biological Journal of the Linnean Society* website on: (c) 6 November 2012 (online prepublication); (b) 10 January 2013 (final publication). Note that on the bottom of the last page the copyright is given as of 2012 but the publication date as of 2013!

This situation may be a further cause of concern in at least two circumstances. The first one is when the "preliminary" and the "final" electronic versions are exactly identical in content and format, including their stated publication date, so that they cannot be distinguished. The only distinction is that, until the online fascicle or volume including the work is completed, the publisher does not consider it "fully published". In such cases the distinction between both "versions" is meaningless and arbitrary, and there seems to exist no ground, if registration of the work in *ZooBank* has been duly done before, to deny availability to the "preliminary version". The 2012 amendment published by the Commission does not clarify this point. Unfortunately this is an invitation to claims for earlier dates.

Minelli's (2013) suggestion that date of registration of a work should be the date of availability of the nomenclatural novelties it contains could be a solution to this problem, but it would imply a complete change of paradigm regarding nomenclatural availability, shifting it from publication to registration, and this would raise another series of problems. Discussing these problems would be beyond the scope of this paper.

The second problem concerns ethics. As we will see in Appendix 1 for BMC publications, several weeks or months can elapse between the online prepublication and the "final publication". In the meanwhile, a second publication may appear which contains a nomenclatural novelty appearing already in the unavailable advanced online publication. This second publication will have priority over the "final publication" of the first work[22]. Furthermore, as the provisional PDFs have remained accessible online during that period, many colleagues may have become aware of the new taxa proposed and one cannot rule out the possibility that sometimes one of them decides to rush out a publication providing availability to new nomina for the same taxa in order for it to appear before the final "official" publication of the work. Given the practices sometimes observed in taxonomic publications[23], deciding to publish a new nomen or nomenclatural act in a journal practising advanced publication is a risky choice that does not seem to be advisable.

In the case of online prepublication, once the final formatted version of the paper is put on the website of the publisher, the initial unformatted version is removed from this portal and no record is kept of the date when the "advanced online publication" was made accessible on this site. This might eliminate subsequent access to evidence of a potential "robbery" of taxonomic and or nomenclatural novelties published between this forgotten document and that of the "final publication". Although this has no nomenclatural consequence, it may have one for historians of science and also for the opinions of colleagues about the intellectual honesty of some authors, especially when several strange "coincidences" have occurred where the same author was involved in the description of the same taxa as those described by other authors, and published during the period between the unavailable prepublication and the final available publication of the same work.

As these examples show, the combination of online publication, advanced online publication, preprints and proof sheets results in very complicated (and potentially controversial) nomenclatural situations, which would have been completely avoided by a simple traditional original paper publication simultaneously or subsequently made accessible online. All these considerations clearly suggest that online prepublication of unformatted papers not being accompanied on the same day (or previously) by the publication of a formatted paper version, having its own ISSN/ISBN, is a very bad practice for works containing nomenclatural novelties and should be strongly

22. Here are two examples in which this was "almost" the case. (1) The new order of insects **MANTOPHASMATODEA** first mentioned online on 18 April 2002 in Klass *et al.* (2002*a*) in *Sciencexpress*, therefore in an unavailable work. The paper version of the same work, which provided availability to this nomen, was only published on 24 May 2002 in *Science* (Klass *et al.* 2002*b*), but in the meanwhile Melic (2002) had proposed the nomen **RAPTOPHASMATODEA** for the same taxon in a paper dated "April 2002". Fortunately, the latter nomen was only proposed conditionally ("*si efectivamente se trata de un nuevo orden de insectos*", i.e., "*if actually a new order of insects is involved*"), so that the latter nomen is unavailable by virtue of Article 15.1. Contrary to what some think, *availability* of nomina above the rank superfamily is regulated by the *Code* (Article 1.2.2), but the application of the Principle of Priority to establish the *validity* of such nomina is not so. (2) A new squirrel species from Turkey was first mentioned as *Spermophilus taurensis* in a work by Gündüz *et al.* (2007*a*), which had been submitted on 24 May 2006 and accepted on 1 February 2007, and "prepublished" online on 28 February 2007, thus being then unavailable. The final paper version of this work was published in June 2007, making the nomen available (Gündüz et al. 2007*b*). In the meanwhile, Özkurt *et al.* (2007) had submitted another work, which was accepted on 15 May 2007 and published both online and on paper on 19 July 2007, where the same species was described as *Spermophilus torosensis*. The latter therefore turns out to be a subjective junior synonym of the former nomen on account of a difference of a few weeks only. Let us note that the PDF of the Gündüz *et al.* (2007*a*) paper which can be downloaded from the website of *Molecular Phylogenetics & Evolution* still bears the same DOI as the prepublication and the mention "*Available online 28 February 2007*" but no mention of the actual date of publication according to the *Code*.

discouraged. This suggestion is consistent with Recommendation 30A.2 of the revised Articles of the botanical Code (Knapp *et al.* 2011, McNeill *et al.* 2012): "*It is strongly recommended that authors avoid publishing nomenclatural novelties in ephemeral printed matter of any kind, in particular printed matter that is multiplied in restricted and uncertain numbers, in which the permanence of the text may be limited, for which effective publication in terms of number of copies is not obvious, or that is unlikely to reach the general public.* (…)" This Recommendation merely discourages printing "ephemeral" paper-publications. We think a similar Recommendation should be added in the zoological *Code*, but then concerning both paper and electronic prepublications.

"Online supporting information" of paper publications

The problem of the availability of new nomina and nomenclatural acts published only in "online supporting information" or "supplementary material" of paper or online publication has apparently not been discussed so far in the taxonomic literature, except for a few words in Krell (2009).

In such cases, most people consider that the paper itself and its online "appendix" (or set of "appendices") constitute the two parts of a single publication or document, but this is not so. These are in fact two distinct documents. The first one, which is part of a paper-printed or electronically released volume or fascicle of a scientific journal, qualifies as a publication as traditionally defined in Article 8 of the *Code*. Therefore, any nomenclatural novelty appearing in this document, if compliant with the requirements of this Article and with the other requirements of the *Code*, is nomenclaturally available. But the additional online document(s) is/are not.

In the last decade, many paper-printed, as well as electronic, publications including both taxonomic and other (e.g., evolutionary, phylogenetic, genetic, etc.) data were published in journals (especially the so-called "high-ranked" ones published by big companies) that oblige authors to relegate parts of the manuscript, considered "secondary", to the "supplementary online material". These additional online documents often include part or all of the "material and methods" of the study, as well as large tables of raw data—although such data are indispensable for any possible repeatability of a study, a crucial basic requirement of the scientific approach. But it is striking to note that, in a number of cases, they also include taxonomic and especially nomenclatural information (e.g., Vieites *et al.* 2007; Stöck *et al.* 2008; Veith *et al.* 2012), including information that is indispensable for nomenclatural availability of a new nomen (e.g., Rubinoff & Haines 2005). It is not unreasonable to suppose that, in the eyes of the editors of such journals, taxonomic and nomenclatural information is "of little importance" and does not "need" to appear in the "noble" part of the paper. But the fact that the authors of such taxonomic papers accept this "devaluation" of their own work, and more largely of their scientific discipline, is intriguing. This attitude results in acceptance and support of an "ancillary" vision of taxonomy, which is one of the problems currently faced by this discipline (Boero 2010). It is particularly unjustified since taxonomic and nomenclatural data as a whole have a much longer life than other biological works producing models and hypotheses (e.g., phylogenetic trees), that are often quickly modified, replaced and forgotten. Taxonomy and nomenclature are the backbone of all biological studies. While taxonomic views evolve, the nomenclature remains and adapts. Thus, the dismissive attitude of some towards these disciplines only testifies to philistinism on the part of its promoters.

The practice of "online supplementary material" developed in recent years in several journals, apparently with the aim of saving printing and distribution costs in scientific publications[24]. There is otherwise little apparent justification for splitting the content of a publication into two parts: an "important" or "main" one printed on paper, and a "subsidiary" or "secondary one" only available (for how long?) online. From the strict point of view of science, this division is unjustified. The quality and reliability of a scientific work does rely not only on its introduction, discussion and conclusion, but also, in a crucial manner and as required by basic scientific

23. For example, an editor or referee who will keep a submitted manuscript for months before sending a report to the author, and publish his/her own paper naming the same taxon in the meanwhile. Minelli (2013: 5) gave in this respect the emblematic example of the chrysomelid beetle *Pachybrachis fraudolentus* Müller, 1955. We, and probably some of our readers as well, are aware of several cases of such disgusting practices, but it is usually not considered "politically correct" to publish detailed information about this. These seem to be mostly induced by the stupid "race" between taxonomists to be the first to describe a new taxon in order to attach one's name to a new nomen. This childish race is caused by the fact that the author's name is part of the "nominal-complex" that designates a taxon (Dubois 2000), a questionable practice which is doubtless in part responsible for the heavy "synonymy load" in zootaxonomy, especially in some groups (Dubois 2008*c*).

methodology, on its material and methods, the data on which it is based (including sometimes large and complex tables or figures) and the interpretation of the latter[25].

Should not taxonomists refuse to publish taxonomic novelties in "truncated" form in journals that practice this policy of segregated "online supporting material", to which taxonomic and nomenclatural data are often relegated? This act or "resistance" by taxonomists would be meaningful in terms of support for their discipline and its place as a fundamental part of biology, without which all other disciplines would lose much of their meaning and reliability.

Subsequent online "formal corrections" to published works

A new and particularly problematic practice initiated in recent years, at least in periodicals published by PLoS such as *PLoS One* or *PLoS Biology*, is that of the subsequent addition, on the Web page of a work previously distributed online, of so-called online "formal corrections" to this work. These may concern the conditions of publication of the work, which have important consequences regarding the availability of nomenclatural novelties it may contain (e.g., Franzen *et al.* 2009; for details see Appendix 1) or taxonomic changes, which may also have nomenclatural consequences such as synonymisations or new combinations (e.g., Santos *et al.* 2009). In both these examples, the "formal correction" appeared on the Web page several months after the original release of the original work: more than two months (19 May–21 July 2009) for the work of Franzen *et al.* (2009) and more than 18 months (10 March 2009–13 September 2010) for the work of Santos *et al.* (2009).

These practices presage a new era in the history of scientific publications and send a worrying message regarding the future of their perpetuity. In traditional paper publications, once published, a work could only be modified or "corrected" through the subsequent publication, in a *new* published document, of "errata", "corrigenda", "additional notes" and so on. So there were two (or more) distinct publications, each one properly able to be cited separately, with its own publication date, which made things easier concerning application of the *Code*'s Rules. But this new practice is different. In this case, the "correction", "addition" or "comment" is added later, but on *the same* Web page as that from which the original document could be downloaded from the first day of its publication. Thus this Web page can be "updated" indefinitely after its original release, and is virtually never finished or closed. This is an illustration of the "civilisation of updates" which is progressively overrunning our society and which has not only philosophical and scientific consequences (see below), but also simple practical ones, because such "updates" are likely to remain unnoticed by many colleagues. Imagine a taxonomist who has downloaded the paper of Santos *et al.* (2009) just after its publication in March 2009 and who is writing in 2013 a paper quoting this work. What are the chances that he/she goes back to the *PLoS Biology* website to check whether or not a "comment", an "addition" or a "formal correction" has been added after its original release on the page of this work[26]? Will everyone now, before citing a publication, need to verify whether it has been "modified", "updated" or "corrected" since its first publication? This would create a completely unstable and unpredictable new world of ephemera, where notionally no electronic publication can be assumed to be "stable" or "finished". In fact, such subsequent online additions are a new kind of "*grey material*" or "*phantom publications*" which may be as difficult to find in the future as some publications in commercial catalogues, leaflets or brochures for which the latter formula was used (China 1962; Vences *et al.* 1999).

Such "updates", if they contain nomenclatural novelties, are of course nomenclaturally unavailable, just like the "supplementary online information" discussed above. But they differ from them in an important respect. Initially, the "supplementary online information" was part of the original manuscript as submitted to the editor of the electronic periodical or book to which the work was submitted. Thus, one can presume that they were seen and

24. In fact, this practice goes a little further, as even in periodicals published only electronically the "supplementary material" must be downloaded, often as Word documents, separately from the PDF of the "noble" part of the paper itself. Although it probably saves costs on the publisher's side (the manpower and time required for editing and formatting these documents), such savings are probably limited and this practice seems quite absurd. An additional nuisance for readers is that, when they first access a work published online, if they do not realise that additional material must be downloaded separately, or if they forget to do so, they will have an incomplete, either electronic or print-out (on their personal printer) version of the publication, and they will very possibly need to come back later to the site of the periodical if they need to look at these additional pages. The fact that the periodicals that practice such discrimination between two parts of their papers do not themselves consider the "additional material" as properly published is illustrated by the fact that such material was not included in the printed versions of the famous paper copies deposited by BMC in five libraries from 2008 to 2012, as discussed in Appendix 1.

considered by the editor and referees before acceptance of the work for publication. But subsequent comments and additions may be of a different nature. In some journals they can just be added by the authors, or by someone else, without being submitted to editorial process. In such cases they are just like comments posted on blogs or on online forums of discussions between persons sharing an interest, and they are not different from dialogues or debates among colleagues, and other private communications, whether in Universities or in bars. They do not belong in the world of scientific publications, where contributions are first examined (or at least are supposed to be so) by peers before being accepted for diffusion[27]. Such subsequent "comments", "additions" or "formal corrections" appear to bypass a regular editorial process and to "publish" some information (or opinions) in a quasi-private way. The problem becomes very evident when such information is not simply the correction of a small mistake in spelling, a number or an illustration, but takes the form of a several-page long new text, which sometimes occur (e.g., Santos *et al.* 2009). Such long texts, which in fact qualify as *new publications*, should rather be submitted for publication as new manuscripts, under a *new title* clearly indicating their nature, so that they can be indexed and appear in bibliographic databases, as has long been practised in paper publications (see e.g. Dubois & Ohler 1995). The work of Santos *et al.* (2009), published on 10 March 2009, is cited in the 2009 volume of the *Zoological Record*, but its "Formal correction" of 13 September 2010 is not mentioned in the 2010–2012 volumes of this journal, so this correction is so to say "out of the record" regarding the long-term archiving of scientific publications.

This example allows pointing out another problem concerning such subsequent additions to works published online. If today (12 October 2013) one downloads the Santos *et al.* (2009) paper, the PDF includes on page 0459 the link to the "Formal Correction S1"[28]. The date of this correction S1 is given nowhere in the PDF of the paper or in the "Supporting Information S1" itself. The only information that appears, on page 0448 of the PDF, is that this paper was published on 10 March 2009. But if one goes to the *PLoS Biology* website, it is stated that the "Formal Correction S1" was posted on this website on 13 September 2010. This means that the PDF that can now be downloaded from this website is different from the original PDF that was seemingly published on 10 March 2009. This original PDF is no more available on the website. Most probably however, the DOI of this PDF was kept identical (we provide examples of this practice below in Appendix 1). So the current PDF of this paper differs from the original one in this respect at least (and possibly in others). This PDF is still dated 10 March 2009, which is misleading. And there is no reason to exclude the possibility that tomorrow or in five years, this PDF will be again modified by inclusion of the link to a new "Formal Correction S2" to this paper that could be added any time! It is thus quite clear that the concept of "scientific publication", as used in such electronic journals, is widely different from the traditional concept. For such periodicals, it refers to a provisional, labile document that can be modified at any time by incorporation, modification or (why not) suppression of part of its content, although keeping the same DOI and stating a misleading publication date.

In our opinion, such "phantom publications", when they include original nomenclatural acts or information, should not only be treated as nomenclaturally unavailable (which they are), but also simply as unavailable

25. It is particularly shocking to find that this editorial policy is often adopted by "major journals" with high "impact factors", having very costly subscription fees and/or page charges, and published by big commercial publishing companies. In contrast, small natural history journals, that are often published by non-profit associations or by academic institutions and that depend largely on the support of their members and subscribers, usually do their best to publish the whole contents of their papers, even if these contain long tables and appendices. Some of them explicitly reject the use of supplementary online material in their editorial policy. Such journals do not put *a priori* limitations on the length of papers or of tables of data and results of scientific works submitted to the journal, considering that the length of a paper is not to be judged "by itself", but relative to its content, to the importance and quality of the new information it provides. Before the development of electronic publication, the same problem existed under another form. Some journals refused to publish long tables of data or other cumbersome information, and required authors to state that additional detailed data are available at their address and can be obtained by writing directly to them! The question could then be asked: what will be the fate of such pieces of information in 50 or 100 years? Can we write today to Darwin or Hennig to ask them for unpublished data they may have kept in their drawers? The period may now be even more reduced, in the cases of electronic periodicals that are discontinued or the sites of which stop providing these additional files after a few years. This is a strange conception of science. Either the information "eliminated" from the "noble" part of a paper was useful for the understanding of the work and evaluation of its merits—for example if a subsequent author wishes to repeat an experiment, an analysis or an observation, or check the validity of some calculations or modelling—and then it should have been included in the paper (even as a long table or appendix), or it is not, and then it should not have been mentioned at all. This practice has tended to be replaced nowadays by that of additional online information, which some publishers encourage or impose, whereas others, even some produced by commercial publishers, do not. Retained integrity is wholly appropriate for the publication of taxonomic and nomenclatural papers, as there will be no risk that indispensable nomenclatural information be relegated to separate online documents that do not qualify as publications in the meaning of the *Code*.

publications, that can be ignored and should not be quoted or mentioned in reference lists of scientific works (see Dubois 2003*b*, 2004).

More generally, as electronic documents can be permanently modified without this resulting in change in their DOI, it is clear that DOIs cannot play the role they are supposed to play to indicate that a document was published under an immutable and inalterable format "*that allows content and layout to be preserved unchanged*" (Article 8.1.3), and another system will have to be devised[29].

Online websites, databases, forums, blogs

The new Articles published by the Commission are quite clear: nomenclatural availability can be provided to documents distributed electronically after 2012 only when they are intended to be permanent publications of fixed content (i.e., that cannot be modified or corrected, even in the slightest details, subsequently to the original online release). Although there are a few exceptions, such electronic books or periodicals usually have an ISBN/ISSN. Thus these Articles exclude from nomenclatural availability the online publication of nomenclatural novelties on websites or in Web forums or blogs. Although this is self-evident, it brings with it some related concerns.

In recent decades, many taxonomic databases appeared online on the Web. The original and "official" purpose of such applications was not to create new taxonomic interpretations or novelties but to provide quick and easy accessibility to "state of the art", or at least "up to date" summarisations of taxonomic research and information dealing with some taxonomic groups (or even all such groups). These sites were therefore originally viewed merely as a technical help to research, not as places where original taxonomic research would be developed or where nomenclatural novelties would be published. Such databases often claim to present the "latest" taxonomic and nomenclatural information, i.e., following the most recent publications in the field, or they choose to present only one taxonomy, even if it is not the latest one. However, some of these applications have moved away from this aim, and tend to generate and propose their own new taxonomic or nomenclatural data or interpretations (e.g., synonymisations or first-reviser actions), usually following the decision of the responsible(s) of the applications, but without having been submitted to any kind of reading or review by colleagues, referees or editors. Because these websites are ephemeral and as discussed not available under the *Code*, it should be clear to all that any such nomenclatural actions have no existence in zoological nomenclature. Thus to maintain this clear distinction they should not be followed nor cited, because they do not qualify as publications (Article 9.11).

Subjective synonymisation, or its counterpart the restoration of a nomen once considered synonymous, is a taxonomic, not nomenclatural act, and as such is not submitted to the Rules of the *Code*. However, whenever it results in a new combination or in abandonment of a combination, it may in some cases require introducing *nomina nova* because of a new secondary homonymy, or resurrecting nomina previously considered invalid, so it may have immediate nomenclatural consequences. Such synonymisations on websites have no "official" nomenclatural existence until they have been published on paper or in available online publications registered in *ZooBank*.

26. Of course, this problem may also exist for paper-printed publications, whenever the "Addenda" or "Corrigenda" (e.g., correcting spellings, quantitative or other data) are not printed at the end of the work itself before publication, but added later (e.g., in reprints), without appearing, and being eventually cited in bibliographic databases like *Zoological Record*, as independent publications, but it is a quite rare situation. As a matter of fact, the nomenclatural availability of such sheets subsequently inserted in reprints is indeed questionable.
27. Of course, the *Code* does not require in the least that a publication be submitted to peer-review to be nomenclaturally available, and this is fully justified! Excellent taxonomic papers are regularly published in journals which do not practice peer-review, and terribly bad ones in journals that practice it (see the provocative enquiry of Bohannon 2013), quite often simply because referees are less competent in the domain than the author of a work (Hołyński 2003, Dubois 2006*c*), but at least some competent colleagues, or the editor or editorial board of the journal, should read a paper before acceptance, as was long the case in Europe before the peer-review system developed. Self-publication of a paper that has not been seen by anyone else than the author is a dangerous and not commandable practice.
28. In this case the document S1 does not contain nomenclatural novelties, so no nomenclatural problem arises, but it is quite likely that examples exist or will exist where this is or will be the case.
29. Another related problem that might affect nomenclatural issues is the procedure of "retraction" of publications, which allows scientists to state that, in their opinion, a published paper should no more be cited—as if human past actions could be "nullified" or "erased". Usually retraction is a consequence of scientific fraud, duplication or plagiarism, especially when these have been pointed out by others. However, so-called retraction cannot affect nomenclatural novelties, as once validly published such novelties have a permanent existence, unless they are "suppressed" by the Commission acting under its Plenary Powers.

Let us give a few examples of such situations.

Moure's bee catalogue was first published in 2007 both online and as a printed book (over 1,000 printed copies). Since then, it has been maintained online. However, it has also been "updated", but only online through a Web site [http://moure.cria.org.br/]. Many "new synonyms" were proposed for Neotropical bees in these "updates", but not yet "published" in the sense of the *Code*, so that their potential nomenclatural consequences (e.g., the need to resurrect nomina or to introduce *nomina nova*) should await their proper publication in taxonomic papers.

A website well-known to all batrachologists is *Amphibian Species of the World* (*ASW*)[30]. The "skeleton" of this database consisted of five paper-published works (Dubois 1984; Frost 1985; Faivovich *et al.* 2005; Frost *et al.* 2006; Grant *et al.* 2006). Initially, this database was supposed to just provide the "state of the art" of amphibian taxonomy and nomenclature. However, soon many nomenclatural novelties, such as new combinations (which as we have seen may have nomenclatural consequences), appeared in successive versions of this list, which were not supported by any paper publication and are therefore "non-existent" in zoological nomenclature. On the *ASW* website, only the "last" or "current" version of the list appears and automatic access to the previous versions is not straightforward, although it is stated to be possible upon request. However, recent versions sometimes quote a previous version of this list as the "authority" for the origin of a change (synonymisation, new combination, first-reviser action, etc.)! This is misleading, as being of labile nature such references do not refer to scientific publications and they should not be cited as "bibliographic" references[31].

A counter-example is worth mentioning here because it shows the appropriate course to follow in such situations. The website *Lisanfos KMS* (Martín & Sanchíz 2012) provides data on recent amphibian fossils. During the preparation of this database, the authors discovered several taxonomic and nomenclatural problems in this group. They therefore published an article reviewing these cases in a paper-printed periodical (Martín *et al.* 2012) where they described and discussed these problems, making all the proposed taxonomic and nomenclatural changes available, where they aptly wrote (p. 161): "*The current International Code of Zoological Nomenclature (...) does not allow for nomenclatural changes to be performed directly on an internet portal such as* Lisanfos KMS *(*www.lisanfos.mncn.csic.es*), since an internet publication is not valid for this purpose. Furthermore, some of the proposed nomenclatural changes require historical and technical discussions, which are better treated in specialized taxonomic articles such as the one presented here.*"

In ornithology, the *Howard and Moore Complete Checklist of the Birds of the World* (Dickinson 2003) faces online competition (from two or more other lists all of which provide online updates). The 2003 edition was followed by several "Corrigenda" (issued as PDF versions of Excel spreadsheets) seen by the editor as informal rather than as valid publications and no attempt was made to qualify them under the terms of the *Code*. The publishers of the fourth edition, due out soon, have undertaken to provide updates only through a journal with an ISSN for precisely the reasons expressed above.

A tradition in ornithology is the existence of many *ad hoc* "Classification Committees", which usually aim to provide a concise list of the valid species, but frequently enter in the nomenclatural field by proposing synonymisations, acceptance or rejection of validly published nomenclatural acts, etc. Most of these "Classification Committees" now have their own websites and promote all these discussions, often followed by "decisions" which have no nomenclatural value and may introduce more problems than solutions to avian taxonomy. Inevitably, some of these committees overlap and it is not uncommon that different committees reach different conclusions. At any rate, the decisions of these committees have no binding value for zootaxonomists regarding both classification and nomenclature. As for the classification, each taxonomist is free to adopt the scheme that he/she considers the best (this is the "freedom of taxonomic thought or actions" mentioned in the

30. [http://research.amnh.org/herpetology/amphibia/].
31. The *ASW* website raises another problem related to such online databases. Some of these online applications are well known and tend to be viewed by some (particularly by non-specialists of the group at stake) as "standards" and authoritative sources of information, even when it has been clearly shown that they are not reliable, at least for part of their information (see e.g. Dubois & Raffaëlli 2009, 2012). To crown it all, some editors or referees now tend to require authors to follow the taxonomic and nomenclatural choices of such databases, as if they were in a way "official", even when the authors explain in their works why they do not follow them. This is unacceptable concerning taxonomy, as it does not respect what the *Code* (Anonymous 1999: 2) calls "*the freedom of taxonomic thought or actions*", which is a basic requirement in science (Dubois 2005, 2011*a*). And as regards nomenclature, this is unacceptable when an editor requires that one follows unpublished taxonomic or nomenclatural changes proposed only on these unavailable online applications but that have not yet been "officially" implemented in paper or available online publications.

"Preamble" of the *Code*). As for the nomenclature, it is solely regulated by the *Code*, and in some cases by specific actions of the Commission, and no *ad hoc* committee is entitled to ignore or cancel the Rules of the *Code*.

Discussion

Authors, editors and referees

The decision of the Commission to allow availability to nomenclatural novelties published only electronically has prompted widespread enthusiasm, especially on the Internet. So far, we are not aware that any critical publication has addressed all the problems that we raise here, most of which merely derive from the very fact of *accepting the possibility* that nomenclatural novelties can now be published online. However, a careful examination of the enthusiastic comments shows that, in at least a number of cases, their authors did not fully comprehend the problems raised by these novelties, let alone the basic concepts, Rules and terms of zoological nomenclature. In its website [http://iczn.org/content/electronic-publication-made-available-amendment-code], the Commission provided references to editorials and press coverage that announced the new amendment, but rightly noted that several of these texts did not report some details of the amendment correctly. Strangely, several of these texts repeat a mistake discussed in Appendix 1, using the term "legitimate" which is relevant in botanical nomenclature but irrelevant in zoological nomenclature. This suggests that at least part of these enthusiastic texts were largely copied from each other, without any critical evaluation (and perhaps even understanding) of their content.

In fact, in opening the Pandora's box of the availability of nomenclatural novelties published electronically, the Commission may well have ushered an era of nomenclatural chaos. This is not very surprising, considering the low (indeed sometimes absent) general level of taxonomic and nomenclatural understanding among scientists (including biologists and even evolutionary biologists) and scientific editors. One is fully justified to feel concerned about the way the new Rules will be "interpreted" and implemented by this international community. An increase in errors is likely, if not inevitable. The fate of these errors (i.e., whether they will be "corrected" or not, and if so after what delay and under which mechanism) is still unknown.

The statement that the level of taxonomic and nomenclatural understanding is weak or non-existent among many biologists, including evolutionary biologists or even systematists, and among editors and referees, may appear strange or shocking to some, so it deserves further comment.

A discussion on electronic publications developed in the *Bulletin of zoological Nomenclature* (the official journal of the Commission) in 2009 and 2010. Although it apparently elicited few reactions, in our opinion the following contribution was particularly important:

> "*For 12 years I have been involved in writing a Catalogue of Palaearctic Coleoptera, in collaboration with 160 specialists. This project covers some 100,000 valid taxa and about 200,000 available taxonomic names. In addition, primary references are given to each of the genus- and species-group names (at the moment, 5 volumes with some 4000 printed pages are published; one following volume may yet be completed this year).*
> *While working on this project we met a large number of difficulties; among the more common ones were poor understanding of nomenclature (professionals included), poor knowledge of published sources and inconsistencies at all levels. Alpha-taxonomists, who are responsible for recognition of essential parts of the diversity of life, commonly have never consulted the Code and have poor knowledge of Opinions. For instance, names published as varieties of subspecies or as aberrations are used for/as valid taxa and genus-group names were published even in the 80s without having been fixed by type species (again by professionals).*
> *The poor knowledge of the Code was illustrated in an interesting way by French phylocodists (again professional zoologists) who ignored the fact that names above family-group are not regulated, and believed that types define the contents of taxa.*
> *Experience suggests that if we introduce an Official Register, some workers will base their work on it while others may ignore it. Thus, in subsequent work on one and the same taxon, some authors will use only registered names while others may use also the unregistered ones. It is perfectly predictable that an Official Register, however useful it may seem to be, will result in a major mess in taxonomy.*
> *Alpha-taxonomy is not adequately supported in most countries. One of the secondary effects of the present situation may be seen in the fact that many taxonomists in Europe work with ideas of the past typologically and cannot even distinguish available and unavailable names. Misspellings are commonly considered as synonyms. The same is true for nomina nuda.*
> *Efforts should be redirected to other issues than Official Registers and similar ambitious projects. To improve the actual*

situation in taxonomy we need to deal with very different issues such as the reintroduction of systematics (with alpha- and beta-taxonomy and nomenclature) in universities, where it has been downsized in the last 30 years, and a re-evaluation of the role of natural history museums in which popularisation has become one of the most important criteria." (Löbl 2009: 307–308).

An important point which apparently escaped the attention of many contributors to this discussion is the current "*poor understanding of nomenclature (professionals included)*" mentioned in this text, which is the result both of the absence of academic teaching of this discipline in most countries and of the low level of competence in this domain of many editors of periodicals and books (Dubois 2003*a*). Most users of the Internet and of online databases do not master nomenclatural Rules at all[32], and it can be predicted with certainty that, now that online publication of nomenclatural novelties has been authorised, they will not differentiate between those published and registered online in an appropriate way and those published in a manner that is not compliant with the *Code*, so that a certain amount of nomenclatural chaos is bound to develop, at least on the Web. This was exemplified by Dubois (2010*a*: 12) with "*the current (December 2009) co-existence in the different language versions of Wikipedia of at least nine pages devoted to the famous Galapagos pink iguana recently described, including six where it is incorrectly designated as '*Conolophus rosada*', an unavailable [nomen], and three where it is correctly named* Conolophus marthae*, the available [nomen] of this species*". Countless other examples of invalid zoological nomenclature on the Web are easy to find.

Nomenclatural mistakes have always existed in taxonomic publications. One century and a half after the seminal works of Linnaeus, in the absence of consensual rules followed by all authors in all countries, a degree of nomenclatural confusion prevailed, and the establishment of an international Code (the "*Règles*") at the beginning of the 20th century brought a major improvement in the situation (Melville 1995). During the first half of the 20th century, taxonomy, which was almost entirely based on morphology and anatomy, was still a discipline practised mostly by specialists—in particular by museum taxonomists, who devoted a large part of their activity to this work and consequently usually had a good or rather good understanding of these nomenclatural Rules. The situation changed progressively but drastically in the second half of that century, when biologists from widely different horizons (ethology, ecology, genetics, cytogenetics, and later molecular phylogeny) became involved in the field of taxonomy, first by describing new "cryptic" species disclosed by non-morphological characters (behaviour, bioacoustics, karyotypes, protein electrophoresis, etc.) and later by erecting new supraspecific taxa (genera, families, orders, etc.) on account of phylogenetic hypotheses based on nucleic acid sequencing. Because they were using "modern techniques", some of these biologists thought that they were opening a new era of systematics where all the ideas and practices of the past could be forgotten or thrown away. Some of them did not look at the *Code* or even know of its existence, seeming to believe that nomenclature could be practised with "common sense" as one's only guide. These authors were increasingly partnered by referees and editors of similar mentality, and this has resulted in a growing nomenclatural chaos in zoological publications. Although, of course, this should be documented by appropriate surveys, experience suggests that the situation of nomenclature in zootaxonomic publications at the beginning of this century is much worse than what it was half a century ago when experienced taxonomists, some professionals and some amateurs, were those publishing nomenclatural novelties.

Short of a full survey it is still possible and desirable to give some examples. Among the many recent publications of nomenclatural mistakes, the most frequent ones are probably the publication of *nomina nuda* and the introduction of a useless new nomen for a taxon already named long ago, but rarer or stranger ones also occur, such as unjustified emendations of nomina, erroneous precedence between nomina, double publication of a new species nomen with different holotypes, etc. In amphibians, birds and insects, such flaws were recently noticed in journals like *Amphibia-Reptilia*, *Bonner zoologische Beiträge*, *Copeia*, *Herpetological Review*, *Journal of Herpetology*, *Journal of the Kansas entomological Society*, *Journal of zoological Systematics and evolutionary Research*, *Molecular Phylogenetics & Evolution*, *Neotropical Entomology*, *Science*, *Systematic Biology*, *The Auk*, *Treubia*, *Zoological Journal of the Linnean Society*, *Zoologischer Anzeiger* or even *Zootaxa*—some of which are quite famous and have high "impact factors" (see details in Dubois 1999, 2003*a*, 2006*b*, 2007, 2013*b*; Dubois *et al.* 2001; Crochet 2007; Nemésio 2007, 2009*a–b*; Nemésio & Rasmussen 2009; Dubois & Raffaëlli 2012; Nemésio & Dubois 2012; Nemésio & Melo 2012; Ohler & Dubois 2012). In ornithology, the introduction of new nomina

32. This is easy to check by looking at the discussions that permanently develop on several well known websites dedicated to nomenclature and taxonomy.

spurred by interest in phylogenetic studies has led to a considerable number of family-series[33] nomina being published which are unavailable because they lack the descriptions required by Article 13 of the *Code* (e.g.: Wolters 1975–1982, 1983; Livezey 2010) or for other reasons, or of unjustified emendations of existing nomina (Mayr 2008, 2011), none of which faults were resolved by referees or editors. Those in other fields will know of many other cases and journals that could be listed here. We do not doubt that most of the papers at stake were read by referees and editors, but what this much incomplete collection of mistakes shows is simply that most of these people are not competent for reviewing the nomenclatural parts of papers. To these problems which have so to say become routine in recent taxonomic publications, new problems are more than likely to be added by the new Rules allowing nomenclatural availability in electronic-only published works.

As nomenclature is a highly specialised technical field which is not mastered by many zoologists, the best solution to these problems would certainly be to have all papers containing nomenclatural novelties reviewed especially, from the technical point of view of nomenclatural accuracy and compliance with the *Code*, by a nomenclature editor. This system has been in force for decades in some journals, such as the Paris Museum periodicals *Adansonia*, *Geodiversitas* and *Zoosystema*, where it certainly avoided the publication of dozens of errors and the creation of dozens of problems, but it is not widespread, even in paper periodicals which often publish taxonomic works. Of course it is time- and taskforce-consuming, so that it can hardly be implemented in journals like *Zootaxa*, as it would require reading from the strict point of view of nomenclature hundreds or thousands of pages a year, so that even this specialised journal regularly publishes nomenclatural flaws—which has prompted the recent publication in its columns of an editorial aiming at avoiding some frequent mistakes (Dubois *et al.* 2011). In ornithology, the Standing Committee on Ornithological Nomenclature (SCON) surveys the literature and takes up concerns with authors privately and with editors of ornithological journals. It also takes cases to the Commission. The *Bulletin of the British Ornithologists' Club* recently decided it would seek a SCON opinion on any new nomen or new nomenclatural act that it was invited to publish. This opinion is focussed wholly on *Code* compliance and usually does not include any comment on any other aspect of the work. In 2014, the Distributed European School of Taxonomy (DEST), which has already provided courses in biological nomenclature since its foundation in 2006, will start giving such courses specially aimed at editors and reviewers of taxonomic journals [http://www.taxonomytraining.eu/].

In fact, it is difficult for journals that rely on editorial work carried out on a voluntary basis to find competent and generous people having enough free time to do the fastidious work of reading carefully such high numbers of pages, but wealthy commercial publishers should be well able to retain and remunerate competent taxonomists (e.g., retired senior citizens or unemployed graduates) for specific tasks of this kind.

Until this is done, we worry about the way the new Rules will be followed. These new Rules are much more complex than those that have been in force so far, which were quite clear: almost any printed document was a "publication" and a publication was nomenclaturally available, apart from the vexed issue of academic theses and a few other particular cases listed in Article 9. In contrast, the complexity of the new Rules will not be apparent to many "Sunday taxonomists" who simply "understood" that electronic publication of nomenclatural novelties have suddenly become easy and straightforward. We therefore strongly encourage editors and referees of online periodicals and books, confronted with submission of taxonomic manuscripts, to be particularly vigilant and to check that the new conditions for nomenclatural availability are all respected.

Actually, given the difficulties and risks described in detail above, the permission given to publish nomenclatural novelties in electronic-only periodicals and books is a bold step. The future will show whether the publishers of such publications will adopt these new regulations, but, in the light of recent experience we can only hope for the best. As shown above, the lack of attention to a single criterion of availability can be enough to nullify the publication of a nomenclatural novelty. The safest way to avoid this possibility, in the coming years at least, may be to avoid publishing nomenclatural novelties online, and to publish them on paper in the traditional way. Besides, this would offer other advantages. These "major" electronic journals, which often seem to show disdain for or neglect of taxonomy, clearly lack editors with particular competence regarding taxonomic and nomenclatural matters, and sometimes fail to have the manuscripts that include such data reviewed by appropriate referees—as is shown in Appendix 1 by the variety of nomenclatural problems encountered in BMC periodicals, in addition to the

33. For justification of the use of the term "*series*" instead of "*group*" (English text) or "*niveau*" (French text), as used inconsistently in the two versions of the *Code* (although these are stated by Article 86.2 to be "*equivalent in force, meaning and authority*"), see Dubois (2000: 40, 2011*a*: 19).

extra problems posed by online publication. The fact, documented in Appendix 1 below, that one year after publication of the 2012 amendment, BMC periodicals still continue to publish new nomina that are unavailable for having been published in e-works not preregistered in *ZooBank*, is quite discouraging in this respect. And this is all the more striking that BMC is an important and wealthy publisher which would largely have, if it was really interested in respecting the *Code* in its publications, easily the means of hiring competent people to avoid such problems. So what will be the situation in other electronic journals published by more modest publishers? Thus, submitting a paper including taxonomic or nomenclatural novelties to at least some online journals carries a risk, as there is no assurance that it will be sufficiently reviewed to avert a need for republication.

This does not mean, of course, that taxonomists should not publish in such journals: they should do so when they are authors or co-authors of works dealing with phylogeny, evolution, ecology, behaviour, etc., all research domains in which taxonomists are often involved. But when it comes to publishing the taxonomic and nomenclatural consequences of such research, and especially nomenclatural novelties, these should rather be published separately, in journals specialised and competent in taxonomy and nomenclature. This "split" would be no more shocking than the current "split" between the "noble" part of articles, printed on paper or immediately available online, and their "supporting" or "dismissible" taxonomic part, often relegated to online supplements that the reader must download separately, and which may escape his/her attention.

Many of those who publish phylogenetic trees need to learn taxonomy and nomenclature first so that they can design their sample in such a way that they produce meaningful results, e.g. by screening specimens of the type species of each generic nomen involved in the survey (including those currently considered invalid subjective synonyms). Then we might see pertinent analysis of the results with conclusions that are meaningful for practicing taxonomists and other co-workers. Furthermore, phylogenetic trees are only hypotheses and are not the only information on which taxonomic decisions must be taken. Thus we would prefer to see such studies published within journals that deal with systematics for their speciality and not with the generality of phylogenetics.

Another advantage of this "split" is that it would reduce the number of authors of the taxonomic and nomenclatural part of the study to the persons who were actually involved in the conception and writing of this part of the work, thus taking account of Recommendation 50A of the *Code*. This would be most welcome at a time when lists of authors of new taxa seem to increase considerably, producing clumsy nominal-complexes (nomen + author + date; Dubois 2000) that may occupy more than one line in a paper and in any resultant checklist. Long lists of authors are a real problem in biology. Let us remember that, according to Recommendation 51A of the *Code*, the complete nominal-complex should be cited in full at least once in any paper mentioning a nomen. This is not just a nuisance when it results in citing nomina like *Vandijkophrynus* Frost, Grant, Faivovich, Bain, Haas, Haddad, de Sá, Channing, Wilkinson, Donnellan, Raxworthy, Campbell, Blotto, Moler, Drewes, Nussbaum, Lynch, Green & Wheeler, 2006. It is likely to cause truncation of the nominal-complex in many cases. And it is certainly the case that few of these 19 names should be listed if Recommendation 50A were followed. Authorships reduced to a few names, preferably one to three, or at most four or five, should definitely be preferred[34]. Complex authorships that fit into each other, such as "X, Y & Z *in* "A, B, C, Z & Y, 1995", which is likely to be abbreviated by some into "X, Y & Z, 1995", are also a potential cause for difficulties. This is not only for reasons of length and palatability, but mostly because authorship and date provide in fact a shortened bibliographic reference to a work and should therefore be easy to find in bibliographic databases, which becomes more difficult when shortened or abbreviated authorship is used[35] (for details see Ng 1994). All these bad practices are so to say concentrated in the

34. Some authors (Ng 1994; Dubois & Raffaëlli 2009; Dubois 2010*f*, 2011*a*) have also argued that nomina themselves should be as short and euphonious as possible, containing preferably not more than 8–12 letters arranged in not more than 4–5 syllables. Longer nomina are not only unpalatable, but tend to be replaced in some publications by abbreviations (such as "Bd" for *Batrachochytrium dendrobatidis*), which points to a misunderstanding of the nature of binominal nomenclature: whereas the abbreviation "Bd" could point to thousands of animal species, no one has ever found useful to use the abbreviations "Mm" for *Mus musculus* or "Xl" for *Xenopus laevis*, because these binomina are short and simple.

35. The problem is not too severe when the first author remains the same: e.g., *Morerella* Rödel, Kosuch, Grafe, Boistel & Veith *in* Rödel, Kosuch, Grafe, Boistel, Assemian, Kouamé, Tohé, Gourène, Perret, Henle, Tafforeau, Pollet & Veith, 2009, which could be shortened as *Morerella* Rödel, Kosuch, Grafe, Boistel & Veith, 2009 or *Morerella* Rödel *et al*., 2009. But when the first author is different, the original reference may be difficult to find in any bibliographic database if searched by the name of its first author: e.g., **MANTOPHASMATODEA** Zompro, Klass, Kristensen & Adis *in* Klass, Zompro, Kristensen & Adis, 2002, which could be shortened as **MANTOPHASMATODEA** Zompro, Klass, Kristensen & Adis or **MANTOPHASMATODEA** Zompro *et al*., 2002.

recent fungus nomen *Batrachochytrium salamandrivorans* Martel, Blooi, Bossuyt & Pasmans *in* Martel, Spitzen-van der Sluijs, Blooi, Bert, Ducatelle, Fisher, Woeltjes, Bosman, Chiers, Bossuyt & Pasmans, 2013, which appears as a textbook case illustrating the misunderstanding of the role of nomina and nominal-complexes in biological publications: nomina are just labels, and as such they should be short and simple.

Nomenclature, taxonomy, and even biology as a whole, would have much to gain from the deliberate separation between taxonomic papers (published in journals specialised in taxonomy) and other papers, even when the latter may be the source of information ultimately used in taxonomy. The best in such cases is to publish the taxonomic-nomenclatural work first, and to quote the new nomina in the non-taxonomic paper. If the latter is published first, the new taxa may be designated there by numbers or letters (e.g., "sp. A", "sp. 1"), and these designations may be referred to in the subsequent taxonomic work, a practice that is already quite widespread in the literature.

In conclusion, zootaxonomists should be aware of these problems, and should scrutinise the conditions in which new nomina and nomenclatural acts were or are published online, not only before 2012 but even after 2011, to check if they comply with the *Code*.

Publishers

As shown above and in Appendix 1, e-publishers who decide to publish works containing taxonomic and nomenclatural information sometimes lack an understanding of some of the basic concepts and regulations of these disciplines. As they continue to act in these domains, it is crucial that they realise that they have a responsibility to improve this situation, or their authors will increasingly go elsewhere if their nomenclatural novelties are not made properly available.

From 19 February 2001 (publication date of the first issue of *BMC evolutionary Biology*) to 30 September 2013, 101 zoological nomenclatural novelties (97 nomina, 4 nomenclatural acts), i.e. 95.3 % of a total of 106 nomenclatural novelties published in BMC periodicals, did not meet the conditions for nomenclatural availability, and other numerous other cases exist in other online journals such as PLoS periodicals, *Palaeontologica electronica* or the *European Journal of Taxonomy* (Appendix 1). These unavailable nomina cannot be used as valid to designate taxa in zoological taxonomy and thus are invalid in all other branches of biology as well, and the nomenclatural acts at stake are null and void. This situation is unwieldy and problematic and should be remedied. What would be the best solution?

Some might argue that the Commission should be called for help and should use its Plenary Powers to provide nomenclatural availability to all the nomina at stake, published in various online periodicals. We do not support this idea. First of all, if this action had to be taken, it would have been at the time when the Commission published the 2012 amendment, in order to "reset the counters to zero" regarding the nomenclatural works published online between 1999 and 2012. Second, we think such an action would be an encouragement to publishers, editors and authors for bad quality taxonomic and nomenclatural work. The Commission has already made a much too frequent use of its Plenary Powers in recent decades to "validate" the mistakes of individual zoologists through the "suppression" (invalidation) of senior synonyms that had been ignored because of "hurried" work. It has gone as far as doing so in some cases where the invalid junior synonym had been used less than 15 times since 1758 (see e.g. Dubois 2005: 426; 2010*c*: 85). In so doing the Commission has shown little respect for its own work and for the Rules of the *Code*.

In the present case, the responsibility for the mistakes and potential mistakes we describe must be shared. The main burden must be borne by the publishers—especially, but not only, those involved in e-publication—because they have failed to keep in step with the Rules of the science on which they publish. We suspect that many editors do not possess a copy of the *Code* or even access it on the Commission's website. It may be argued that publishers have not met their responsibility when they publish papers that leave their authors with the need to publish again. As demonstrated by Appendix 1, there will need to be a serious effort to regain an appropriate level of competence deserving of the trust to authors. We return to this topic below.

The authors must share the responsibility too: if they choose to engage in taxonomy and nomenclature they should know the Rules (although often they have been failed by their teachers). And, of course, the Commission must share responsibility because of the incomplete or unclear wording of some of the Articles published in 1999

and 2012.

When someone is responsible for an error or nuisance, it is his/her duty to repair it at his/her own expense. We therefore suggest that, in order to clarify the awkward situation caused by their online publication of unavailable nomenclatural novelties, all the e-periodicals involved in such situations should contact the authors of the relevant papers and propose them the publication of new papers regularising the situation, as was done by the journal *Science* in the case of *Hyposmocoma molluscivora* (Rubinoff & Haynes 2005, 2006). These papers should be published as soon as possible, either on paper or online but then complying with the 2012 amendment of the *Code* concerning the availability of publications. For e-journals that are responsible for several such cases, the best might be to group all these papers in a single issue, which could start with an editorial explaining the situation and apologising to the authors and users of the works for the inconvenience. Of course, all these papers should be published free of charge for the authors. Another alternative solution, such as the publication of all these corrections in another periodical not involved in the errors, although technically possible and nomenclaturally acceptable, should be at the expense of the original journals, at least in the sense that they would no longer be cited as the original source of the new nomina.

Secondly, these e-publishers should take all the necessary steps to avoid the repetition of such problems. In particular, they should adapt their publishing policy to the specific requirements of scientific disciplines including that of zoological nomenclature, not only by following the new Articles of the *Code* about preregistration of publications, but also in reconsidering and perhaps refraining from applying to such works some of their recent practices, such as online prepublication of works containing nomenclatural novelties or relegation of these novelties to "online supplementary material" or to subsequent online "formal corrections" devoid of nomenclatural availability. If they fail to do so, their lack of competence will steadily become clearer to the community of active taxonomists at large and they will be avoided. Other journals exist or will exist that can or will facilitate the proper publication of such works.

Particular attention should be given to the practice described above of "publishing" on the websites of e-periodicals subsequent comments, additions and "formal corrections" to works they previously published. This practice belongs to what can be called a "culture of updates", a culture which is progressively overrunning our society, particularly in all domains that have to do with computers and electronic communication. In these domains, more and more tools and products tend to become labile, existing for a short while only to be replaced by "updates" or "new versions". Many such updates are downloaded automatically every day on computers as soon as they are connected with the Internet. There may be several reasons for such practices, from real progress in the tools to pure commercial practices, trying to impose on customers the "need" to buy new products regularly rather than keeping them for years or decades or repairing them (the well-known commercial practice of "*planned obsolescence*"). The idea that a publication is not a final, permanent and fixed product that can be referred to for decades or centuries, but is instead an ephemeral product that can be changed, corrected, updated, indefinitely, is very far from the academic world and belongs in a separate, much less professional "culture". This is not evidence of well-thought, careful progress in knowledge dissemination where publication and retention are made through identified steps that follow each other without erasing the preceding one, so that they can be reconstructed and analysed in a historical perspective. It is instead part of a culture of immediate gratification, of instant communication and of permanent change in the information. It is not suited to a culture in which hypotheses compete. It is a short-term culture of Internet which has in fact more to do with entertainment, publicity, news and provisional information than with science. Scientific periodicals should be very careful not to become similar to "forums", blogs or other websites accessible to all without any editorial control, often involving the mere statement of unsubstantiated "opinions" by unidentified persons signing with "usernames". By contrast, genuine scientific work are based on a rational approach and on a repeatable and refutable methodology, and signed by scientists who assume responsibility for the content.

We provide below in Appendix 2 an additional discussion about a few other problems related to e-publications, particularly regarding the discipline of taxonomy.

Libraries

Libraries should play their part in a concerted action in favour of a consistent, reliable and stable nomenclature of animal taxa. This requires their keeping, securing and indexing all the documents they receive or received,

including preprints and separates of taxonomic papers, facsimiles of online published works, and optical discs. This indexing should include as many details as possible, especially concerning the precise dates on which these documents were received (and if possible mailed, information that often appears on the envelope of the mailing).

They should also care for the long-term conservation of the content of documents received in the form of optical discs, in view of the fact that the latter have a short or very short life. This content should be saved under another, more persistent format.

The Code *and the Commission*

The decision of the Commission to implement new Rules for the nomenclatural availability of publications was taken after a large international discussion in which different opinions were expressed. It would be futile and unproductive to come back to this discussion now, but a few reflections are in order.

Changes in the zoological *Code*, unlike those in the botanical one, are not taken democratically in international scientific congresses, as they once were, but through the vote of a small group of non-elected but co-opted individual zoologists[36], but, unless and until this system is changed (Dubois 2011*a*), such decisions should be followed by all practicing zootaxonomists. Not doing so would increase the pain through growing nomenclatural confusion. Whether the decision taken was the best possible is questionable, and will be seen in the coming years and decades. But Codes are conventions, and no Code can be perfect, as they must perform a compromise between different problems and situations coming from the past, the present and the (uncertain) future. There have been rather numerous changes in the zoological *Code* in the recent decades, some of which were clearly unfortunate (see above and Dubois 2010*b*, 2011*a*), but it could be even worse to change yet again, and perhaps again, Rules that have been recently modified, as no taxonomist could follow an unstable and unpredictable *Code*. The recent inconsistent changes concerning publications on optical discs (see Table 1) are an example of modification that was clearly decided too rapidly, and every effort should be made to avoid this. So we think the new 2012 amendment to the *Code*, even if imperfect, should now be accepted and followed by all zootaxonomists. Let us just hope that the problems we have identified do not result in chaos in zoological nomenclature.

Despite these general comments, we suggest that Articles 8.4.1 and 9.12 of the current *Code* should be modified in order to clarify the distinction between paper-printed publications and facsimiles: above we provided suggestions in this respect.

In fact, most of the problems outlined here originate from a basic change in the *Code* concerning the kind of evidence used to ascertain the availability of nomenclatural novelties. Until the 1999 *Code*, most of the criteria in use were *intrinsic* to the publication. The compliance to such criteria (existence of a paper-printed publication, explicit intention to establish a new nomen, diagnosis or description, designation of onomatophore, etc.) could be assessed directly through studying the publication itself. A single important piece of information had sometimes to be sought from *extrinsic* sources: the publication date. The new Rules concerning electronic publication are quite different, because they require finding, or in some cases checking, several pieces of information from extrinsic sources, such as registration in *ZooBank*, presence of ISSN/ISBN or identification of the "final" version of a work published online and of its actual distribution date. This cannot in the least be considered as a progress, as it makes the work of taxonomists longer, more cumbersome[37], and sometimes the results remain nevertheless uncertain (as shown by several examples in Appendix 1). If one of our aims is really nomenclatural robustness, the number and importance of extrinsic factors should in contrary be reduced, but this seems difficult in e-publications, because of the many problems outlined above (existence of several successive versions of works with different dates of online accessibility, additional information provided in "supplementary" or "subsequent" documents, etc.). If one adds to these problems the low nomenclatural culture of many, amateur but also professional, taxonomists, it is difficult to be very optimistic regarding the number of errors, misinterpretations or contentious cases which are likely to spread in taxonomic works, at least in the first years after the 2012 amendment. Particular attention will have to put in examining the compliance of works with the new Rules.

36. Some of whom are also publishers or editors of commercial periodicals, which in some cases may raise concerns about the possibility of conflicts of interest.
37. And sometimes more time-consuming and costly, especially in countries where Internet access is not straightforward and cheap (see Funk *et al.* 2005).

The weaknesses of several of the recent decisions of the Commission outlined above do not encourage considering the latter as an infallible body unlikely to make mistakes, sometimes even severe ones. The weaknesses of *ZooBank* pointed out here (difficult finding of ISSNs and of registration dates; possible disappearance of some registered information from the application) go in the same direction. These facts suggest that the new Article 8.6 of the 2012 amendment is highly questionable, as it amounts to giving the Commission carte blanche for new decisions in this domain of the availability of publications where it has not shown a particular competence and clear-sightedness in recent decades. In this domain like in others, the fact that such important decisions can be left in the hands of a small group of self-recruited zootaxonomists, editors and computer-scientists is past its time, and well conceived changes in the decision-making process regarding modifications in the *Code* should be seriously considered (for more detailed proposals, see e.g. Dubois 2011*a*).

As we have seen, since the beginning of this century, electronic publications have been at the root of repeated nomenclatural problems, resulting in the introduction in the taxonomic literature of a number of unavailable nomina. What should be done regarding these nomina? We have suggested above that their regularisation should be at the expense of the periodicals that published them. We think this would have a pedagogical and dissuasive function, and could avoid or minimise the repetition of such errors. We do not support the alternative of asking the Commission to erase all these mistakes as if by magic, as we think this would send the wrong message to the community. Furthermore, such a solution would apply only to the well-known cases and problems, i.e., presumably those published in a few "major" journals, but others would remain unnoticed for various periods, and never-ending problems are likely to appear as long as rigorous application of the *Code* is not clearly stated to be the only Rule for all.

Some will probably argue that our point of view on this matter is unnecessarily "rigid", but we think it is only strict and that zoological nomenclature needs to be followed thoroughly as otherwise arbitrariness and confusion soon follow. As zoological nomenclature concerns a very high number of nomina and acts, even a small error rate leads to high number of errors, and as for many zoological groups the number of working taxonomists is low, in such cases the time necessary for corrections and revisions may be long. The term *rigidity* applies, in our opinion, to the unnecessary and unjustified use of recent concepts and Rules of nomenclature to old zoological works, like those of de la Cepède in herpetology (for details see Dubois & Raffaëlli 2009: 26–27). We are hostile to "*a rigid application of the Rules to old, well-known zoological works*" (Bour & Dubois 1984), which serves to destabilise the field, but we are in favour of a *strict* application of the Rules to *recent* works, which promotes future stability. In recent decades, the Commission has not had a consistent attitude in this respect. In has shown unnecessary rigidity in some cases (the "suppression" of de la Cepède's works was in no way beneficial to zoological nomenclature and only had a disturbing effect on a nomenclatural stability that had existed more than two centuries) and unnecessary permissiveness in other cases (see e.g. Dubois 2005: 426, 2010*c*: 85): in both cases, it appears that the decisions may have been taken just to "please" some "important zoologists" rather than to serve "nomenclatural stability". We think a more balanced and reasonable attitude should be in order.

Krell (2009: 271) stated that the Commission has a double function and duty: "*First, it has been serving the scientific community by setting up guidelines and rules for naming animals (i.e., the International Code of Zoological Nomenclature). The second major duty of the [Commission] has been deciding upon cases in which following the Code would not serve the stability of nomenclature.*" We think a third function should be added here, that of "*Keeper of the Law*" (Dubois & Ohler 1997: 299). If the Commission itself does not respect its own Principles and Rules in its decision, it can hardly expect individual zoologists to do so, and nomenclatural reliability, universality and robustness will continue being regularly threatened.

Before September 2012, the Rules of the *Code* clearly excluded under Article 9.8 the possibility for electronic publications to be available according to the *Code*. As documented below in Appendix 1, some members of the Commission then played a role of "experts" for some electronic publishers. In order to strictly follow the *Code*, they should clearly have advised them to publish, beside the electronic version of their periodicals, a distinct paper-printed version, with its own ISSN, and complying with Article 8.1.2. But in fact they tried to invent awkward solutions to please these publishers, and they suggested them to deposit five isolated facsimiles of their PDFs in libraries, without providing the possibility for anyone else to obtain them free of charge or by purchase, as required by this Article. Is it the role of individual members the Commission to make personal interpretations of the *Code* in order to serve particular interests? The Rules should allow naming millions of organisms and applying millions of nomina in a single and strict way, in order to limit such shortcomings as those outlined here. The role of the

Commission is to work at a general, not particular, level, trying to take into account the possible future developments when devising changes in the Rules that are supposed to apply to numerous works and for a long time.

As any juridical text, the *Code* should be a clear and self-speaking document, that do not require "interpretations" or require very few of them, but can be followed *automatically* by all zootaxonomists worldwide, so that any two specialists working on both sides of the planet can come by themselves to the same solution regarding any nomenclatural problem, without having to consult each other or any "board", "commission" or "court". In this respect, the personal opinion of "commissioners" has no more weight, relevance or importance than that of any zoologists whenever competing "interpretations" of some Articles of the *Code* are at stake (see e.g. Dubois & Nemésio 2007). If an Article of the *Code* is unclear enough to allow several incompatible interpretations, it is deficient and should be replaced by a new wording, but there is no justification in calling on members of the Commission to play the role of "referees" or "magistrates" in unclear situations for which they were in fact responsible[38].

Conclusions and recommendations

Taxonomy is currently facing a very particular and sensitive stage of its centennial history. The development of new concepts, technologies and tools has resulted in a renewal of the theoretical and practical bases of the discipline. The rapid and massive progress in nucleic acid sequencing often entails basic modifications in classifications, with recognition of many new taxa and the need to name them properly. The nomenclatural consequences of such taxonomic decisions have no guarantee of being long-lasting, as, quite often, phylogenetic hypotheses change from white to black with new studies, sometimes simply following the addition or deletion of one or a few terminal taxa or genes, or methodological changes in sequence alignment or tree construction. In this quite unstable situation, which is likely to last for decades if not longer, if the naming process is done without care and method, the resulting nomenclatural confusion will hamper considerably the international communication between biologists. It is more than time for biological, and particularly zoological, nomenclature, to leave the Stone Age, to abandon the "principle of authority" which it has largely followed so far and to adopt and follow clear, stringent and universal Rules, in order to become really professional (Dubois 2011*a*). This includes the need to have precise and drastic Rules for the availability of new nomina and nomenclatural acts.

The e-publication of new nomina is a further step in the direction of speeding up their availability, a step often seen as of paramount importance for taxonomy (see e.g. Polaszek 2010). Taxonomists have been criticised for the lack of speed in which biodiversity is being described, resulting from the taxonomic impediment (Anonymous 1994). But this situation only reflects the lack of support (institutional, financial, collegial) to the discipline of taxonomy. Taxonomists are not increasing in numbers (Tancoigne & Dubois 2013) even though they have never been more in demand, and the taxonomic expertise is, at best, stagnating. The new historical situation that results from the combination of the *biodiversity crisis* (Wilson 1985) and the *taxonomic gap* (Dubois 2010*d*) qualifies as a new paradigm for biology, the *taxonomic urgency* (Wheeler *et al.*, 2004; Dubois 2010*d–e*). It requires a strong acceleration of the field and laboratory work of exploration, study, description and naming of the species of the globe, in order to reduce as much as possible the risk of losing forever precious and irreplaceable pieces of information in many domains (Reaka-Kudla *et al.* 1997). Millions or dozens of millions of species are still awaiting discovery, collection, study and description, and, if the current *inertia* of the international scientific community in

38. In fact many decisions of the Commission are not taken unanimously but on the basis of majority. This was the case of the 2012 amendment, for which there were only 23 favorable votes among 27 voters (Anonymous 2012*d*: 169). This information is important, as it shows that there was no unanimity in the community of zootaxonomists in favour of this amendment. The quantitative difference between those in its favour and the others is irrelevant because the composition of the Commission does not reflect that of the international community of taxonomists (for details see Dubois 2010*a*), as new members of the Commission are not elected but co-opted, a system in which the majority tends to reinforce itself, or at least to avoid risking to challenge its power. So it is unknown what would have been the proportion of zootaxonomists supporting the amendment if the whole community had been given the opportunity to vote on this matter. The results of the votes obtained on this question at the meeting organised on 29 November 2007 by the Linnean Society of London (Hawksworth 2009; Dubois 2010*a*) suggest that the proportions of both positions might have been much closer to each other than those obtained in the microcosm of the Commission.

front of this urgency (Tancoigne & Dubois 2013) is not quickly overcome, many of them will turn extinct in our century before having been so (González-Oreja 2008). But the current *taxonomy crisis* (Dubois 2003*a*) makes this challenge particularly difficult to meet.

Several recent publications (e.g., Dayrat 2005; Padial *et al*. 2010; Vences *et al.* 2013) have been devoted to the methodological problems of taxonomy, whether conceptual (e.g., the quest for the "unified species concept", or nomenclatural questions) or technological (molecular techniques, databases, electronic communication, cyber-taxonomy, georeferencing, etc.), and the term "*integrative taxonomy*" has become fashionable. Although, as pointed out by Valdecasas *et al.* (2008: 211), "*taxonomy has been integrative for most of its history*", these reflections and proposals are certainly useful, but they fail to address the core problems of the taxonomic impediment, which are (1) the considerable manpower shortage of taxonomy and (2) the many barriers put to the collection of specimens in natural habitats in many parts of the world. Thus doing, they rather appear to be the search for "magical solutions" and they will not be sufficient to solve the problem of the taxonomic urgency (Wheeler 2004; de Carvalho *et al.* 2005, 2007, 2008; Crisci 2006*a–b*; Valdecasas *et al.* 2008; Dubois 2010*b*; Boero 2010). The "*triumvirate adjoining a unitary taxonomic cyberstructure + automated DNA barcoding + molecular phylogeny*" has been qualified as "*a threefold myopia*" (de Carvalho *et al.* 2008).

Even if optimistic views on this matter have been recently expressed (Wheeler *et al.* 2012), it is doubtless that "*collecting new species in the field will remain the rate-limiting step*" for the inventory of biodiversity (May 2004), more precisely "*speciodiversity*": most still unkown and undescribed species are in the vanishing tropical forests and other threatened habitats (savannahs, mountains, rivers, lakes, marshes) of the whole planet, especially of the "South", and in the oceans, not in the laboratories, sequencers or computers of our cities, especially of the "North". No "technical solution" will bring these species from the field to the laboratories, even as nucleic acid sequences for barcoding analysis. In order to face the taxonomic urgency, more than "miracle solutions" (mostly based on technology instead of manpower), taxonomy requires a strong increase in the active field, and subsequent laboratory, work by competent taxonomists worldwide. This requires (1) important increase in the number of positions of professional taxonomists (i.e., salaries), especially in the countries of the "South"; (2) high quality theoretical training in taxonomy, including nomenclature; (3) reduction of regulatory impediments on scientific collecting, as highlighted in the "*Buffon Declaration*" (Anonymous 2008*b*); (4) massive funds allocated to field work; (5) permanent support to institutional collections of specimens (Dubois 2010*c*); (6) appropriate funding of taxonomic revisions and publications; and (7) above all, "*recognition as a robust science by peers and policy-makers, without which taxonomy itself may fall victim to extinction*" (de Carvalho *et al.* 2005).

Electronic publication has been touted as one of the solutions to the taxonomic impediment, but *good taxonomy is not fast taxonomy.* Developing e-publication is important, but only if measures are in place to support the discipline of taxonomy as a whole.

As we have seen, the shift from paper to online publication, which might appear to some at first as a simple matter, becomes quite problematic when nomenclatural aspects are taken into consideration. This is not because nomenclatural Rules would be "unnecessarily complex". Their complexity is unavoidable, as it results from the fact that the nomina of taxa are part of a corpus of millions of items, with a continuous history of more than 250 years, and are the indispensable keys for the access to the information about taxa and organisms stored in millions of publications: precise and stringent Rules are needed for the management of these nomina in order to avoid the inauguration of a chaos in which nobody would know what a given nomen means. If this is not properly managed, different nomina could be used for the same taxon or different taxa designated by the same nomen, which would impede, potentially very seriously, long term international communication about organisms among biologists and between them and the rest of the society.

Despite being newcomers in the field of taxonomic publications, and having been far from showing particular expertise in this field during the few years of their activity, some publishers and editors of electronic-only periodicals have considered themselves entitled to use a threatening tone to provide advice to taxonomists and a degree of arrogance to the Commission regarding the Rules of nomenclatural availability applied to online publications. We think taxonomists, who often have a much wider and longer experience in the field, are just as entitled to give advice to publishers and to the various other actors involved in the publication of nomenclatural novelties in zootaxonomy. The following recommendations summarise the outcomes of the discussions above.

Recommendations to authors, editors and referees

[R1] Before publication of a nomenclatural novelty (new nomen or nomenclatural act, such as first-reviser action, justified emendation, etc.), care should be taken to consult and follow the Rules and Recommendations of the *Code* in its most recent form, including the 2012 amendment published after the 1999 edition of this book.

[R2] A nomenclatural novelty (new nomen or nomenclatural act) is available only if published in a way that complies with the Rules of the *Code* for *publication availability*, i.e., either for paper publication following Articles 8.1 and 8.4 of the 2012 amendment of the *Code*, or for electronic publication following Articles 8.1 and 8.5 of this amendment. Works containing nomenclatural novelties should therefore never be submitted to or published in periodicals or books that do not clearly comply with these Rules. Authors should never accept that nomenclatural novelties in their papers be relegated to "online supporting information" of these papers, or added subsequently to the latter as online comments or "formal corrections", as such online documents are nomenclaturally unavailable.

[R3] Authorship of publications containing nomenclatural novelties, and particularly new nomina, should be short and preferably limited to one to three, or exceptionally four or five, authors, those who have indeed contributed to the *taxonomic and nomenclatural* part of a collective work that resulted in these nomenclatural novelties. Authorship of nomenclatural novelties, particularly new nomina, should preferably be concise, not fitting one within another (e.g., "X *in* Y"). Collective research works that contain both a non-taxonomic (e.g., phylogenetic, genetic, ethological, etc.) and a taxonomic part should preferably be split so that there are two (or more) publications, with different authorships but possibly the same title followed by a number or subtitle, whether or not they are published in the same periodical or not—which may be the case to follow recommendation **[R2]**. The new nomina should be published first in the taxonomic-nomenclatural work. If the non-taxonomic work is published first, the new taxa may be designated there by numbers or letters (e.g., "sp. A", "sp. 1"), and these designations may be referred to in the subsequent taxonomic work.

Recommendations to publishers

[R4] Publishers, including those that publish only online, should ensure all their papers containing nomenclatural novelties are read by specialised editors with mastery of the Rules of zoological nomenclature. If possible, they should hire competent nomenclature editors for the careful reading of all their papers from the strict point of view of nomenclatural availability, allocation, validity and accuracy.

[R5] Publishers who since 2000 have published works containing nomenclatural novelties that do not comply with the Rules of the *Code* for publication availability (e.g., for being in electronic-only form before 2012) have betrayed the confidence of the authors who had entrusted their works to them for publication. They should repair this prejudice as soon as possible, by contacting all the authors of these works and offering them the opportunity to rapidly publish free of charge corrective papers similar to the paper of Rubinoff & Haines (2006) in *Science*.

[R6] Taxonomic papers including nomenclatural novelties should never be prepublished, either as preprints (nomenclaturally available, but that will then become the original edition of the works) or online prepublications (nomenclaturally unavailable, but carrying a risk of ethical problems in case the final publication occurs weeks or months later). There should be a single original publication, either printed on paper, or online following *ZooBank* registration, or both published on the same day.

[R7] The fact that an electronic document can be modified while keeping the same DOI is not compatible with the requirements of zoological nomenclature, and another system of registration of electronic documents as permanent and inalterable will have to be devised. In the meanwhile, electronic publishers should refrain to replace on their websites a PDF by another one bearing the same DOI and publication date. Subsequent modifications, corrections, additions or deletions from on original document should appear on a distinct document having a distinct DOI and publication date.

[R8] Publishers declining to follow recommendation **[R6]** and insisting on depositing preprints in libraries or in publishing online preliminary PDFs should keep track of these documents in their archives (ensuring access to them in case of need), even after publication of the final edited and formatted version of the work, and should always provide on their site information about the date on which they were prepublished.

[R9] Publishers and editors should not require authors to relegate the nomenclatural novelties in their papers to

"online supporting material" or subsequent online comments or "formal corrections" where they would not be nomenclaturally available—thus running the risk that the knowledgeable authors rightfully withdraw their manuscripts from the journal.

[R10] In the reference lists of both paper and online publications, we recommend that, from now on, a distinction be made between paper publications, online publications not having been preregistered in *ZooBank* before publication, and online publications having been preregistered in *ZooBank* (with their registration reference), and the actual and precise date of publication (distribution) of these documents be clearly indicated. The list of references below illustrates a possible way to do this.

Recommendations to libraries

[R11] Libraries which receive or have received from publishers facsimiles of PDFs published online, or optical discs containing such works, should keep track of (1) the date of reception of these documents (e.g., through stamping the reception date on the document itself), or (2) even better, the date of mailing of these documents by the publisher or printer (e.g., through archiving the envelope showing the post office stamping date, or the accompanying letter, in both cases stamped on the day of reception).

[R12] Such paper printed facsimiles or optical discs, which are isolated short documents and are usually not bound in volumes or fascicles, should be carefully archived and indexed in order to be easily found and provided upon request to potential users or persons or institutions enquiring about them.

[R13] Given the relatively ephemeral reliability of these supports, the contents of optical discs should be copied at regular intervals on new discs or other more perennial supports, after checking readability of files.

Recommendations concerning the Code*,* ZooBank *and the Commission*

[R14] The entries in *ZooBank* should provide easy and straightforward access to the ISSN numbers of periodicals and the date of their registration and this information should not be liable to be modified. Besides, the fact that some works that have purportedly been registered in *ZooBank* are missing on this web application clearly needs fixing. These improvements of *ZooBank* are the duty of the Commission, which currently assumes the responsibility of this application.

[R15] We think the Commission should be very careful about introducing further changes, particularly retroactive ones, in the Rules of nomenclatural availability of publications after those implemented in 2012. The repeated changes and proposals of changes in this respect during the period 1999–2012 (e.g., concerning optical discs) has led to instability and to misunderstanding in the community of taxonomists and users of taxonomic information, and further repetition of such changes would add further confusion to communication about organisms and taxa.

[R16] We make an exception to the previous recommendation regarding the Articles 8.4.1 and 9.12 of the current *Code*, which in our opinion should be improved. For reasons detailed above, we suggest that, starting on a date that remains to be fixed, but not retroactively, (1) to be considered as nomenclaturally available, a paper-printed work should either bear an ISSN/ISBN or/and be preregistered in *ZooBank*, and (2) it be recognised in the *Code* that paper-printed facsimiles or reproductions of unavailable electronic publications differ from genuine available publications through (2a) not being obtainable, when first issued, free of charge or by purchase, even if paper copies have been deposited in five major libraries or other archives; (2b1) having been directly printed from the PDF as provided on a publisher's website, bearing the same ISSN/ISBN as the latter or no such identifiers; and/or (2b2) not having been preregistered in *ZooBank* and/or missing evidence that this preregistration has occurred.

[R17] The Commission should insist upon a strict respect of the Rules concerning nomenclatural availability of works, including the new ones, and should not indulge in validating *a posteriori* errors made in this respect by publishers because of their superficial and partial consideration of the Rules, because so doing would send the message that these Rules are mere suggestions that can be followed or not without significant consequences. Even if this results in a few problems in the short run, this should limit the spread of such problems in the longer run.

[R18] However, should the new Rules prove to have dramatic consequences regarding the quality and

reliability of nomenclatural works, steps might have to be taken in due time to cancel these new Rules and to replace them by better ones. Despite the fact that the previous Rules, until the 1999 *Code*, where only paper publications were nomenclaturally available, had largely stood the test of time, being only minimally technology-dependent and as such much less fragile than are potentially electronic publications, communication and archiving, it is quite unlikely that scientific publication will come back to pre-electronic times. The best course of action will then be perfecting the *Code* to adapt to the new situation and cope with its problems, some of which are likely to appear only after a certain period of practice of the new Rules.

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Note. In this reference list, a work that has been first published under a paper version (whether accompanied by an online version bearing a different ISSN/ISBN, or not) is just cited without further mention, but a work that was first distributed as an online document is indicated as such, and additional information about it is provided at the end of the reference: (1) before 2012, whether paper printed facsimiles are known to have been deposited in five major libraries; (2) after 2011, whether the work was preregistered in *ZooBank* before online distribution, thus qualifying as an **online publication** available for zoological nomenclature, or not, thus qualifying as an **online document** unpublished in the sense of the zoological *Code*. The precise dates (day, month) given for some references between brackets after the year are those indicated on the PDF of the work itself, but may be different from the actual date of publication in the sense of the *Code* (see text for details).

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APPENDIX 1. NOMENCLATURAL PROBLEMS IN ONLINE PERIODICALS: THE BIOMED CENTRAL EXAMPLE AND A FEW OTHERS

BioMed Central and its publishing policy

The commercial scientific publishing company BioMed Central was founded in United Kingdom in 2000 as part of the Current Science Group (now Science Navigation Group). In 2008, it was acquired by Springer Science + Business Media, a major publisher in science, technology and medicine. A few BMC periodicals sporadically publish taxonomic papers, some of which include nomenclatural novelties, so it is important for taxonomists to know whether these publications are nomenclaturally available, i.e., before 2012, whether genuine autonomous paper versions of these works were published, and after 2011, if these periodicals followed the 2012 amendment of the *Code*.

Concerning the first question, the following information was available on 6 November 2012 in different parts of the site of this publisher [http://www.biomedcentral.com]:

> "*BioMed Central is an STM (Science, Technology and Medicine) publisher of 220 open access, online, peer-reviewed journals.* (…) *The original research articles in all journals published by BioMed Central are* open access. (…) *BioMed Central has taken steps to ensure that all open access articles published by BioMed Central are deposited in a number of safe* open access archives. (…) *All of BioMed Central's journals are online-only, available digitally and in PDF format.* (…) *BioMed Central publishes a number of journals, most of which are available only in electronic form. Some articles will occasionally be reproduced in special print editions and supplements.* (…) *Under the terms of BioMed Central's* open access charter*, all open access articles are made available and publicly accessible via the Internet without any restrictions or payment by the user. PDF versions of open access articles in BioMed Central are available for download and provide a convenient way for users to make printed copies themselves.* (…) *BioMed Central deposits the open access articles that it publishes in multiple digital archives around the world to guarantee long-term digital preservation.* (…) *A* ***hard copy version*** *of the full collection of original research papers published by BioMed Central is also available for purchase directly from our customer services department. For more information about this please* contact us."

As some pieces of information above seem to be contradictory, one of us (AD) followed the last advice and wrote on 6 November 2012 to the Customer Services of this publisher for enquiry. He soon received the following replies from Demitrakis Kavallierou, Customer Services Executive at BioMed Central:

> "*Thank you for contacting BioMed Central. I have now asked the Reprints Department to clarify how hard copies of journals can be purchased and what this entails. I can confirm that we do not publish hard copies of any of our journals. All of the journals within the BioMed Central catalogue are online only. Furthermore the journals that you refer to in your email are free to view without any subscription. Their content can also be downloaded and printed free of charge.*" (6 November 2012).

> "*As a follow up to my email yesterday, I would like to inform you that BioMed Central does not print any of journals/ articles unless we receive an actual order. When this occurs our Reprints Department assesses the order and then provides the customer with a price. However, it would always be much more cheaper* [sic] *and more efficient for any institution/customer to simply access the journal in question and print the articles that they require.*" (7 November 2012).

This information suggests that, until November 2012 at least, none of the online BMC journals published any paper version at the time of the electronic release of their issues or before. If this is true, all the nomenclatural novelties published until 2012 in these journals are unavailable for the purpose of zoological nomenclature: their electronic version is unavailable by virtue of Article 8.5.1, and no original paper copy of these periodicals was released complying with Article 8.1.2.

However, a survey of the BMC website showed that, in some cases, paper "copies" of the concerned papers were deposited in five libraries. Since, when contacted to inquire whether paper versions of works published by

BMC can be obtained, the reply from the publisher is clearly "No", such paper copies do not comply with the requirement of Article 8.1.2 and they do not qualify as available publications but as facsimiles which do no provide nomenclatural availability.

Tables 2 provides a list of 44 works that we found in several online-only BMC periodicals, where new zoological nomina and nomenclatural acts were published before October 2013, and Table 3 gives a list of these 106 nomenclatural novelties (102 new nomina, 4 nomenclatural acts). These lists are probably not exhaustive, because the search function in the BMC website is not convenient to find nomenclatural novelties. The 44 works were published in *BMC evolutionary Biology* (20 works), *Parasites & Vectors* (17 works), *Zoological Studies* (3 works), *Frontiers in Zoology* (2 works), *BMC Microbiology* (1 work) and *BMC Research Notes* (1 work). The 102 new nomina appearing in these texts fall into four categories regarding their nomenclatural availability: (1) 73 nomina (71.6 %) are unavailable for having been published only online before 2012 (including 20 for which no paper facsimiles were deposited in libraries, 42 for which facsimiles were found to have been deposited in one library at least, and 11 for which no facsimiles were found in a library where they were supposed to have been deposited); (2) 4 nomina (3.9 %) are unavailable both for the previous and for other reasons (see text below); (3) 20 nomina (19.6 %) were published after the publication of the 2012 amendment but did not follow its prescriptions; and (4) only 5 nomina (4.9 %) were clearly made available under the 2012 amendment of the *Code.* The 4 nomenclatural acts (lectotype designations), published in 2013, are also unavailable for having been published in works that appear not to have been preregistered in *ZooBank* before publication (see below for more details). So altogether, of the 106 nomenclatural novelties at stake, 101, i.e. 95.3 %, are unavailable. In order to fully understand these matters, a careful analysis of all these cases is necessary, but let us consider first a few other questions.

TABLE 2. A list of 44 works containing new zoological nomina and nomenclatural acts published online in BMC periodicals from 19 February 2001 to 30 September 2013. The new nomina belong in the four higher nominal-series (name groups of the *Code*) recognized by Dubois (2000, 2006*a*): species-, genus-, family- and class-series. **NP**: number of publication (by chronological order of online publication). **NRT**: number and ranks of new taxa, or new nomenclatural acts: F, familia; G, genus; S, species; sF, subfamilia; sS, subspecies; T, tribus; U, unranked "higher taxon"; LD, lectotype designation. **DPF**: deposition of paper facsimiles in five libraries announced in the online publication: N, no; P, yes, in various libraries including the Paris Museum library; V, yes, in various libraries but not in Paris. **MPM**: shelf mark of the paper facsimile in the Paris Museum library (Paris Museum mark / SUDOC mark). **ZBR**: *ZooBank* preregistration of work (made before online publication). **DPR**: date (day.month.year) of online prepublication of unformatted, unedited work, as stated in the work. **EDP**: earliest date known (day.month.year) of existence of the online formatted, edited work. **DDF**: date (day.month.year) of deposition of paper facsimile in the Paris Museum library; a simple date means that a facsimile exists in the Paris Museum library, accompanied by evidence about the date of its mailing to this institution; "NA" means that no deposition of facsimiles in libraries was announced in the online publication; "Unseen" means that a facsimile deposition was announced in the online publication but that no evidence of its existence was found in the Paris Museum library; "DDU" means that a paper facsimile was seen by us in the Paris Museum library, but its deposition date is unknown. **Categories of availability of work**: AWR, work available through statement of *ZooBank* preregistration; UFC, work unavailable through online publication, despite deposition of facsimiles in five libraries announced in the publication, confirmed in the Paris Museum library; UFD, work unavailable through online publication, despite deposition of facsimiles in five libraries not announced in the publication, but discovered in the Paris Museum library; UFU, work unavailable through online publication, despite supposed deposition of facsimiles in five libraries announced in the publication, unconfirmed in the Paris Museum library; UMR, work unavailable through online publication after 2011 but without statement of *ZooBank* preregistration; UOO, work unavailable through online-only publication before 2012. The rows of unavailable works are on a white background, those of works available for nomenclatural purposes on a light grey background.

NP	Reference	Periodical	Higher group	NRT	DPF	MPM	ZBR	DPR	EDP	DDF	Availability
Works published before 4 September 2012											
1	Andriaholiniriana *et al.* 2006	*BMC evolutionary Biology*	**MAMMALIA**	3 S	N	None	No	23.02.06	Unknown	NA	UOO
2	Herrmann *et al.* 2006	*Frontiers in Zoology*	**NEMATODA**	4 S	N	None	No	12.09.06	Unknown	NA	UOO
3	Craul *et al.* 2007	*BMC evolutionary Biology*	**MAMMALIA**	2 S	N	None	No	31.05.07	Unknown	NA	UOO
4	Stöck *et al.* 2008	*BMC evolutionary Biology*	**AMPHIBIA**	1 S	N	CINZ 2 / PPN 145481816	No	23.02.08	Unknown	NA + DDU	UFD
5	Lecompte *et al.* 2008	*BMC evolutionary Biology*	**MAMMALIA**	5 T	N	None	No	10.07.08	Unknown	NA	UOO
6	Poinar 2008	*Parasites & Vectors*	**DIPTERA**	1 S	N	None	No	15.07.08	Unknown	NA	UOO
6	Poinar 2008	*Parasites & Vectors*	**PROTOZOA**	1 S	N	None	No	15.07.08	Unknown	NA	UOO
7	Chantangsi *et al.* 2008	*BMC Microbiology*	**PROTOZOA**	1 G, 1 S	N	None	No	22.07.08	Unknown	NA	UOO
8	Giraldo *et al.* 2008	*BMC evolutionary Biology*	**LEPIDOPTERA**	1 sS	V	None	No	28.11.08	Unknown	Unseen	UFU
9	Zaldívar-Riverón *et al.* 2008	*BMC evolutionary Biology*	**HYMENOPTERA**	1 T	N	None	No	04.12.08	Unknown	NA	UOO
10	Depaquit et al. 2009	*Parasites & Vectors*	**DIPTERA**	1 S	P	Not found	No	08.01.09	Unknown	Unseen	UFU
11	Vilela *et al.* 2009	*BMC evolutionary Biology*	**MAMMALIA**	1 sF	N	None	No	03.02.09	Unknown	NA	UOO
12	Poinar 2009	*Parasites & Vectors*	**ISOPTERA**	1 S	P	CINZ 6 / PPN 145483347	No	18.02.09	28.04.09	28.04.09	UFC
12	Poinar 2009	*Parasites & Vectors*	**PROTOZOA**	10 G, 11 S	P	CINZ 6 / PPN 145483347	No	18.02.09	28.04.09	28.04.09	UFC
13	Andrade Filho *et al.* 2009	*Parasites & Vectors*	**DIPTERA**	1 S	P	CINZ 1 / PPN 145359387	No	14.05.09	12.06.09	12.06.09	UFC
14	Freeman & Sommerville 2010	*Parasites & Vectors*	**PROTOZOA**	1 G, 1 S	P	CINZ 3 / PPN 145371654	No	27.11.09	15.01.10	15.01.10	UFC
15	Biju *et al.* 2009	*BMC Research Notes*	**AMPHIBIA**	2 G, 1 S	P	CINZ 4 / PPN 14547903X	No	07.12.09	Unknown	DDU	UFC
16	Traversa 2010	*Parasites & Vectors*	**PROTOZOA**	1 S	P	CINZ 5 / PPN 145484548	No	25.03.10	Unknown	DDU	UFC
17	Haug *et al.* 2010	*BMC evolutionary Biology*	**CRUSTACEA**	1 U	N	None	No	21.09.10	Unknown	NA	UOO
18	Zhao *et al.* 2010	*BMC evolutionary Biology*	**DERMAPTERA**	1 F, 1 G, 2 S	P	CINZ 7 / PPN 148617344	No	10.11.10	Unknown	DDU	UFC
19	Malm & Johanson 2011	*BMC evolutionary Biology*	**TRICHOPTERA**	1 S	P	CINZ 8 / PPN 149766483	No	12.01.11	Unknown	DDU	UFC
20	Paladini *et al.* 2011	*Parasites & Vectors*	**PLATYHELMINTHES**	1 S	P	CINZ 10 / PPN 154214116	No	09.06.11	Unknown	DDU	UFC
21	Bargues *et al.* 2011	*Parasites & Vectors*	**MOLLUSCA**	1 S	P	CINZ 13 / PPN 157988406	No	12.07.11	Unknown	DDU	UFC
22	Carvalho *et al.* 2011	*Parasites & Vectors*	**DIPTERA**	1 S	P	Not found	No	09.08.11	Unknown	Unseen	UFU
23	Béthoux *et al.* 2011	*BMC evolutionary Biology*	**PLECOPTERA**	1 F, 1 G, 1 S	V	None	No	31.08.11	Unknown	Unseen	UFU
24	Freeman & Shinn 2011	*Parasites & Vectors*	**CNIDARIA**	1 S	P	Not found	No	24.11.11	Unknown	Unseen	UFU
25	Poinar 2011	*Parasites & Vectors*	**PROTOZOA**	1 G, 1 S	P	CINZ 12 / PPN 157709493	No	07.12.11	Unknown	DDU	UFC
26	Poinar 2012	*Parasites & Vectors*	**NEMATODA**	1 S	P	Not found	No	01.02.12	Unknown	Unseen	UFU
27	Yamaguchi *et al.* 2012	*BMC evolutionary Biology*	**PROTOZOA**	1 G, 1 S	P	CINZ 15 / no PPN	No	08.03.12	Unknown	DDU	UFC
28	Tan *et al.* 2012	*BMC evolutionary Biology*	**COLEOPTERA**	1 G, 4 S, 1 T	P	None	No	09.07.12	16.12.12	14.01.13	UFC
29	Fregin *et al.* 2012	*BMC evolutionary Biology*	**AVES**	3 F	N	None	Yes	25.08.12	Unknown	NA	AWR
Works published after 3 September 2012											
30	Poinar & Steenberg 2012	*Parasites & Vectors*	**NEMATODA**	1 S	P	CINZ 17 / no PPN	No	01.10.12	Unknown	Unseen	UFC + UMR
31	Johnson *et al.* 2013	*BMC evolutionary Biology*	**MOLLUSCA**	1 S	N	None	Yes	24.01.13	Unknown	NA	AWR
32	Bilandžija *et al.* 2013	*Frontiers in Zoology*	**MOLLUSCA**	2 S	N	None	No	06.02.13	Unknown	NA	UMR
33	Freeman *et al.* 2013	*Parasites & Vectors*	**PROTOZOA**	1 S	N	None	Yes	27.02.13	Unknown	NA	AWR
34	Thompson *et al.* 2013	*Parasites & Vectors*	**PROTOZOA**	1 S	N	None	No	26.04.13	Unknown	NA	UMR
35	Pyron *et al.* 2013	*BMC evolutionary Biology*	**SQUAMATA**	1 sF	N	None	No	29.04.13	Unknown	NA	UMR
36	Lamsdell & Selden 2013	*BMC evolutionary Biology*	**ARTHROPODA**	1 F, 1 S	N	None	No	10.05.13	Unknown	NA	UMR
37	Stein *et al.* 2013	*BMC evolutionary Biology*	**ARTHROPODA**	1 G, 1 S	N	None	No	11.05.13	Unknown	NA	UMR
38	Yoon *et al.* 2013	*Parasites & Vectors*	**PLATYHELMINTHES**	1 G	N	None	Yes	07.06.13	Unknown	NA	AWR
39	Lima *et al.* 2013	*Parasites & Vectors*	**PROTOZOA**	1 S	N	None	No	03.08.13	Unknown	NA	UMR
40	Kadej & Háva 2013	*Zoological Studies*	**COLEOPTERA**	6 S	N	None	No	08.08.13	Unknown	NA	UMR
41	Liu *et al.* 2013	*Zoological Studies*	**OSTEICHTHYES**	1 S	N	None	No	16.08.13	Unknown	NA	UMR
42	Lee & Bezděk 2013	*Zoological Studies*	**COLEOPTERA**	4 LD	N	None	No	10.09.13	Unknown	NA	UMR
43	Rabi *et al.* 2013	*BMC evolutionary Biology*	**CHELONII**	1 S	N	None	No	22.09.13	Unknown	NA	UMR
44	Lin & Hastings 2013	*BMC evolutionary Biology*	**OSTEICHTHYES**	2 T	N	None	No	25.09.13	Unknown	NA	UMR

TABLE 3. A list of 106 new zoological nomina and nomenclatural acts published online in BMC periodicals from 19 February 2001 to 30 September 2013, with information on their nomenclatural availability. **NP**: number of publication in Table 2. **NN**: number of nomen or nomenclatural act. **Categories of availability of works and nomina**: AWR, work available through *ZooBank* preregistration; UFC, work unavailable through online publication, despite deposition of facsimiles in five libraries announced in the publication, confirmed in the Paris Museum library; UFD, work unavailable through online publication, despite deposition of facsimiles in five libraries not announced in the publication, but discovered in the Paris Museum library; UFU, work unavailable through online publication, despite supposed deposition of facsimiles in five libraries announced in the publication, unconfirmed in the Paris Museum library; UMP, work unavailable through online publication after 2011 but without statement of *ZooBank* preregistration; UNP, nomen unavailable despite its *ZooBank* preregistration; UOO, work unavailable through online-only publication before 2012; UVC, nomen unavailable because of various other criteria (see text). These nomina belong in four nominal-series (name groups of the *Code*) recognized by Dubois (2000).The following formats are used for these nomina: *italics* for those of the species- and genus-series, *ITALIC CAPITALS* for those of the family-series and **BOLD CAPITALS** for those of the class-series. The rows of unavailable nomina are on a white background, those of available nomina on a light grey background.

NP	NN	Reference and first page	Higher group	Rank or act	New nomen or nomenclatural act	Availability
Works published before 4 September 2012						
1	1	Andriaholiniriana *et al.* 2006: 6	**MAMMALIA**	Species	*Lepilemur aeeclis*	UOO
1	2	Andriaholiniriana *et al.* 2006: 8	**MAMMALIA**	Species	*Lepilemur randrianasoli*	UOO
1	3	Andriaholiniriana *et al.* 2006: 9	**MAMMALIA**	Species	*Lepilemur sahamalazensis*	UOO
2	4	Herrmann *et al.* 2006: 1	**NEMATODA**	Species	*Pristionchus pseudaerivorus*	UOO
2	5	Herrmann *et al.* 2006: 3	**NEMATODA**	Species	*Pristionchus americanus*	UOO
2	6	Herrmann *et al.* 2006: 3	**NEMATODA**	Species	*Pristionchus marianneae*	UOO
2	7	Herrmann *et al.* 2006: 3	**NEMATODA**	Species	*Pristionchus pauli*	UOO
3	8	Craul *et al.* 2007: 7	**MAMMALIA**	Species	*Lepilemur otto*	UOO
3	9	Craul *et al.* 2007: 8	**MAMMALIA**	Species	*Lepilemur manasamody*	UOO
4	10	Stöck *et al.* 2008: 1	**AMPHIBIA**	Species	*Bufo siculus*	UFD
5	11	Lecompte *et al.* 2008: 6	**MAMMALIA**	Tribus	*ARVICANTHINI*	UOO
5	12	Lecompte *et al.* 2008: 6	**MAMMALIA**	Tribus	*MILLARDINI*	UOO
5	13	Lecompte *et al.* 2008: 6	**MAMMALIA**	Tribus	*APODEMINI*	UOO
5	14	Lecompte *et al.* 2008: 6	**MAMMALIA**	Tribus	*MALACOMYINI*	UOO
5	15	Lecompte *et al.* 2008: 6	**MAMMALIA**	Tribus	*PRAOMYINI*	UOO
6	16	Poinar 2008: 1	**DIPTERA**	Species	*Lutzomyia adiketis*	UOO
6	17	Poinar 2008: 1	**PROTOZOA**	Species	*Paleoleishmania neotropicum*	UOO + UVC
7	18	Chantangsi *et al.* 2008: 1	**PROTOZOA**	Genus	*Auranticordis*	UOO
7	19	Chantangsi *et al.* 2008: 1	**PROTOZOA**	Species	*Auranticordis quadriverberis*	UOO
8	20	Giraldo *et al.* 2008: 1	**LEPIDOPTERA**	Subspecies	*Heliconius timareta florencia*	UFU + UNP
9	21	Zaldívar-Riverón *et al.* 2008: 1	**HYMENOPTERA**	Tribus	*ALEIODINI*	UOO
10	22	Depaquit *et al.* 2009: 1	**DIPTERA**	Species	*Phlebotomus (Euphlebotomus) barguesae*	UFU + UVC
11	23	Vilela *et al.* 2009: 1	**MAMMALIA**	Subfamilia	*CHAETOMYINAE*	UOO
12	24	Poinar 2009: 1	**ISOPTERA**	Species	*Kalotermes burmensis*	UFC
12	25	Poinar 2009: 1	**PROTOZOA**	Genus	*Foainites*	UFC
12	26	Poinar 2009: 1	**PROTOZOA**	Species	*Foainites icelus*	UFC
12	27	Poinar 2009: 1	**PROTOZOA**	Genus	*Spiromastigites*	UFC
12	28	Poinar 2009: 1	**PROTOZOA**	Species	*Spiromastigites acanthodes*	UFC
12	29	Poinar 2009: 1	**PROTOZOA**	Genus	*Trichonymphites*	UFC
12	30	Poinar 2009: 1	**PROTOZOA**	Species	*Trichonymphites henis*	UFC
12	31	Poinar 2009: 1	**PROTOZOA**	Genus	*Teranymphites*	UFC
12	32	Poinar 2009: 1	**PROTOZOA**	Species	*Teranymphites rhabdotis*	UFC

12	33	Poinar 2009: 1	**PROTOZOA**	Species	*Oxymonas protus*	UFC
12	34	Poinar 2009: 1	**PROTOZOA**	Genus	*Oxymonites*	UFC
12	35	Poinar 2009: 1	**PROTOZOA**	Species	*Oxymonites gerus*	UFC
12	36	Poinar 2009: 1	**PROTOZOA**	Genus	*Microrhopalodytes*	UFC
12	37	Poinar 2009: 1	**PROTOZOA**	Species	*Microrhopalodytes polynucleatis*	UFC
12	38	Poinar 2009: 1	**PROTOZOA**	Genus	*Sauromonites*	UFC
12	39	Poinar 2009: 1	**PROTOZOA**	Species	*Sauromonites katatonis*	UFC
12	40	Poinar 2009: 1	**PROTOZOA**	Genus	*Dinenymphites*	UFC
12	41	Poinar 2009: 1	**PROTOZOA**	Species	*Dinenymphites spiris*	UFC
12	42	Poinar 2009: 1	**PROTOZOA**	Genus	*Pyrsonymphites*	UFC
12	43	Poinar 2009: 1	**PROTOZOA**	Species	*Pyrsonymphites cordylinis*	UFC
12	44	Poinar 2009: 1	**PROTOZOA**	Genus	*Endamoebites*	UFC
12	45	Poinar 2009: 1	**PROTOZOA**	Species	*Endamoebites proterus*	UFC
13	46	Andrade Filho *et al.* 2009: 1	**DIPTERA**	Species	*Pintomyia dissimilis*	UFC
14	47	Freeman & Sommerville 2009: 1	**PROTOZOA**	Genus	*Desmozoon*	UFC
14	48	Freeman & Sommerville 2009: 1	**PROTOZOA**	Species	*Desmozoon lepeophtherii*	UFC
15	49	Biju *et al.* 2009: 1	**AMPHIBIA**	Genus	*Ghathophryne*	UFC
15	50	Biju *et al.* 2009: 1	**AMPHIBIA**	Genus	*Xanthophryne*	UFC
15	51	Biju *et al.* 2009: 1	**AMPHIBIA**	Species	*Xanthophryne tigerinus*	UFC
16	52	Traversa 2010: 1	**PROTOZOA**	Species	*Cryptosporidium ducismarci*	UFC
17	53	Haug *et al.* 2010: 12	**CRUSTACEA**	Unranked "higher taxon"	**VERUNIPELTATA**	UOO
18	54	Zhao *et al.* 2010: 1	**DERMAPTERA**	Familia	*BELLODERMATIDAE*	UFC
18	55	Zhao *et al.* 2010: 4	**DERMAPTERA**	Genus	*Belloderma*	UFC
18	56	Zhao *et al.* 2010: 4	**DERMAPTERA**	Species	*Belloderma arcuata*	UFC
18	57	Zhao *et al.* 2010: 6	**DERMAPTERA**	Species	*Belloderma ovata*	UFC
19	58	Malm & Johanson 2011: 16	**TRICHOPTERA**	Species	*Oecetis corbeti*	UFC
20	59	Paladini *et al.* 2011: 1	**PLATYHELMINTHES**	Species	*Gyrodactylus salinae*	UFC
21	60	Bargues *et al.* 2011: 1	**MOLLUSCA**	Species	*Lymnaea meridensis*	UFC
22	61	Carvalho *et al.* 2011: 1	**DIPTERA**	Species	*Evandromyia spelunca*	UFU
23	62	Béthoux *et al.* 2011: 1	**PLECOPTERA**	Genus	*Gulou*	UFU
23	63	Béthoux *et al.* 2011: 1	**PLECOPTERA**	Species	*Gulou carpenteri*	UFU
23	64	Béthoux *et al.* 2011: 2	**PLECOPTERA**	Familia	*GULOUIDAE*	UFU
24	65	Freeman & Shinn 2011: 1	**CNIDARIA**	Species	*Myxidium incomptavermi*	UFU
25	66	Poinar 2011: 1	**PROTOZOA**	Genus	*Vetufebrus*	UFC
25	67	Poinar 2011: 1	**PROTOZOA**	Species	*Vetufebrus ovatus*	UFC
26	68	Poinar 2012: 1	**NEMATODA**	Species	*Halophilanema prolata*	UFU
27	69	Yamaguchi *et al.* 2012: 1	**PROTOZOA**	Genus	*Rapaza*	UFC
27	70	Yamaguchi *et al.* 2012: 1	**PROTOZOA**	Species	*Rapaza viridis*	UFC
28	71	Tan *et al.* 2012: 1	**COLEOPTERA**	Genus	*Pareuryomma*	UFU
28	72	Tan *et al.* 2012: 1	**COLEOPTERA**	Species	*Pareuryomma ancistrodonta*	UFU
28	73	Tan *et al.* 2012: 1	**COLEOPTERA**	Species	*Pareuryomma cardiobasis*	UFU
28	74	Tan *et al.* 2012: 1	**COLEOPTERA**	Species	*Omma delicata*	UFU
28	75	Tan *et al.* 2012: 1	**COLEOPTERA**	Species	*Tetraphalerus decorosus*	UFU
28	76	Tan *et al.* 2012: 1	**COLEOPTERA**	Tribus	*PRONOTOCUPEDINI*	UFU + UVC
29	77	Fregin *et al.* 2012: 1	**AVES**	Familia	*SCOTOCERCIDAE*	AWR
29	78	Fregin *et al.* 2012: 1	**AVES**	Familia	*ERYTHROCERCIDAE*	AWR
29	79	Fregin *et al.* 2012: 1	**AVES**	Familia	*MACROSPHENIDAE*	AWR + UVC

Works published after 3 September 2012						
30	80	Poinar & Steenberg 2012: 1	**NEMATODA**	Species	*Parasitylenchus bifurcatus*	UFC + UMR
31	81	Johnson *et al.* 2013: 1	**MOLLUSCA**	Species	*Bathymodiolus antarcticus*	AWR
32	82	Bilandžija *et al.* 2013: 3	**MOLLUSCA**	Species	*Congeria jalzici*	UMR
32	83	Bilandžija *et al.* 2013: 4	**MOLLUSCA**	Species	*Congeria mulaomerovici*	UMR
33	84	Freeman *et al.* 2013: 1	**PROTOZOA**	Species	*Nucleospora cyclopteri*	AWR
34	85	Thompson *et al.* 2013: 1	**PROTOZOA**	Species	*Trypanosoma vegrandis*	UMR
35	86	Pyron *et al.* 2013: 4	**SQUAMATA**	Subfamilia	*CANDOIINAE*	UMR
36	87	Lamsdell & Selden 2013: 1	**ARTHROPODA**	Familia	*STROBILOPTERIDAE*	UMR
36	88	Lamsdell & Selden 2013: 1	**ARTHROPODA**	Species	*Strobilopterus proteus*	UMR
37	89	Stein *et al.* 2013: 1	**ARTHROPODA**	Genus	*Arthroaspis*	UMR
37	90	Stein *et al.* 2013: 4	**ARTHROPODA**	Species	*Arthroaspis bergstroemi*	UMR
38	91	Yoon *et al.* 2013: 1	**PLATYHELMINTHES**	Genus	*Omanicotyle*	AWR
39	92	Lima *et al.* 2013: 1	**PROTOZOA**	Species	*Trypanosoma livingstonei*	UMR
40	93	Kadej & Háva 2013: 2	**COLEOPTERA**	Species	*Cryptorhopalum acevedoi*	UMR
40	94	Kadej & Háva 2013: 3	**COLEOPTERA**	Species	*Cryptorhopalum davidsoni*	UMR
40	95	Kadej & Háva 2013: 3	**COLEOPTERA**	Species	*Cryptorhopalum delacruzi*	UMR
40	96	Kadej & Háva 2013: 3	**COLEOPTERA**	Species	*Cryptorhopalum rawlinsoni*	UMR
40	97	Kadej & Háva 2013: 3	**COLEOPTERA**	Species	*Cryptorhopalum thompsonii*	UMR
40	98	Kadej & Háva 2013: 3	**COLEOPTERA**	Species	*Cryptorhopalum youngi*	UMR
41	99	Liu *et al.* 2013: 1	**OSTEICHTHYES**	Species	*Pomacentrus micronesicus*	UMR
42	100	Lee & Bezděk 2013: 2	**COLEOPTERA**	Lectotype designation	*Cneorane cyanipennis*	UMR
42	101	Lee & Bezděk 2013: 7	**COLEOPTERA**	Lectotype designation	*Cneorane violaceipennis*	UMR
42	102	Lee & Bezděk 2013: 9	**COLEOPTERA**	Lectotype designation	*Cneorane rugulipennis*	UMR
42	103	Lee & Bezděk 2013: 9	**COLEOPTERA**	Lectotype designation	*Cneorane femoralis*	UMR
43	104	Rabi *et al.* 2013	**CHELONII**	Species	*Xinjiangchelys wusu*	UMR
44	105	Lin & Hastings 2013: 1	**OSTEICHTHYES**	Tribus	*STATHMONOTINI*	UMR
44	106	Lin & Hastings 2013: 1	**OSTEICHTHYES**	Tribus	*NEOCLINIINI*	UMR

It seems that few authors so far have been aware of the problems posed by such situations. Actually, we only found one publication where this question was discussed in detail, by a member of the Commission:

> "*Until the beginning of the 1990s it was safe to assume that the PDFs distributed by electronic means also existed in a traditionally paper-printed edition. More recently, electronic-only journals emerged (Llewellyn et al. 2002), and starting probably in 2005, articles containing nomenclatural content were published entirely in electronic form. Rubinoff and Haines (2005) published a new species of moth with interesting behaviour in the journal* Science *with the original description only available as 'Supporting Online Material'. When the authors realised that nomenclatural acts are required by the current Code to be published as a hard copy, they published the description in the paper version of* Science *again in 2006 (Rubinoff and Haines 2006). This case was resolved, but in the same year (2005), the sportive lemurs* Lepilemur aeeclis*,* L. randrianasoli*, and* L. sahamalazensis *were published in* BMC Evolutionary Biology *by Andriaholinirina et al. (2005)* [sic]*. In the following year, Herrmann et al. (2006) published the nematodes* Pristionychus [sic] mariannae [sic]*,* P. pauli*,* P. americanus*, and* P. pseudaerivorus *in* Frontiers in Zoology*.* BMC Evolutionary Biology *published two more lemurs in 2007:* Lepilemur otto *and* L. manasamody *(Craul et al. 2007). Last year, Poinar (2008) described in* Parasites & Vectors *the dipteron* Lutzomyia adiketis *with its trypanosomatid* Paleoleishmania neotropicum *from Dominican amber; the flagellate* Auranticordis quadriverberis *Chantangsi et al. (2008) was introduced in* BMC Microbiology *and the toad* Bufo siculus *in* BMC Evolutionary Biology *(Stöck et al. 2008). If we are aware that all these journals do not come in a paper version, we realise that all these names are unavailable. I know from two authors that they were not aware that no paper copies were produced, and obviously not every taxonomist shares this awareness either.* Bufo siculus *entered the printed taxonomic literature in the year of its description (Razetti* [sic] *2008). Actually, I have received Razetti's* [sic] *paper as a PDF, hence have no indication that a paper version exists. I just assume, as everybody else does, that journals that are not generally known as electronic-only do exist on paper. Web of Science (28 May 2009) lists 10 citations (nine in the printed literature) for the paper of Craul et al. (2007) and 12 citations (11 in the printed literature) for the paper of Andriaholinirina et al. (2006). Papers in BMC journals are recognised and cited, and the names published are entering the scientific record despite being unavailable according to the zoological Code.*" (Krell 2009: 273).

These comments, as well as subsequent ones in the same paper, are interesting, but they elicit a few remarks.

(1) This text is erroneous in seeming to consider that, as soon as a nomen "*enter[s] the printed taxonomic literature*", it becomes nomenclaturally available. Contrary to what this text suggests, the subsequent use by Razzetti (2008) of the nomen *Bufo siculus* does not in the least provide nomenclatural availability to this nomen, although it appears indeed in a paper-printed publication. This is on account of Articles 16.1 and 16.4 of the 1999 *Code*, which read as follows:

> "***Article 16. Names published after 1999.***
> *16.1.* ***All names: intention of authors to establish new nominal taxa to be explicit.*** *Every new name published after 1999, including new replacement names (nomina nova), must be explicitly indicated as intentionally new.*
> (…)
> *16.4.* ***Species-group names: fixation of name-bearing types to be explicit.*** *Every new specific and subspecific name published after 1999, except a new replacement name (a nomen novum)* (…)*, must be accompanied in the original publication*
> *16.4.1. by the explicit fixation of a holotype, or syntypes, for the nominal taxon* (…)*, and,*
> *16.4.2. where the holotype or syntypes are extant specimens, by a statement of intent that they will be (or are) deposited in a collection and a statement indicating the name and location of that collection* (…)."

Razzetti's (2008) paper did not claim any intention to introduce a new available nomen and did not mention any type specimen—incidentally, if it had done so, Razzetti would have become the author of this nomen. The purpose of this paper was just to discuss, among other questions, whether this nomen had senior synonyms. Although no such synonyms were found, this nomen remained unavailable after this publication and cannot be valid until it is made available, by its original author or another one. The same applies to all the other nomina referred to by Krell (2009) in the text above[39], except *Hyposmocoma molluscivora*.

(2) According to the last sentence of the paragraph above, "*Papers in BMC journals are recognised and cited, and the names published are entering the scientific record despite being unavailable according to the zoological Code*". This is doubtless a reality, but this is not new. All along the history of zoological taxonomy since a *Code* has been in force, there have been careless authors and editors who did not follow the Rules, but there have also been careful authors who corrected these mistakes instead of accepting them as granted. If they had not, after more than 250 years of loose practice, zoological nomenclature would be in a terrible state of disorder, and communication between taxonomists and between them and other biologists and the rest of society would have been considerably hampered. To manage a corpus of about 2 million nomina cannot result from simple "consensus" and "usage". Just like for million cars running on million roads worldwide, Rules are needed to drive safely the car of nomenclature. A negative example that supports this statement is that of higher zoological nomenclature (above superfamily), which, not being regulated by Rules, is in a state of confusion that is growing every year (see Dubois 2011*a*): no one knows what nomina like **AMPHIBIA**, **AVES**, **MAMMALIA**, **INSECTA** or **HEXAPODA** mean, because each author or group of authors has his own interpretation, opinion and taste about this. Action by the Commission is needed in this case, just like in that of e-publication, and it is not appropriate to consider the current chaos as an inevitable misfortune. Whether the Rules for e-publication implemented this year by the Commission will allow reducing this chaos is unknown, but what is clear is that if zootaxonomists, including Commission members, accept that these new Rules can be ignored by some authors and journals because this would be "inevitable", the chaos will rapidly grow.

(3) All examples given by Krell (2009) concern new nomina of the species-series. He completely ignored the fact that nomina of the other nominal-series, as well as all nomenclatural acts, are also governed by the *Code* and must also follow the Rules concerning publications and availability. As Frank-Thorsten Krell appears to have played a role of intermediary between the Commission and BMC, this explains perhaps why from 2008 on this publisher did not deposit paper facsimiles of its papers including new nomina above the rank species, although it did so for species (see below), except "by chance" when the same work included also new specific nomina.

Starting in November 2008 (Giraldo *et al.* 2008), changes occurred in some papers of the BMC periodicals (but not all), which suggests that their publisher or editors then became aware of some of the problems posed by their online publication of new nomina. This apparently resulted from a contact BMC had originally with the Commission in September 2005 (see below), i.e., five years after the launching of its first periodicals in 2000. A second change occurred in August 2012, just before the recent decision of the Commission to modify the Rules of availability of publications.

A detailed analysis of the status of the nomenclatural novelties published by BioMed Central

Papers published by BMC before 4 September 2012

Nomina published only online before 2012

All 29 papers published by BMC before the publication of the 2012 amendment should have followed the 1999 *Code*, without paying attention to the 2008 proposed amendment or other proposals. Unfortunately, it was not the case for any of them. Only one of these papers followed the 2012 amendment, although it was published before the latter!

Let us start with the simplest case, that of nomina that are unquestionably nomenclaturally unavailable for having been published only online before 2012 on the BMC site, without any statement that paper facsimiles were deposited in libraries. Table 3 gives (under abbreviation "UOO") the list of these 21 new nomina, published from 2006 to 2010 in 10 electronic-only publications: 11 concern mammals, 4 nematodes, 3 protozoa and one each

39. This is fortunate in a sense, because if it was not the case, the two incorrect subsequent spellings (aponyms and ameletonyms; Dubois 2000) introduced by Krell (2009) himself in his text (*Pristionychus* and *mariannae*; see Table 3) would have become the original spellings (protonyms) of these nomina and could not be corrected, even by their actual authors, except by the Commission using its Plenary Powers.

wasps, flies and crustaceans. As for the ranks of these nomina, 12 are species, 1 genus, 6 tribes, 1 subfamily and 1 unranked "taxon" above the rank superfamily. All these nomina being nomenclaturally unavailable, they cannot be used as valid in scientific publications: before doing so, they will need to be published again in a manner compliant with the updated Rules of the *Code*. The same would apply to other zoological nomina that may have been proposed as new before 2012 under similar conditions in other online periodicals. To these zoological nomina, should certainly be added problematic nomina published by BMC in other taxonomic groups or organisms (e.g., Iversen *et al.* 2007), but we did not carry out a research about such cases.

Nomina published online before 2012 in works with paper copies deposited in libraries

Among the 29 BMC papers published before September 2012 listed in Table 1, where new nomina of zoological taxa were proposed, 19 (under abbreviations "UFC" and "UFU") follow a procedure described below. Besides, a single one ("AWR"), prepublished online in August 2012 (Fregin *et al.* 2012), follows the procedure implemented in the 2012 amendment to the *Code*, including prior registration of the work in *ZooBank* before online publication, which undisputably provides nomenclatural availability to two of its new familial nomina (see below for the third one).

In the purpose of providing availability to some new nomina (listed in Table 3) published online in these 19 works (with abbreviations "P" or "V" in column "DPF" of Table 2), BMC included in each of these papers a standard sentence in the form: "*In order to comply with the International Code of Zoological Nomenclature, paper copies of this electronic article have been deposited in the following libraries:* (…)" (Giraldo *et al.* 2008: 8); "*In accordance with section* [sic] *8.6 of the ICZN's International Code of Zoological Nomenclature, copies of this article are deposited at the following five publicly accessible libraries:* (…)" (Poinar 2009: 16); or slightly different. An unexpected result of our enquiry was the discovery that the Paris Museum also harbours a paper copy of the work by Stöck *et al.* (2008), although this was not mentioned in the work itself! If this copy was deposited in the hope to render this work and its new nomen *Bufo siculus* nomenclaturally available, this was not an appropriate action, as probably few taxonomists would have had the idea of enquiring "blindly" about the presence in this library of a paper copy of an electronic document that was not announced in the latter! In fact, this was the purpose of the condition of Article 8.6 of the 1999 *Code*, applying to d-publications, which required that the famous five major libraries be "*identified by name in the work itself*".

As we have seen above, we consider that this Article 8.6 did not apply to e-publication under the form of PDFs. Therefore the deposition of these five copies, if it was indeed done, did not provide availability to the online versions of these works because these copies, being mere facsimiles of unavailable works, do not qualify as available p-publications under the criteria of the *Code*.

As we have also seen, even if our interpretation of Article 8.6 of the 1999 *Code* is challenged, and if these publications were to have been considered available from 1999 to 2012, after publication of the 2012 amendment they are anyway unavailable for zoological nomenclature because of the retroactivity of Articles 8.5 and 9.12, as reminded in our statement **[S3]** above (p. 20).

Three questions (Q1) and (Q3) remain relevant concerning these facsimiles:

(Q1) *Is there evidence that these copies were indeed printed and deposited in libraries?* The only way to obtain robust evidence that paper copies of a PDF were indeed printed and deposited in libraries is to inquire directly from the librarians in charge of the latter. As most (17 out of 19) of these works mentioned the library of the Paris Museum as one of the five places of deposition, we inquired there. Table 2 provides detailed information on these 17 publications (with abbreviation "P" in column "DPF"). We only found paper copies of 13 of these 17 works ("UFC") in this library. This does not necessarily mean that the other 4 were never sent there, as they may have been misplaced or lost, but at least an uncertainty remains.

Above, we considered these paper copies as mere facsimiles of the original PDFs distributed online. Strictly speaking, this would mean that not only the content but also the layout of both documents is exactly the same (just like in a photograph, a photocopy or a scan for example). Consequently, any voluntary change, even slight, in either the content (a single letter difference, e.g. to "correct a mistake", may be enough, as it may result in a spelling change in a nomen) or the format, would result in fact in the creation of a distinct document, which would question the interpretation of these documents as "*facsimiles or reproductions*" of the original unavailable PDF.

Of the 13 works in the Paris Museum library, 10 seem to be strictly identical to a printed copy of the online PDF. The paper copy of the work of Yamaguchi *et al.* (2012) sent to the Paris Museum is printed with a size reduction allowing to accommodate two pages on one, and all even pages are upside-down compared to the odd ones, but the content and layout appear to be the same (Figure 2). But two printed copies are slightly or grossly different from the online one. The paper copy of Malm & Johanson (2011) differs from the PDF by the use of a different colour (violet instead of blue) in the titles, in some figures and in other details (see Figure 3). The differences are much stronger for the Bargues *et al.* (2011) paper (see Figure 4). They bear on the number of pages (22 in the PDF, 23 in the paper deposited copy), the layout of all pages from page 6 on, and above all several figures and pages from that page on. Several figures have been duplicated and appear twice in the paper copy, whereas others have disappeared. In the printed copy, fig. 2 has been replaced by fig. 8 in the PDF, fig. 4 by fig. 10, fig. 5 by fig. 11, fig. 6 by fig. 12, but these four figures appear again at their right place below in the paper copy starting on page 13! Clearly the two documents are different ones, and this is all the more striking and worrying that they bear the same ISSN and DOI. During the period of work on a digital document, its content may change from one version to another without requiring a change of DOI, but for the purpose of nomenclature the published document must be permanent and non modifiable and its DOI must explicitly include reference to this version.

FIGURE 2. First page of Yamaguchi *et al.* (2012) under two different versions: (a) PDF dated 8 March 2012, downloaded from the BMC website on 6 November 2012; (b) paper facsimile dated 8 March 2012, received by the Paris Museum library before 5 November 2012 (two pages on one, successive pages printed upside down).

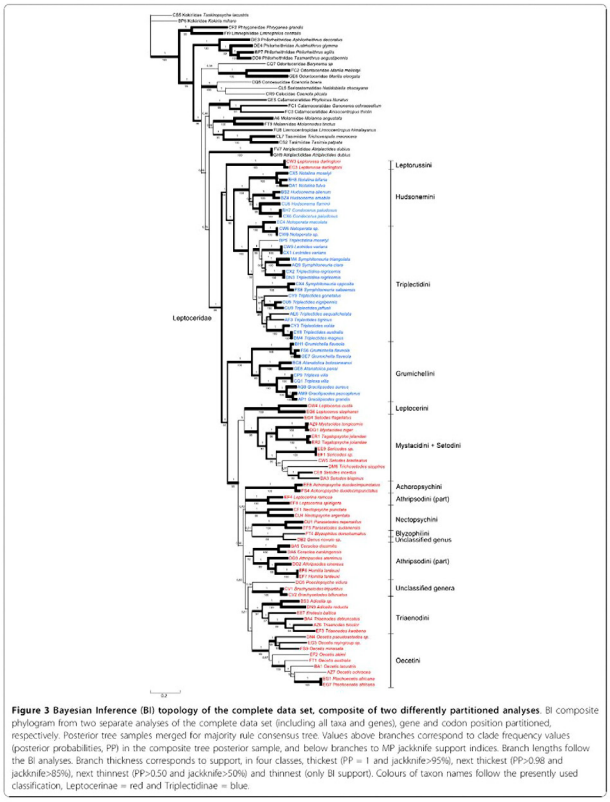

Figure 3 Bayesian Inference (BI) topology of the complete data set, composite of two differently partitioned analyses. BI composite phylogram from two separate analyses of the complete data set (including all taxa and genes), gene and codon position partitioned, respectively. Posterior tree samples merged for majority rule consensus tree. Values above branches correspond to clade frequency values (posterior probabilities, PP) in the composite tree posterior sample, and below branches to MP jackknife support indices. Branch lengths follow the BI analyses. Branch thickness corresponds to support, in four classes, thickest (PP = 1 and jackknife>95%), next thickest (PP>0.98 and jackknife>85%), next thinnest (PP>0.50 and jackknife>50%) and thinnest (only BI support). Colours of taxon names follow the presently used classification, Leptocerinae = red and Triplectidinae = blue.

a

Malm and Johanson *BMC Evolutionary Biology* 2011, **11**:10
http://www.biomedcentral.com/1471-2148/11/10

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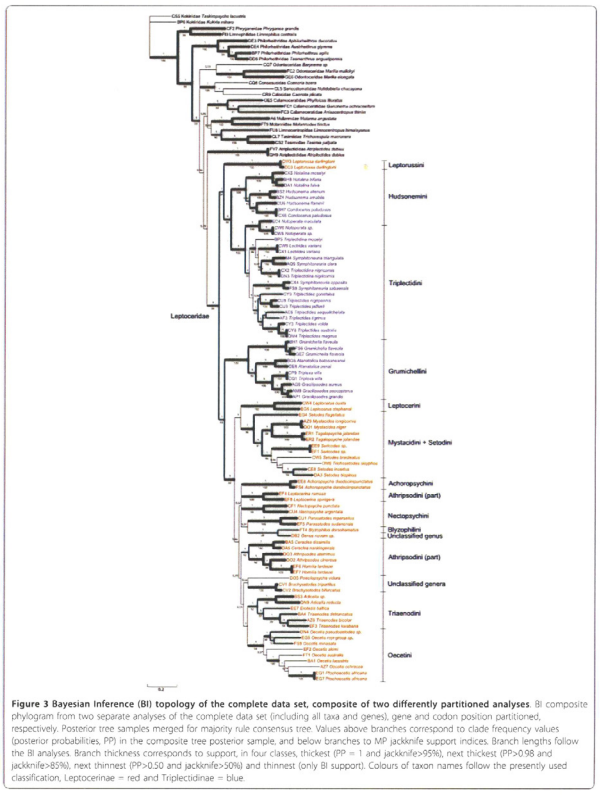

Figure 3 Bayesian Inference (BI) topology of the complete data set, composite of two differently partitioned analyses. BI composite phylogram from two separate analyses of the complete data set (including all taxa and genes), gene and codon position partitioned, respectively. Posterior tree samples merged for majority rule consensus tree. Values above branches correspond to clade frequency values (posterior probabilities, PP) in the composite tree posterior sample, and below branches to MP jackknife support indices. Branch lengths follow the BI analyses. Branch thickness corresponds to support, in four classes, thickest (PP = 1 and jackknife>95%), next thickest (PP>0.98 and jackknife>85%), next thinnest (PP>0.50 and jackknife>50%) and thinnest (only BI support). Colours of taxon names follow the presently used classification, Leptocerinae = red and Triplectidinae = blue.

b

FIGURE 3. Page 9 of Malm & Johanson (2011) under two different versions: (a) PDF dated 12 January 2011, downloaded from the BMC website on 11 November 2012; (b) paper facsimile dated 12 January 2011, received by the Paris Museum library before 5 November 2012 (compared to the PDF, throughout the printed document blue was replaced by violet and red by orange).

Should these differences be considered to challenge the interpretation presented above that all the famous five deposited printed copies are mere facsimiles of the original unavailable PDFs? We do not think so. This would be the case only if these changes had been *voluntary* on the part of the publisher, editor or author who deposited these copies in libraries: e.g., to correct a misprint, especially in a new scientific nomen. But the differences mentioned above are not of this kind! They may be considered to have been caused merely to save costs in the printing process (when the format has been reduced to divide the number of pages by two), by lack of attention in the management of colour printing, or by gross technical dysfunction in the management of figures in the electronic document from which the PDF was printed. None of these mistakes can be considered as voluntary or as "corrections". This question can be approached from the point of view of *reductio ad absurdum*: considering these documents as distinct publications would mean that exact copies of a PDF would not qualify as a publication, but that faulty copies would! Rather, faulty copies should in our opinion be considered just like defective copies of books or periodicals that are sometimes found, with missing or duplicated pages, changes in the order of pages, unreadable pages (because of various problems such as shortage of ink), etc. Such imperfect copies do not qualify as publications distinct from the other copies of the same printed work, but as *faulty* copies of the latter. It is only in the case where *all* the copies of a work are defective in the same way because of such a problem that they will have to be considered as the "original publication" of a work in the meaning of the *Code*. Our interpretation of such cases is therefore that such copies which differ in some respect from the original PDF, but which bear the same ISSN/ISBN and DOI, should also be considered as mere (but faulty) facsimiles of the original unavailable PDFs, and therefore unavailable documents for the purpose of zoological nomenclature.

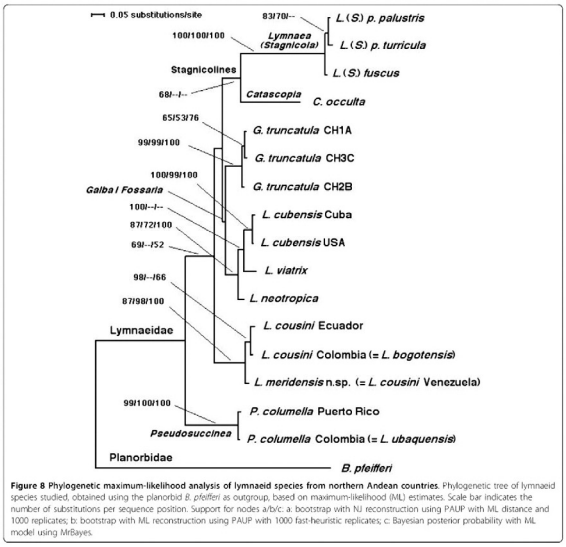

Figure 8 Phylogenetic maximum-likelihood analysis of lymnaeid species from northern Andean countries. Phylogenetic tree of lymnaeid species studied, obtained using the planorbid *B. pfeifferi* as outgroup, based on maximum-likelihood (ML) estimates. Scale bar indicates the number of substitutions per sequence position. Support for nodes a/b/c: a: bootstrap with NJ reconstruction using PAUP with ML distance and 1000 replicates; b: bootstrap with ML reconstruction using PAUP with 1000 fast-heuristic replicates; c: Bayesian posterior probability with ML model using MrBayes.

nidamental gland. The spermiduct, of granular outer surface, emerges from the carrefour, runs distalward and finally narrows to merge into a similarly granular prostate (Figure 11B). The prostate increases in width to its distal end, shows ventrally a lengthwise fissure, formed by the folding of its left margin, and finally two rounded protuberances, from whose convergence the vas deferens arises (Figure 11C). The vas deferens appears as a long, more or less uniformly thin duct which merges into a penis which is included within the penial sheath (Figure 11D).

The penis sheath is regularly cylindrical, with a somewhat thicker proximal part. The penis sheath is a little longer than the prepuce (ratio range of 0.93-1.38; mean 1.18 ± 0.18). The prepuce is thicker, around twice as wide as the penis sheath at the point of insertion of the penial sheath and gradually narrowing to terminate in the male genital pore (Figure 11D).

DNA sequence markers Specific classification can be based on the sequences of rDNA ITS-2 (GenBank Accession No. FN598154; haplotype H1), rDNA ITS-1 (FN598159; haplotype HA) and mtDNA *cox*1 (FN598164; provisional haplotype code Ha). For supraspecific classification, the nucleotide sequence of the 18S rRNA gene (FN598151) can be employed. The amino-acid sequence corresponding to the mtDNA COX1 protein (FN598164; provisional haplotype code H1) does not appear to be helpful for species discrimination.

a

Accession No. FN598151. The 18S rDNA sequence of *L. ubaquensis* from Laguna Ubaque (Colombia) showed a sequence different to the aforementioned one, but identical to that of *P. columella* from Puerto Rico, with a 1850 bp length and a 51.70% GC content (0.238 A, 0.282 G, 0.235 C, 0.245 T), and which has been deposited under Acc. No. FN598152. When comparing both 18S sequences, a total of 16 nucleotide differences appear, including 11 mutations and 5 insertions/deletions (indels) (see Figure 2).

When comparing the 18S sequence shared by *L. ubaquensis* and *P. columella* with the only *P. columella* 18S from Argentina [EU241866] previously available in GenBank, a total of 22 nucleotide differences unexpectedly appeared (6 ts, 4 tv and 12 indels in a 1856 bp-long pairwise alingment), most differences representing singleton polymorphic sites in conserved areas of the secondary structure of this gene.

The multiple sequence alignment, including the ten different 18S sequences of (a) *L. cousini* and *L. bogotensis*,

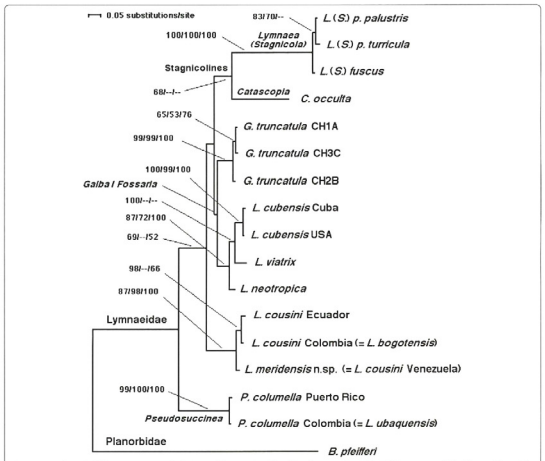

Figure 2 Nucleotide differences in a total of 62 variable positions found in the complete 18S rDNA sequence of the lymnaeid species compared and their location in the secondary structure. Helix, Position and Difference number = numbers to be read in vertical. Position = numbers refer to positions obtained in the alignment made with MEGA 4.0. Identical = . Indel = Bold text corresponds to helix E10-1 of the variable area V2 where differences in the 18S rRNA gene of Lymnaeidae are concentrated [46]. Accession Nos. = [EMBL: Z73980-Z73985] [46]; [EMBL: Z83831] [47]; [EMBL: AM412222] [42]: *L. cousini* and *P. columella* from present study. Sequence correspondences: * *L. cubensis*, *L. viatrix* and *L. cousini* without definitive genus ascription; ** 18S identical in *L. viatrix* and *L. neotropica* [42]; *** 18S identical in *P. columella* and *L. ubaquensis* (present paper); **** 18S identical in *L. cousini* from Ecuador, *L. bogotensis* and *L. meridensis* n. sp. (= *L. cousini* from Laguna Mucubaji, Venezuela) (present study)

b

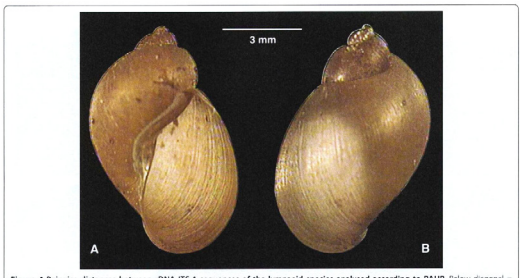

Figure 4 Pairwise distances between rDNA ITS-1 sequences of the lymnaeid species analysed according to PAUP. Below diagonal = total character differences; above diagonal = mean character differences (adjusted for missing data). Sequence correspondences: * *L. cousini* HA corresponds to the population of Chanchu-Yacu (Ecuador); ** *L. cousini* HB = *L. bogotensis*; *** *L. meridensis* n. sp. = *L. cousini* from Laguna Mucubaji (Venezuela); **** *P. columella* HA from Puerto Rico = *L. ubaquensis*; ***** *P. columella* [GenBank: AY186751] from Cuba [69]

32 and 204, whereas all others show threonine and serine, respectively. Worth mentioning is that *L. cousini* from Laguna Mucubaji (Venezuela) shows a COX1 amino-acid sequence identical to that of *L. viatrix* from Argentina (AM494010) (Figure 7).

Phylogenetic Analysis

The combination of the two internal transcribed spacers in a single data-set generated a robust tree, indicating phylogenetic accordance between the two spacers. The ML model best fitting this data-set was HKY85+G, using a ts/tv ratio of 1.062 (kappa = 2.08626), base frequencies for A, C, G and T of 0.2094, 0.2696, 0.2405 and 0.2806, respectively, a proportion of invariable sites = 0, and a gamma-distribution shape parameter of 0.53. To assess the reliability of the nodes in the ML tree (Figure 8), a bootstrap analysis using 1000 replicates was made using fast step-wise addition and the neighbor-joining (NJ) algorithm with the ML pairwise distances in PAUP. Finally, a Bayesian phylogeny reconstruction procedure was applied to obtain posterior probabilities (BPP) for the nodes in the ML tree with MrBayes.

In the ML tree obtained (Figure 8), *L. cousini* from Chanchu-Yacu (Ecuador) and *L. bogotensis* from Bogota savannah (Colombia) cluster together with *L. cousini* from Laguna Mucubaji (Venezuela), within a well supported clade (87/98/100 in NJ/ML/BBP). This clade appears basal to the *Galba/Fossaria* species and the European stagnicoline species groups. However, this basal position does not seem to be clearly resolved, given the relatively low supports. *Lymnaea ubaquensis* from Ubaque (Colombia) clusters in the same branch with *P. columella* from Puerto Rico with the highest support, but the relationship of this branch with the main node including all other lymnaeid species is not well resolved. A similar, low-supported link appears between the European *Lymnaea* (*Stagnicola*) species and the basally appearing Palaearctic *C. occulta*, contrary to the relationships between the different *Galba/Fossaria* species which are well supported.

The topology obtained with the NJ algorithm using LogDet distances (Figure 9) is somewhat different to that shown by the ML tree (Figure 8). Here again, *L. cousini* from Ecuador, *L. bogotensis* from Colombia and *L. cousini* from Venezuela cluster together with a 100% bootstrap support, but this branch now appears as a sister group of the *Galba/Fossaria* species clade, a 97% of bootstrap value supporting this relationship. As in the ML phylogeny, *L. ubaquensis* from Ubaque (Colombia) clusters with *P. columella* from Puerto Rico in a 100% supported branch which appears basal to the rest of lymnaeids. The position of the Palaearctic *C. occulta* in this topology becomes interestingly different, changing to appear separated from the rest of European stagnicolines and becoming basal to the node including the *Galba/*

c

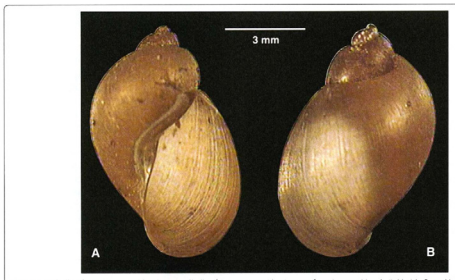

Figure 10 Shells of *Lymnaea meridensis* n. sp. Shells of *Lymnaea meridensis* n. sp. from Laguna Mucubaji, Mérida State, Venezuela, in ventral (A) and dorsal (B) views.

Table 2 Lymnaeid shell measurement comparison between *Lymnaea cousini*, *L. bogotensis* (= *L. cousini*), *L. ubaquensis* (= *Pseudosuccinea columella*) and *L. meridensis* n. sp. (= *L. cousini* from Laguna Mucubaji, Venezuela), from their respective type localities in northern Andean countries

	L. cousini Chanchu-Yacu, Chillogallo Ecuador		*L. bogotensis* Savannah of Bogota Colombia		*L. ubaquensis* Laguna de Ubaque Colombia	*L. meridensis* n. sp. Mucubaji, Mérida State Venezuela
Shell parameters	Jousseaume (1887) [1]	Paraense (1995) [2]	Velasquez (2006) [3]	present study	present study	present study
	n = n.s.	n = 24	n = 30	n = 30	n = 30	n = 16
Shell length (SL)	10-14	6.6-8.5	3.1-11.7 (6.85 ± 2.3)	4.4-7.2 (6.03 ± 0.65)	7.9-11.8 (9.47 ± 0.97)	6.6-9.3 (8.05 ± 0.78)
Shell width (SW)	5-6/6-10	6.0	7.0	2.9-4.2 (3.64 ± 0.38)	4.6-6.9 (5.49 ± 0.52)	3.7-6.0 (5.24 ± 0.58)
Last spire length (LSL)	n.s.	n.s.	n.s.	3.9-6.3 (5.26 ± 0.56)	7.2-10.8 (8.62 ± 0.89)	6.1-8.4 (7.57 ± 0.13)
Spire length (SpL)	n.s.	3	4.6	1.3-2.5 (1.99 ± 0.26)	1.7-3.2 (2.37 ± 0.30)	1.6-2.7 (2.24 ± 0.31)
Aperture length (AL)	7-10	6	7.1	2.8-4.6 (3.79 ± 0.42)	5.5-8.6 (6.65 ± 0.72)	4.8-6.0 (5.70 ± 0.15)
Aperture width (AW)	4-6	4	5.3	1.9-3.0 (2.53 ± 0.28)	3.4-5.0 (4.06 ± 0.39)	2.5-3.9 (3.39 ± 0.13)
Whorl number	4	5	n.s.	3-4 (3.20 ± 0.41)	3-4 (3.13 ± 0.35)	3-3 (3.00 ± 0.00)
SW/SL ratio	n.s.	0.54-0.65 (0.59 ± 0.03)	0.54-0.71 (0.62 ± 0.05)	0.57-0.67 (0.60 ± 0.02)	0.53-0.65 (0.58 ± 0.03)	0.58-0.66 (0.62 ± 0.04)
AL/SL ratio	n.s.	0.61-0.69 (0.65 ± 0.02)	0.55-0.76 (0.64 ± 0.05)	0.60-0.67 (0.63 ± 0.02)	0.66-0.75 (0.70 ± 0.02)	0.65 0.73 (0.69 ± 0.04)
AL/SpL ratio	n.s.	1.59-2.23 (1.88 ± 0.18)	1.23-3.17 (1.84 ± 0.41)	1.62-2.19 (1.91 ± 0.15)	2.37 3.75 (2.82 ± 0.30)	2.17-3.03 (2.58 ± 0.43)
SpL/SL ratio	n.s.	0.31-0.38 (0.35 ± 0.02)	0.24-0.45 (0.36 ± 0.05)	0.30-0.37 (0.33 ± 0.02)	0.20-0.28 (0.25 ± 0.02)	0.24-0.30 (0.27 ± 0.03)

Range include minimum and maximum extremes, with mean and standard deviation SD in parentheses. Measurements in mm. n.s. = not specified. [1] = [55]; [2] = [40]; [3] = [43]

d

FIGURE 4. Four pages of Bargues *et al.* (2011) under two different versions: (a) page 11 of PDF dated 12 July 2011, downloaded from the BMC website on 11 November 2012, showing its fig. 8 with its correct legend; (b–d) pages 6, 9 and 15 of paper facsimile dated 12 July 2011, received by the Paris Museum library before 5 November 2012, showing its fig. 2 (legend of fig. 2 in PDF, tree of fig. 8 in PDF), its fig. 4 (legend of fig. 4 in PDF, photograph of fig. 10 in PDF) and its fig. 10 (legend and photograph of fig. 10 in PDF).

As we have seen printed copies of the 13 works mentioned above, we can confirm their existence, but we cannot be positive for the other four works that we did not find in the Paris Museum. This would require enquiries in other major libraries, a process that would be very time consuming and that might not be able to remove the uncertainty in certain cases. This reason alone would be enough to reject the deposition of copies in five libraries as an inappropriate nomenclatural Rule.

(Q2) *What were the dates of deposition of these paper copies?* Concerning the dates of deposition of facsimiles in libraries, the paper copies of the 13 works, as well as the work of Stöck *et al.* (2008), that we found in the Paris Museum provide incomplete but enlightening information. Nothing is known about the reception date of 10 of these works, but the other four can be precisely dated.

The printed version of the paper by Andrade Filho *et al.* (2009) is accompanied in the Paris Museum library by the original of a letter from Ciaran O'Neill, Assistant Journal Development Editor at BioMed Central, which explains why this copy was sent to the Paris Museum library. This letter is dated 12 June 2009 and it was stamped at reception on 17 June 2009 (see Figure 5). So the date of 12 June 2009 can be safely considered the deposition date of this paper version. This is almost one month after the date of online availability that is printed on the PDF, and also on the paper facsimile that is identical to it: 14 May 2009.

The situation is similar for the paper by Freeman & Sommerville (2010), except that in this case the date of online availability of the PDF is 27 November 2009, that of the accompanying letter by Ciaran O'Neill 15 January 2010, and that of reception at the Paris Museum library 20 January 2010 (see Figure 5). So in this case the distribution date shifts from 2009 to 2010.

The paper facsimile of the work by Poinar (2009), which contains many new nomina (see Table 3) is accompanied by a letter by Ciaran O'Neill dated 28 April 2009 (see Figure 5), but in this case neither the letter nor the PDF were stamped at reception. Anyway in this case more than two months had elapsed after release of the online version (18 February 2009).

Finally, the paper facsimile of the work by Tan *et al.* (2012) is accompanied by an undated letter by Philippa Harris, that was stamped at reception on 14 January 2013 (see Figure 5). As we will see below, this is much later than both the online prepublication date (9 July 2012) and the earliest date known of the existence of the online formatted, edited work (16 December 2012).

Although no dates are associated with the other 10 facsimiles, these four examples seem to indicate that as a rule BMC did not send the printed versions on the same day as the online one. Perhaps additional information in this respect could be found in other libraries which received these works. Incomplete as they are, these data suggest that the facsimiles were distributed several weeks or months after the publication date that appears on the document itself. There is a simple explanation to this delay: it is due to the fact that BMC periodicals first release provisional versions of their papers on their site and that they consider the date of this release as the "publication date" of the work, which is inconsistent with the Rules of the *Code*.

(Q3) *What is the nomenclatural status of "preliminary versions" or works made available online before the "final version"?* This leads us to the main problem regarding the date and reference of the "original publication" of nomenclatural novelties published online by BMC. Let us illustrate this with the case of the paper by Tan *et al.* (2012) listed in Table 2.

On 6 November 2012 at 8 h 58, we downloaded this paper from the website of BMC. We then received an unformatted "*provisional PDF*" (see Figure 6a). Under Articles 9.9 and 21.8.3 of the 2012 amendment, such a "*preliminary version*" of a work accessible electronically must be considered as "*not published*" then. According to the *BMC evolutionary Biology* website and to the provisional PDF itself, the latter had been available for downloading from this site since 9 July 2012. On 19 November 2012, we downloaded it again from the website and it was still under the form of a provisional unformatted PDF. It had therefore been available as such on this website for more than four months. On 16 December 2012 at 19 h 21, we downloaded this paper again, but then it appeared as the formatted "final version" of the paper (see Figure 6b). We were then surprised to realise that both the website and the formatted PDF still announced 9 July 2012 as the publication date of the work! The real online distribution date of the final formatted version of Tan *et al.*'s paper is unknown, but must be between 19 November and 16 December 2012, i.e., between four of five months after the publisher's date of 9 July. Furthermore, both in the provisional PDF available on the site from 9 July to at least 19 November 2012, and on the final PDF available at least since 16 December 2012, the standard sentence mentioned above appears, where the authors state that they "***have*** [emphasis ours] *deposited paper copies of the above article*" in five major libraries, including that of the

Paris Museum. However, as we have seen above, the paper copy of this work that was received in the Paris Museum library was stamped at reception on 14 January 2013, more than six months after the date that still appears on the online PDF of this paper.

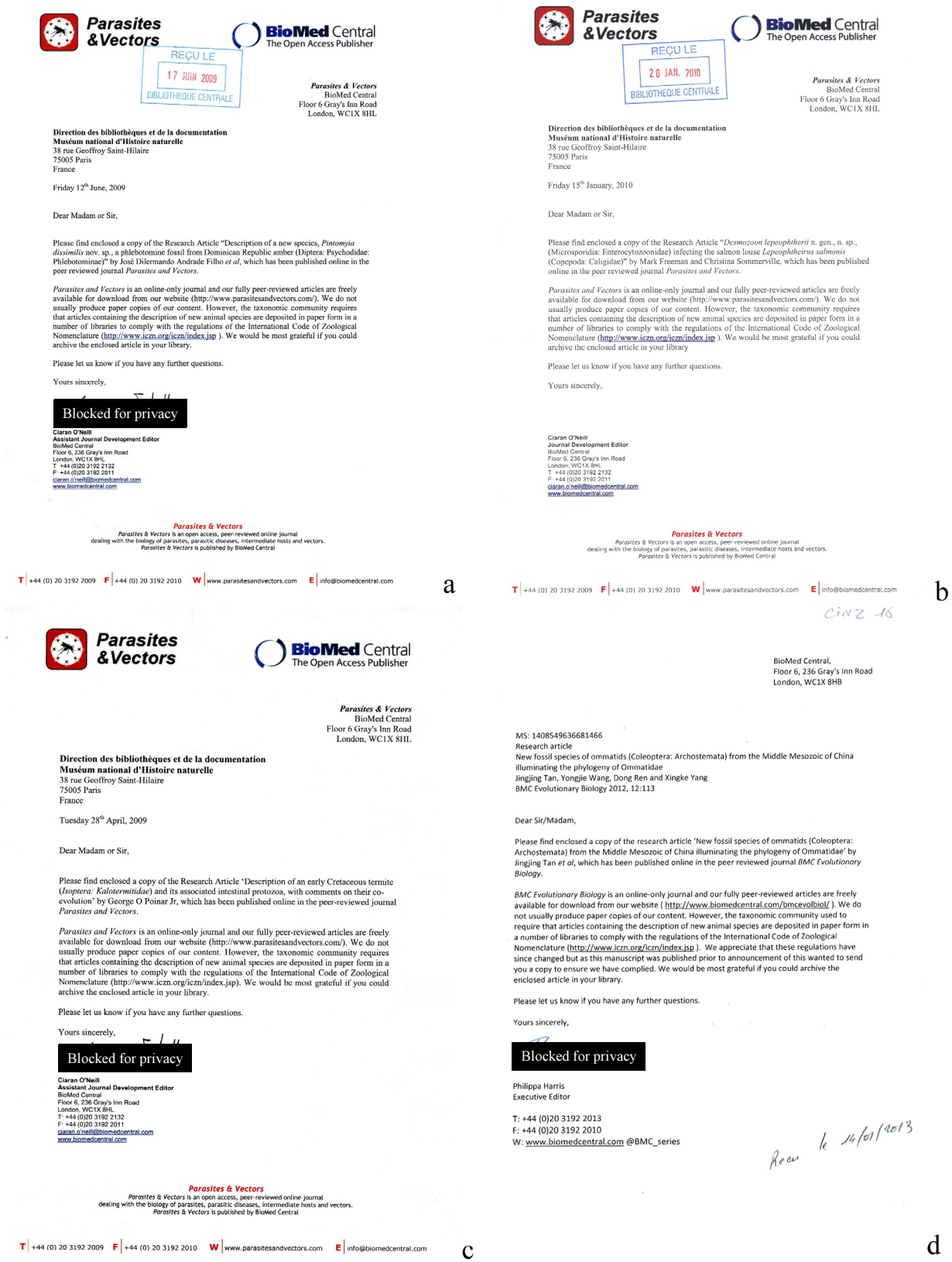

FIGURE 5. Accompanying letters of four documents received by the Paris Museum library: facsimiles of PDFs of (a–c) three works published by *Parasites & Vectors* (Andrade Filho *et al.* 2009, Freeman & Sommerville 2010, Poinar 2009) and (d) a work published by *BMC evolutionary Biology* (Tan *et al.* 2012), letter received on 14 January 2013.

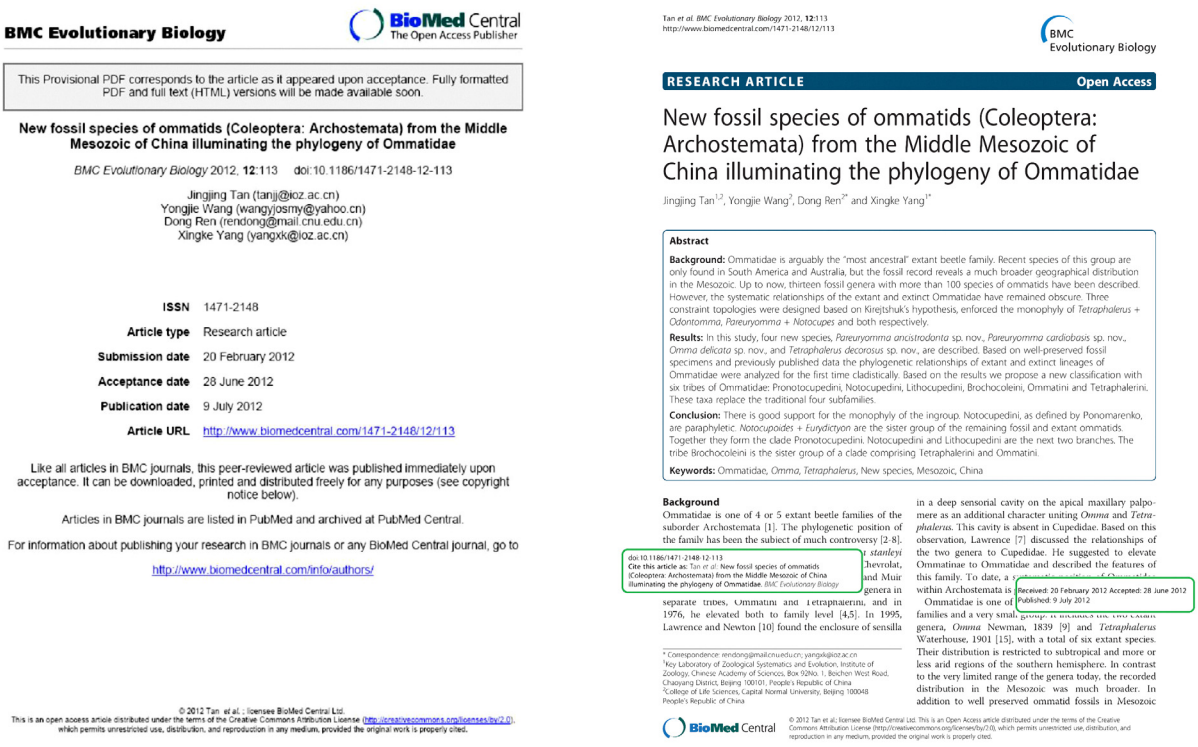

FIGURE 6. First page of PDFs of Tan *et al.* (2012) under two different versions, both dated 9 July 2012, as downloaded from the BMC website on: (a) 6 November 2012 (prepublication); (b) 16 December 2012 (final publication). In (b), the small boxes surrounded with green are taken from pages 18 (dates) and 19 (DOI and reference).

It is therefore quite clear that, regarding publication dates ***as defined by the* Code**, the information provided by the BMC website is wrong and unreliable for nomenclatural purposes, and this applies to *all* the PDFs produced by this publisher!

Furthermore, comparison of the PDFs of the preliminary and final versions of the paper by Tan *et al.* (2012) shows that several, and quite important, changes have been made in the content of the work between the two versions. Our Figures 7 and 8 show that the four figures of this work presenting drawings of specimens were given different numbers and legends in the two versions, and that one figure was duplicated and another one missing in the provisional PDF. According to the document examined, the same drawings apply to different species in all cases! It is therefore fully misleading to consider that this is the "same work" and the fact that both bear the same publication date *and the same DOI* are very worrying concerning the reliability of the information provided about works published online by this publisher.

Given the fact that BMC journals *all* follow the practice of advanced online publication (*online prepublication*) of unformatted manuscripts, the question raised for the paper of Tan *et al.* (2012) has more generality. Another example for which we have precise information is the paper by Tancoigne *et al.* (2011) that was prepublished on the site of *Frontiers in Zoology* on 18 March 2011, and published in its final form on 14 April 2011, but with mention of the first date as its publication date. This question has no or little consequence in the case of works that do not include nomenclatural novelties (like the latter) or published only online before 2012, as anyway, according to the retroactive Rules of the 2012 amendment, all such works are nomenclaturally unavailable. But this will have consequences for works published electronically after 2011 complying with the new Rules. Article 8.5.2 now states that the publication date of any such electronic work must be given in the work itself. Although this Article does not state this explicitly, it seems quite clear that this date must be accurate, and not several months later than the date announced on a website or a PDF. In the case of papers for which facsimiles have been deposited in libraries, as the facsimile must have been prepared *after* creation of the formatted PDF, the deposition date of the facsimile,

if known, can provide at least an “earliest date known” of existence of the latter, as we have done here in Table 2. But in the absence of such copies, the actual publication date will remain unknown, which may be a problem in case of conflict of synonymy or homonymy.

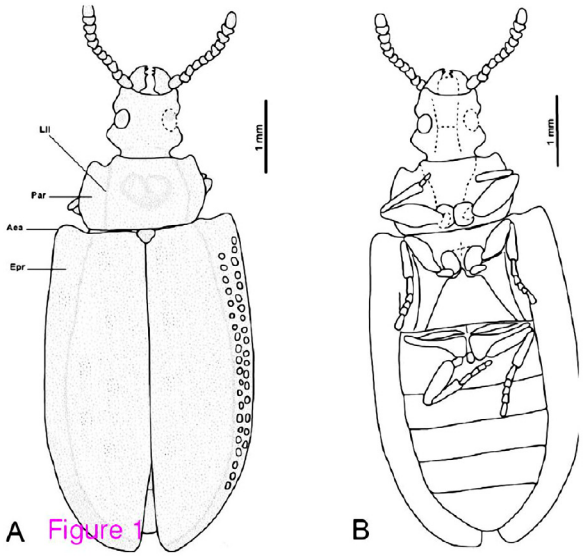

Figure 1 ***Pareuryomma cardiobasis*** **sp. nov.,** holotype, No. CNU-C-NN2010809 *Pareuryomma cardiobasis* sp. nov., holotype, No. CNU-C-NN2010809. A, line drawing, dorsal view. B, line drawing, ventral view. Abbreviations: Aea = Anterior elytral angle; Epr = Epipleural rim; Lll = Lateral longitudinal line; Par = Paranotum

a

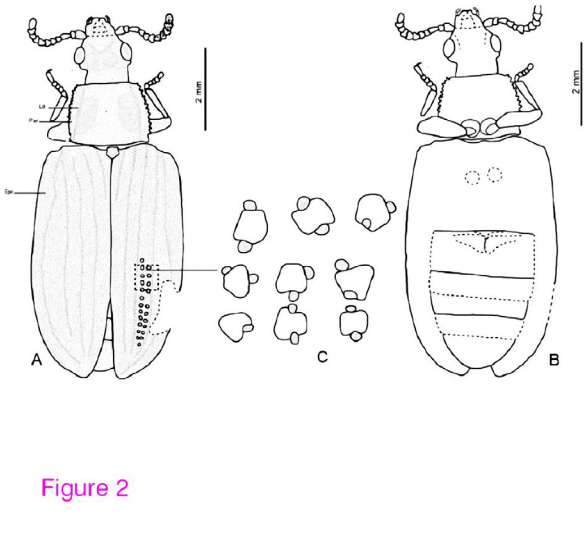

Figure 2 ***Tetraphalerus decorosus*** **sp. nov.**, holotype, No. CNU-C-NN2010812 *Tetraphalerus decorosus* sp. nov., holotype, No. CNU-C-NN2010812. A, line drawing, dorsal view. B, line drawing, ventral view. C, line drawing of elytral cells. Abbreviations: Epr = Epipleural rim; Lll = Lateral longitudinal line; Par = Paranotum

b

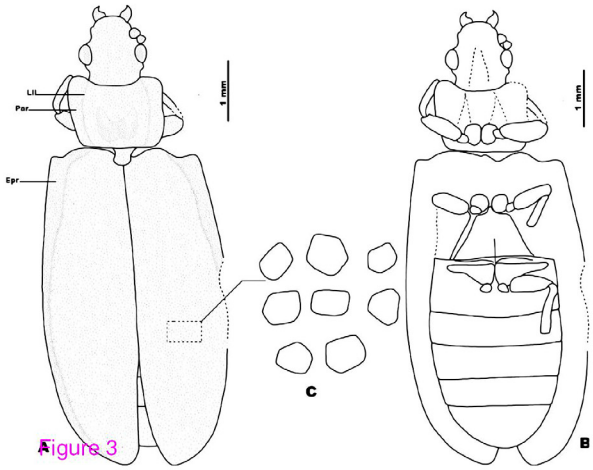

Figure 3 ***Pareuryomma ancistrodonta*** **sp. nov.** holotype, No. CNU-C-NN2010808 *Pareuryomma ancistrodonta* sp. nov. holotype, No. CNU-C-NN2010808. A, line drawing, dorsal view. B, line drawing of ventral view. C, line drawing, elytral cells. Abbreviations: Epr = Epipleural rim; Lll = Lateral longitudinal line; Par = Paranotum

c

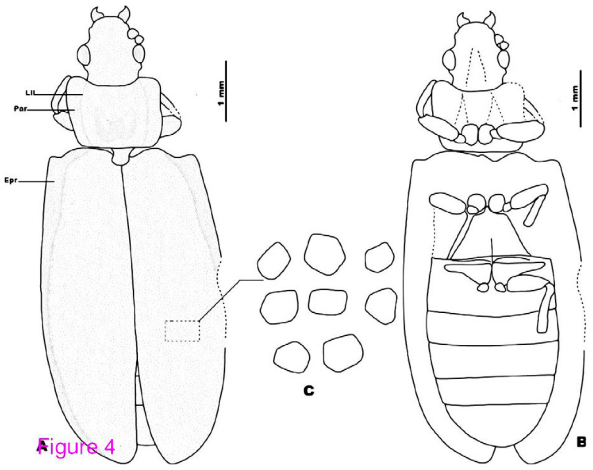

Figure 4 ***Omma delicata*** **sp. nov., holotype, No. CNU-C-NN2010813.** A, line drawing, dorsal view. B, line drawing, ventral view. Abbreviation: Epr = Epipleural rim

d

FIGURE 7. Four figures of prepublication of Tan *et al.* (2012), as downloaded from the BMC website on 6 November 2012. Note than fig. 3 and 4 are identical but with different legends.

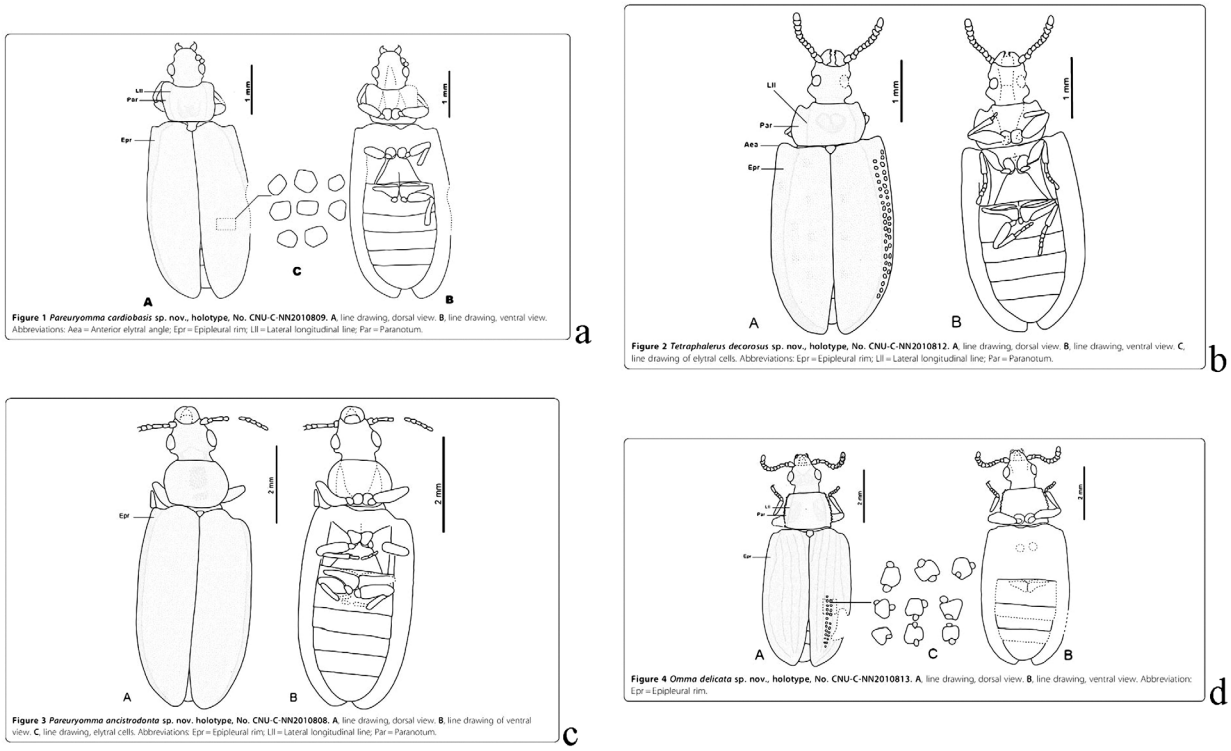

FIGURE 8. Four figures of final publication of Tan *et al.* (2012), as downloaded from the BMC website on 16 December 2012. Compare with our Figure 7 and note that: fig. 1 of final publication corresponds to fig. 3 and 4 of prepublication but with legend of fig. 1 of prepublication; fig. 2 of final publication corresponds to fig. 1 of prepublication but with legend of fig. 2 of prepublication; fig. 4 of final publication corresponds to fig. 2 of prepublication but with legend of fig. 4 of prepublication; fig. 3 of final publication does not appear in prepublication but its legend is that of fig. 3 of prepublication.

We have no evidence that paper copies of unformatted "provisional PDFs" were ever distributed or deposited in libraries but, if this happened, because of Article 9.12 they would be in the same situation as the other paper copies mentioned above: they would be facsimiles of unavailable works (the "preliminary versions" of works subsequently published online), and therefore unavailable themselves.

In the unlikely but not impossible case where, for some reason (e.g., withdrawal of manuscript by author), the "*final version*" later happened to be never published, the online "*preliminary version*", and eventually its facsimiles deposited in libraries, would remain unpublished documents.

Although all these discussions may appear as futile quibbling, they are not, for two reasons: (1) a period of several weeks or months may have elapsed between the date of online accessibility of the "*preliminary version*" and that of publication of the "*final version*", which is far enough for allowing the publication of another work describing the same taxa; (2) in case the "final" online version is never published, it is important to know that such a "*preliminary version*" is not nomenclaturally available. All these considerations strongly suggest that the best solution to avoid any problem of this kind in taxonomic works is to adopt the editorial policy that was that of *Zootaxa* until 2012 and which is still that of other journals, and to publish both online and printed versions as distinct documents, with different ISSN/ISBNs, *strictly on the same day*, and to completely reject the practice of electronic prepublication of taxonomic papers.

Other nomenclatural problems regarding these publications

Despite the low number (44) of papers published by BMC before 1 October 2013 that include nomenclatural

novelties, several of them contain nomenclatural mistakes of various kinds, some of which also have bearing on the availability of these novelties.

Some of the mistakes in these works are simple misprints without nomenclatural consequences, that just testify to quick and superficial proof-reading, such as the absence of italics and of a capital at the beginning of the genus nomen "*evandromyia*" (Carvalho *et al.* 2011: 1), the use of the term "*haplotype*" instead of "*holotype*" (Bargues *et al.* 2011), of the word "*synonomize*" instead of "*synonymize*" (Lin & Hastings 2013: 12), or of the strange abbreviation "*nect.*" Instead of the Latin term "*nec*" (Tan *et al.* 2012: 7).

Chantangsi *et al.* (2008: 12) recognise an "*iconotype*" although such kinds of "types" do not exist in zoological nomenclature.

The paper by Correa *et al.* (2010) testifies to a confusion between taxonomy and nomenclature, e.g. in the sentence: "*Most genus names are not fixed and are based more on phenotypic resemblances than on sound evolutionary and phylogenetic considerations*" (p. 8). Of course this statement applies to the taxonomic concept of genus used, not to the generic nomina. On the same page, the authors state that, for some of the genera they recognise, some nomina are "*preferable*", an incorrect term, as priority is a Rule that must be followed, not a "preference" or a choice. An uncertain sentence like this should have no place in a taxonomic paper: "*According to the ICZN,* Lymnaea *should be the unified name, but given that the type species belongs to clade C2,* Galba *could be a more appropriate name*" (p. 8). The paper introduces an incorrect subsequent spelling (*Catascopium* for *Catascopia*) and does not implement in its tab. 1 and fig. 1 the use of the generic nomina presented as valid in the text, which makes the understanding of the whole text difficult.

The generic nomen *Pareuryomma* is presented in the "Remarks" of Tan *et al.* (2012: 7) as an emendation: "*we amend the genus name from* 'Euryomma' *to* 'Pareuryomma'". This is incorrect, because the replacement of *Euryomma* by *Pareuryomma* was not due to the former one being an incorrect original spelling, but a junior invalid homonym: instead of an emendation, *Pareuryomma* is a *nomen novum*, as rightly written in the synonymy—but the presentation of this synonymy itself is incorrect and incomprehensible.

None of these mistakes and awkwardnesses has real nomenclatural consequences, but they testify to a poor editorial work regarding taxonomy and nomenclature, or to the absence of such a work. A few other errors have nomenclatural consequences, however.

The original spelling of the tribe nomen *MILLARDINI* coined by Lecompte *et al.* (2008), which is based on the generic nomen *Millardia*, is incorrect. Since it is nomenclaturally unavailable for having been published only online, this spelling does not have to be conserved by virtue of Article 29.4 of the 1999 *Code*, so that if this nomen is again published in order to become available, it should be corrected into *MILLARDIINI*. Let us note that the nomen *MALACOMYINI* proposed as new in the same paper had already been used by Ducroz *et al.* (2001) but was a *nomen nudum* for missing a type-species designation. In order to be used as valid, this nomen will require to be made available in a third publication. This unfortunate repetition of unavailable nomina for a new taxon is not unique in the recent years (see e.g. Dubois 2012*b*).

The new specific nomen *Paleoleishmania neotropicum* coined by Poinar (2008) is unavailable for having been published only online, but it would be so even if it had been published on paper, as it does not include an "*explicit fixation*" of holotype or hapantotype as required by Article 16.4 of the 1999 *Code*. If published again to become available, this mistake should be corrected.

The new specific nomen proposed by Depaquit *et al.* (2009), even if it had been duly published, would be questionably available as it also misses an "*explicit fixation*" of holotype. "*One holotype female*" in the Paris Museum is mentioned on page 5, but no information is given to distinguish it from the other seven females studied and it is not specified if this is the specimen shown in fig. 2. This case is borderline and the potential availability of the nomen could be discussed, but, in case the nomen was to be published again in a new paper complying with the *Code*, this would be a good opportunity to correct these deficiencies and to make the nomen indisputably available.

Fregin *et al.* (2012) published three new familial nomina of birds: *ERYTHROCERCIDAE*, *MACROSPHENIDAE* and *SCOTOCERCIDAE*. The PDF of their paper provides a precise publication date (25 August 2012) and the following statement: "*We have registered this publication in ZooBank under the following LSID:* (…)". This paper and these nomina indeed appear on the *ZooBank* website. Therefore, this publication complies with the conditions of the new Article 8.5 and these nomina would appear nomenclaturally available. Unfortunately, this is true only for two of them. As a matter of fact, as proposed in this publication, the familial nomen *MACROSPHENIDAE* is unavailable, as no diagnosis or "*description or definition that states in words characters that are purported to differentiate the*

taxon" (Article 13.1.1) was provided, on the pretext that "*no diagnostic morphological characters that are shared by all its members are known*" (Fregin *et al.* 2012: 8). But nowhere in the *Code* or in taxonomic textbooks does the requirement for such diagnoses appear, and this would be unjustified. *Polythetic* taxa (Sneath 1962) are not rare in taxonomy (see e.g. Dubois 1988), which is not shocking at all by itself: if taxa are to correspond to evolutionary entities there is no reason why all their members should share some "diagnostic" or even "apognostic" characters. But such taxa can always be diagnosed by a combination of characters, some applying to some of its members, and others to other members, i.e. in a relative or composite way (with possible overlapping with the diagnoses of sister-taxa), not in an absolute and monothetic way (see examples e.g. in Dubois & Raffaëlli 2009, 2012). The *Code* just requires any kind of diagnosis, not necessarily an *apognosis* (Dubois 1997). The authors could well have provided an *idiognosis* (Dubois & Raffaëlli 2009), that could apply to all species of the family.

Finally, the paper by Tan *et al.* (2012) proposes a new tribe nomen *PRONOTOCUPEDINI*, but this nomen is nomenclaturally unavailable, not only for failing to mention the nomen of its type-genus (Article 16.2), but, even worse, for not being based on an available and then considered valid generic nomen (Articles 11.7.1.1, 29.1)! If made subsequently available in another work, a nomen for this tribe should be based on the nomen of one of its two genera currently recognised as valid, *Eurydictyon* or *Notocupoides*.

All these cases again testify to the poor mastering of nomenclatural Rules by a number of recent taxonomists, referees and editors, even among professionals, and to the weak interest and attention given to these matters by BMC publisher and editors.

Papers published by BMC after 3 September 2012

All 15 taxonomic papers including nomenclatural novelties published by BMC after the publication of the 2012 amendment should have followed this amendment. Unfortunately, it was the case for only 3 (20 %) of them, despite the publication in one of these journals of a paper (Minelli 2013) specifically devoted to this question. Table 2 provides the list (which might also be incomplete) of the 15 papers we found on the BMC website, published between 3 September 2012 and 1 October 2013, that contain new nomina or nomenclatural acts. We examine below for each of them whether it complies with the conditions (C4) to (C7) above for a nomenclatural novelty introduced in a work published online to be available: (C4) this work must have been registered *before* publication in *ZooBank* and contain evidence, in the work itself, that such registration has indeed occurred; (C5) this document must be, or be "*intended*" to be, permanently archived by "*an organization other than the publisher* (…) *and* (…) *capable of doing so*"; (C6) the *ZooBank* entry must provide the name and Internet address of this organisation; (C7) this entry must provide the ISBN/ISSN of this work[40].

Works preregistered in *ZooBank*

The new nomina proposed by Freeman *et al.* (2013) and Yoon *et al.* (2013) were so in works that were properly preregistered in *ZooBank*, and the entries in *ZooBank* provide indeed the information required by Article 8.5 of the 2012 amendment, so these nomina are doubtless nomenclaturally available[41].

When proposing their new nomen *Bathymodiolus antarcticus*, Johnson *et al.* (2013) apparently followed the 2008 proposed amendment rather than the 2012 amendment: they mentioned the *ZooBank* registration number of the nomen itself (urn:lsid:zoobank.org:act:47DBB0D0-E4A8-49DE-9EC5-A86133CFBACA), which in fact is not required for nomenclatural availability, instead of that of the work which included it

40. In fact, this formulation does not correspond to the reality of the current structure of *ZooBank*. The ISSN does not appear in the individual entry of the publication itself, but in the general entry of the periodical at stake. This absence of correspondence between the requirements of the 2012 amendment and the real application *ZooBank*, although both are under the control of the Commission, may be confusing for users of *ZooBank*, especially newcomers.

41. Let us note however that there is a mistake in the *ZooBank* entry for the "name" *Omanicotyle heterospina*, which is credited to Yoon *et al.* (2013), although these authors just introduced an aponym (new combination) of the nomen *Bivagina heterospina* Mamaev & Parukhin, 1974. An aponym keeps the same authorship, date and onomatophore as its protonym, it is not a distinct "name" with its own author and date (for details see Dubois 2011*a*, 2012*a*).

(urn:lsid:zoobank.org:pub:8F5506FB-A40B-4A61-B182-41E5FC6C0749). However, according to the "*Examples*" section of Article 8.5.3 (see Table 1), this information is acceptable for nomenclatural availability of this new nomen.

Works not preregistered in *ZooBank*

The 18 new nomina introduced by Poinar & Steenberg (2012), Bilandžija *et al.* (2013), Pyron *et al.* (2013), Lamsdell & Selden (2013), Stein *et al.* (2013), Kadej & Háva (2013)[42], Liu *et al.* (2013), Rabi *et al.* (2013) and Lin & Hastings (2013) are unavailable simply for having been published online in works not preregistered in *ZooBank* and not stated to have been so in the publication itself.

The papers by Thompson *et al.* (2013), Lima *et al.* (2013) and Lee & Bezděk (2013) present an unexpected situation. In each of the three papers, it is stated that this work has been preregistered in *ZooBank* prior to publication, and LSIDs are provided, so that it would appear that the nomenclatural novelties they contain (see Table 3) are nomenclaturally available. However, at least at the time of writing these lines (13 October 2013), none of these works, of the new nomina or nomenclatural acts they contain or of the LSIDs cited, are present on the *ZooBank* application[43]! These three works are stated on their PDFs to have been published respectively on 26 April, 3 August and 10 September 2013, dates which are wrong if they are the dates of prepublication of the provisional versions of these works (see above), but at least it is clear that their final, formatted versions were published before 13 October 2013, as we downloaded them before that date. Therefore the conditions (C4) to (C7) above appear not to have been fulfilled and the nomenclatural novelties at stake appear to be unavailable. However, such a situation seems to be open to several interpretations. The simplest and most straightforward one is that the authors forgot to preregister their works in *ZooBank* before publication. In such a case, and according to the examples given for Article 8.5.3.3 in the 2012 amendment (see Table 1), these nomenclatural novelties are unavailable, and could not be made so by subsequent registration: in order to become available, they would need to be published again, following the *Code*'s requirements. However, another possibility would be that the authors did indeed preregister their works, but that, for some mysterious reason, these registrations were later erased from *ZooBank*, or that they are still pending display on the website. In fact, this interpretation seems implied by the fact that the authors were able to mention LSIDs for these papers, and it is unlikely that they "invented" them! But then the 2012 amendment is silent about the nomenclatural interpretation and consequences of such a possibility!

To sum up the information in Table 2, from 4 September 2012 to 30 September 2013, BMC published at least 15 papers including nomenclatural novelties, but stated to have registered only 6 of them (40 %) in *ZooBank*, but of these 6, only 3 (20 %) were indeed mentioned on the *ZooBank* website on 13 October 2013. If such figures have some generality among e-publications, the least that can be said is that, one year after the publication of the 2012 amendment, its impact on such publications is quite disappointing.

BMC justifications

A very enlightening text by Tim Sands (Executive Editor, *BMC evolutionary Biology*) and Elizabeth C. Moylan (Biology Editor, BMC series journals) is worth quoting integrally here (except for the many Internet addresses it is stuffed with, which render its reading awkward):

> "*BioMed Central first approached the* International Commission on Zoological Nomenclature […] (*ICZN), the body providing the rules by which animal species are named, in September 2005. We wanted to ensure that our journals best served the needs of the taxonomy and biodiversity research communities and ensure that we complied*

42. Kadej & Háva (2013) introduced their first new specific nomen under two distinct "original spellings": *Cryptorhopalum acevedoi* (p. 2) and *C. ecevedoi* (p. 3), the latter being clearly a misprint. If this nomen is published again in a way compliant with nomenclatural availability, only the spelling *acevedoi* should be used.
43. However, the names of some the two authors of these papers, as well as the references of other papers co-signed by them, are indeed registered in *ZooBank*.

with the rules of the International Code of Zoological Nomenclature […].

In order to comply with 'the Code', BioMed Central had to guarantee […] *that printed copies of papers describing zoological taxa were available at five major publicly accessible libraries. This was a slightly bizarre state of affairs in the digital age, when anyone could simply access the article online.*

The ICZN proposed a revision to 'the Code' in 2008, to expand the methods of publication allowable and explicitly include electronic publications. Four years later, and after much debate, the ICZN has now voted […] *to recognise electronic-only publication as 'legitimate' if the publication is registered in the ICZN's official online registry,* ZooBank […].

This is a highly significant development for BioMed Central's online open access journals given the wealth of zoological taxonomic research we publish […].

In an interview […] *for* BMC Evolutionary Biology […] *outlining the changes to 'the Code',* Dr Frank-Thorsten Krell […]*—Curator of Entomology at the Department of Zoology, Denver Museum of Nature & Science, and Commissioner of the International Commission on Zoological Nomenclature and Chair of the ICZN ZooBank Committee— discusses the implications the new code has for authors and Editors.*

'We had arrived at the awkward situation that open access papers, having the widest possible availability to readers, were unavailable for nomenclature.' *Dr Frank-Thorsten Krell, Commissioner, ICZN.*

As well as allowing publication in a wider range of sources, Dr Krell points out that publication in online open access journals actually improves upon the existing requirement within 'the Code' to disseminate findings widely. Ironically, before this change publication in obscure and little-read print journals would fit the letter of 'the Code', while respected, highly-read and open access online publications were excluded.

The new amendment to the International Code of Zoological Nomenclatures brings zoology in line with the requirements of botanists and mycologists who voted last year […] *in favour of electronic publication resulting in an amendment to the International Code of Nomenclature for algae, fungi and* plants […]. *BioMed Central is updating its editorial policies to ensure that taxonomic publications in our journals conform to the various requirements of each Code.*

The great hope […] *is that MycoBank, ZooBank and other similar online resources will have the transformative effect on taxonomic science that GenBank did for the genomics community. Now the challenge is to fill them with taxonomic data.*

Our thanks to the ICZN for fruitful discussions over the years and to our colleagues Matt Cockerill, Philippa Harris, Matt Hodgkinson, Genevieve Horne, Helen Whitaker and Hans Zauner for championing the cause over the last 7 years." (Sands & Moylan 2012).

These lines deserve a few comments.

(1) Whereas online publication is a very recent phenomenon, the future of which is unknown, zoological nomenclature has existed without interruption for more than 250 years, and has been regulated by an international *Code* since the very beginning of the 20th century (Melville 1995). This *Code* has regularly and slowly evolved, not through "revolutions" but through successive "adaptations", often implemented by way of a "trial-and-error" process (Dubois 2005: 396, 2011*a*). This is because nomina are the key to the information about biodiversity that has been stored in the enormous taxonomic and biological literature for two and a half centuries, and this key should not be broken and become inefficient if we still want to retrieve this information. One of the main purposes of the *Code* is to maintain a long-term continuity in the status of nomina, which imposes some constraints in the evolution of the Rules governing their use and management. Any change must be studied in detail before being implemented: as all Rules are interrelated in a single functional body, any change brought to one Rule may have unexpected consequences in other Rules and in nomenclature as a whole. For this reason, changes in the Rules, *in particular retroactive ones*, should be done only with great care and prudence, to avoid deleterious consequences (see examples in Dubois 2010*b*). In such a situation, it should be put to the credit to the Commission that such a drastic change as allowing all of a sudden, after 250 years, the electronic availability of new nomina, was decided after a careful collective reflection and discussion, and was not made retroactive except for a few months (see footnote 5, p. 6 above)—as would have been for example the decision of making available the famous five paper-printed copies that never provided availability to the online works of which they were facsimiles. Some taxonomists were even in favour of a longer delay before adoption of such changes ("*it is urgent to wait*"; Dubois 2010*a*: 21). The discussion above, in particular regarding some of the problems related to distinction between

paper publications and facsimiles, sounds indeed as an indication that perhaps some of the decisions taken were not thought in deep enough beforehand, or at least that the *Code* should be more explicit in some cases.

(2) Taxonomic literature is one of the oldest scientific literatures. It has accumulated an enormous amount of information. This information was produced patiently by hundreds of thousands of workers around the world, in a modest and serious way, far from glitter and ostentation, because taxonomists have soon realised that the task of describing the species diversity of the planet was a gigantic one that would take centuries. It was published in various countries and languages in thousands of periodicals and books. This unrivalled collective enterprise has been possible only in a spirit of modesty, patience and collaboration. Many actors of this enormous endeavour were not even paid for this work. Still nowadays, at least in some parts of the world (mostly Europe and North America), a large proportion of this important and urgent work is carried out by non-professional taxonomists (Löbl & Leschen 2005; Fontaine *et al.* 2012)—thus testifying to a strong deficiency of "official science" to address the *taxonomic urgency*, i.e., the unprecedented combination of the taxonomic impediment, taxonomic gap and biodiversity crisis (Dubois 2010*d–e*; Tancoigne & Dubois 2013). The achievements of taxonomy have largely been produced in the shadow, and they were made possible not only by the personal involvement of countless researchers, often without funding or with very limited financial support, but also of countless publishers and editors of journals of all kinds and importance, who published hundreds of millions of pages, tables and plates describing and illustrating in every details the living organisms of our planet.

In contrast, what have been the achievements so far of electronic publishing in the field of taxonomy? It has produced a few hundred pages[44], part of which were relegated in their online "supplementary material", and it has shown so little interest and respect for the nomenclatural Rules in force for the whole taxonomic community that it has already created a number of nomenclatural problems that will now have to be solved. Of the 106 nomenclatural novelties BMC published, only 5 are nomenclaturally available. We think electronic publishers should be less arrogant when they speak of their predecessors. To professional taxonomists who have devoted their life to the study and description of biodiversity, and often to voluntary editorial work for taxonomic journals, the words of BMC about "*obscure and little-read print journals*" cannot but sound as an insult which requires excuses[45]. But for these "*obscure and little-read print journals*" and the, often unpaid, researchers and amateurs who made their publication possible, including through making for free the secretariat work of typing, formatting and preparing the manuscripts for printing, we would know much less about the living organisms of our planet[46]. Furthermore, it seems to be a paradox that the publishers of these contemptible journals have demonstrated a better knowledge of nomenclatural Rules than publishers of big and widely read journals!

(3) Contrary to what happens in many other scientific fields, where many publications become soon obsolete, taxonomic and nomenclatural publications have a very long life. Works from the middle of the 18th century are still used by taxonomists of today, mostly for their nomenclatural content. This huge literature of varied origins has been spread in many libraries worldwide but has long been accessible only or mostly to specialists, so that the production and international electronic distribution of digitalised copies of these works is an *enormous progress* which is *highly welcome* by all taxonomists. Similarly, taxonomists are doubtless in favour of electronic diffusion of their works and of wide access to these documents. But this should not be done at the expense of their quality. Online taxonomic publications should allow a progress in taxonomy, not a regression in terms of quality of work,

44. Altogether, the 44 works listed in Table 2, which cover a period of 8 years, represent a total of 687 pages, excluding the "additional files" which do not even appear in the PDFs of these papers. By way of comparison, during the last *week* before the completion of the first version of the present paper (5–9 November 2012), the journal *Zootaxa* published 683 pages in 31 papers. These figures allow to put a perspective to the statement above about "*the wealth of zoological taxonomic research*" published by BMC. Although, according to its website on 13 October 2013, BMC publishes 257 journals, none of them has the terms "systematics", "taxonomy" or "nomenclature" in its title.

45. This case is not unique. This kind of language is quite common among activists in favour of a shift of all nomenclatural works to online-only publications. For example, on 29 September 2005, a member of the Commission posted "funny words" in the *Zoobank-list* forum [http://list.afriherp.org/pipermail/zoobank-list/2005-September/000031.html] about the imaginary *Upper Croatian Journal of Tardigrades*. The use of "humour" in scientific publications should be made with caution, because the "sense of humour" may differ among people, communities and cultures. Some people may find a "joke" funny whereas others will take it as contemptuous or aggressive. It is difficult to know whether this ill-inspired "humour" shows more contempt for Croatia, its inhabitants and taxonomists, or for Tardigrades, but to be sure it does not show much respect for the centennial work of countless taxonomists of all countries to improve our knowledge of the biodiversity of our planet, even in its most "modest" forms. Using an imaginary example like South Kentucky instead of Croatia might perhaps have sounded less aggressive to non-American readers.

particularly regarding nomenclature. If electronic publications contribute to an increase in the nomenclatural chaos, they will not be perceived positively by practising taxonomists and will not qualify as "*respected*" publications by their community. E-publishers should pay more attention to the needs of taxonomists, and not only to their own needs. As mentioned above, taxonomic publications have so far produced hundreds of millions of pages, including costly colour plates, monographs, etc. Until the *Code* was changed in 2012, it required paper publication of taxonomic works for availability of nomina and nomenclatural acts. Well, compared to these millions of pages printed in the last centuries, printing a few hundred pages to comply with this international Rule can certainly not be taken as an excessive and insuperable requirement, especially when it concerns big and wealthy companies that certainly have less financial problems than small taxonomic journals. Burning tears of sympathy and compassion for these unfortunate companies doubtless come to the eyes of taxonomists when they read a sentence like this in *BMC evolutionary Biology*: "*Unfortunately, the current version of the ICZN code makes life needlessly complex for online journals that publish species descriptions (such as* BMC Biology*,* BMC Evolutionary Biology *and* Frontiers in Zoology*) by requiring the production of printed copies*" (Zauner 2009)[47]. Well, the terrible difficulty to find a printer to print a few dozens of pages a year, and the terrible costs this would have entailed for these poor publishers, were certainly worth ignoring the needs of taxonomists and publishing unavailable nomenclatural novelties online, without wondering whether *this* would "*make life needlessly complex*" for taxonomists.

(4) We appreciate the recent decision of BMC to finally pay attention to nomenclatural matters, but we think it comes quite late. The nomenclatural errors in online periodicals discussed above do not take their root either in online publication itself or in the *Code*, but in the deliberate non-respect of the *Code* by professional scientific publishers. The problems posed by online publications in biological nomenclature were new and could not be solved in the snap of a finger. They needed appropriate consideration. Furthermore, one would have expected that these problems would have been primarily addressed by the actors directly involved in online publications, i.e., publishers like BMC. BMC (founded in 2000) is proud to produce 257 open access online periodicals and its website provides very detailed instructions and advices to their potential authors in many domains—but not a single one about nomenclatural Rules. As we have seen above, for seven years these journals have published papers that did not comply with the nomenclatural Rules in force, and they continue to do so after publication of the 2012 amendment (of the 27 nomenclatural novelties published by BMC after that date, only 3 are available). According to Sands & Moylan (2012) themselves, this company started being interested in nomenclatural matters and developed a first contact with the Commission only in 2005, and the decision to "*update[e] its editorial policies to ensure that taxonomic publications in our journals conform to the various requirements of each Code*" was announced only in 2012. But the problems caused by unprofessional publication of unavailable nomina before and after that date remain and will have to be resolved. This point was discussed in detail above.

(5) The absence of genuine interest of the publisher and editors of these journals is stressed by the bad and arbitrary indexing of these publications regarding their nomenclatural novelties. As can be easily checked in the third column of our Table 3, until October 2013 at least, terms like "new species", "new genus" or "new family" did not systematically appear on first page in their abstracts or keywords, so that search of nomenclatural information in the website is hazardous and sometimes very time-consuming.

(6) Finally, we wish to point out the use in BMC of incorrect terms to designate nomenclatural concepts and tools. The term "*legitimate*", used in the text quoted above, does not belong in the vocabulary of zoological nomenclature. It does not appear even once in the zoological *Code*. It is a term of botanical nomenclature, and does

46. All along the history of science, many crucial scientific contributions, for example the seminal works of Mendel or Hennig, were published in "*obscure and little-read*" journals of books, whereas many terribly bad works were loudly published in well-known and highly praised journals. Despite the current destructive ideology and practice of "impact factors", basing the evaluation of the scientific "quality" of a work on the journal where it was published, instead of studying its content, is not a serious and advisable scientific approach (Shubert 2012). The use of "impact factors" and other bibliometric indicators also contributes to "disciplinary rejection", i.e., the overall underrating of some disciplines, like taxonomy, for which such indicators are inappropriate (Ellis 2002). In fact, in many cases only time will tell if a scientific work was important when it was released. Furthermore, nowadays the fact that a journal was released locally and in few printed copies is not a genuine problem anymore, at least as long as the Internet is working, as even the rarest and most obscure works can be scanned and instantaneously distributed worldwide by millions of copies—which nevertheless remain no more than copies of the original publication.
47. A similar complaint appears in the text of Polly (2013: 2) who mentioned the "*great increase in cost*" that resulted for his periodical from the (supposed) need to print its PDFs. The idea that *publishers* can *complain* about the need of *printing* journals is indeed a new one in the history of mankind!

not have a strict equivalent in zoological nomenclature, although it corresponds there partly to the term "*available*" (see Dubois 2011*b*: 50). Similarly, the use after 2007 in several BMC papers of the terms "*section 8.6*" in the standard sentences mentioned above is fully incorrect. There are no "sections" in the zoological *Code*, but only chapters and articles, and what is meant here is "*Article 8.6*"—but there are sections in the botanical *Code*. It therefore seems that the persons in charge of taxonomy in BMC in the period 2006–2013 were better acquainted with botanical than with zoological nomenclature, and did not seem to have realised that these two nomenclatural systems are so widely divergent that, as desirable as this may seems, it is quite unlikely that they will once be unified under a single "*Biocode*" (Dubois 2011*b*). Of course, the use of these incorrect terms (legitimate, section) does not impede communication but testifies to a lack of knowledge of the official text of the *Code*, that is a founder text for all zootaxonomists. Such gross terminological mistakes certainly elicit a justified feeling of unease among them.

Similar problems in other periodicals

Similar problems do exist with other online publications, but various situations are encountered, so that no generalisation is possible: each publication must be carefully checked by itself to ascertain the possible availability of nomenclatural novelties it may contain.

PLoS

Another important company that occasionally publishes taxonomic papers is the Public Library of Science (PLoS). The site of *PLoS One* [http://www.plosone.org/static/information.action] provides only the following laconic information: "*Open-access—freely accessible online, authors retain copyright*". We did not carry out a complete and detailed investigation among the hundreds of works published by PLoS that might contain nomenclatural novelties, but a brief survey of the online journals *PLoS One* and *PLoS Biology* showed us that at least six distinct policies have been followed by the publisher of these journals over the years:

(Po1) In the first years of their existence, starting in 2006, these journals simply published the online version without any printed copy (e.g., Sereno *et al.* 2008). The nomenclatural novelties that such works may contain were clearly unavailable in their original e-publications.

(Po2) In 2008, some papers at least followed a policy similar to that described above for BMC. For example, in the PDF of their work, bearing the publication date of 28 May 2008, Fisher & Smith (2008: 2) stated: "*In accordance with section* [sic] *8.6 of the ICZN's International Code of Zoological Nomenclature, printed copies, and a pdf version of the article have been sent to be deposited at the following six publicly accessible libraries:* (…)". Strangely, the same text appears, under the signature of Donat Agosti, in a "Comment" dated 29 May 2008, available from the web page of this paper, which is redundant with the PDF of the work such as it appears today on the *PLoS One* website, suggesting that perhaps this "Comment" was incorporated in the PDF only after its first electronic release. Anyway, for reasons discussed at length above, under the 2012 amendment these six copies qualify as facsimiles, not as an autonomous paper publication, and they do not provide availability to the three species nomina proposed as new in the paper. Let us note that, although the Paris Museum library is listed among the six libraries chosen for this "deposition", we found no trace of this work (or of any other printed work from the journal *PLoS One*) in this library. Following the 2008 proposed amendment of the *Code*, the three new nomina were also registered in *ZooBank*, but as the final 2012 amendment requires registration of works, not of nomina, and as this is valid only after 2011, these three nomina remain unavailable as of today (except if they were published again as new in a p-publication in the meanwhile).

(Po3) A third publishing policy appeared in 2009. It is illustrated in Figure 9. This policy applied to works originally published only online, following the policy (Po1), in order to provide them retrospectively with nomenclatural availability. On the webpage of the paper by Gingerich *et al.* (2009), which bears the publication date of 4 February 2009, a subsequent "Comment" was added on 22 May 2009, announcing that "*A print-run of numerous copies of the paper has been created on May 22nd May 2009* [sic]" and that these copies are obtainable against payment by "*Anyone who requests a copy*".

FIGURE 9. Three documents concerning Gingerich *et al.* (2009) downloaded from the PLoS website on 18 December 2012: (a) first web page devoted to this work on the website; (b) first page of PDF of work, dated 4 February 2009; (c) comment 2, dated 22 May 2009, accessed through the link "Comments: 2" on top of (a).

This policy was apparently developed as a consequence of a "Comment" posted on 21 May 2009 by "Keesey" (username or patronym?) on the webpage of the paper by Franzen *et al.* (2009), dated 19 May 2009 (Figure 10). Citing Article 8.6 of the 1999 *Code*, the author of this "Comment" stated that the new nomina in this work were unavailable but could be made available by the deposition of copies in five libraries, and asked: "*What is the authors' response? The publishers? Are there plans to address this? (Or should the ICZN be modified?)*". On the same day, the managing editor of *PLoS One* provided the following reply in the same "Comment" section of the webpage:

FIGURE 10. Three documents concerning Franzen *et al.* (2009) downloaded from the PLoS website on 18 December 2012: (a) first web page devoted to this work on the website; (b) comment 7, dated 21 May 2009, accessed through the link "Comments: 13" on top of (a); (c) "formal correction", dated 21 July 2009, accessed through the link "Formal correction: 1" on top of (a).

> "*I am the Managing Editor of PLoS One.*
> *Regarding the requirements for making the name Darwinius masillae nomenclaturally available in the eyes of the ICZN, we have been in discussion [with] Ellinor Michel (the ICZN Executive Secretary) and have additionally*

consultated [sic] *with Richard L. Pyle (an ICZN Commissioner). They have advised us that by doing the following, we have met the ICZN code and therefore the name should be considered nomenclaturally available.*
A print-run of fifty copies of the paper has been created on May 21st. The top sheet of each copy has the following text appended to the footer: 'This document was produced by a method that assures numerous identical & durable copies, and those copies were simultaneously obtainable for the purpose of providing a public and permanent scientific record, in accordance with Article 8.1 of the International Code of Zoological Nomenclature. Date of publication: 21st May 2009'.
Apart from this wording, these copies are identical to the electronic version that is freely available from our web site at: http://www.plosone.org/ar.
These copies are now obtainable from our offices at 185 Berry Street, Suite 3100, San Francisco, CA 94107, USA. Anyone who requests a copy, and tenders a fee of $10 (towards the cost of postage and printing) will receive a copy.
Having made the printed copies available, we have been told by the individuals named above that we have conformed with the relevant ICZN codes. They have also indicated that the proposed resolution is an interim step, which should meet the requirements of the Code until a formal amendment is published within the next few years.
We are very grateful to the ICZN for their actions to resolve this matter.
***Competing interests declared:** I am the Managing Editor of PLoS One.*"

Later, on 21 July 2009, a "formal correction" of this work was posted on the PLoS website:

"*The following subsection should be added beneath the Methods subsection 'Terminology':*
Nomenclatural Acts.
The electronic version of this document does not represent a published work according to the International Code of Zoological Nomenclature (ICZN), and hence the nomenclatural acts contained herein are not available under that Code from the electronic edition. A separate edition of this document was produced by a method that assures numerous identical and durable copies, and those copies were simultaneously obtainable (from May 21st 2009) for the purpose of providing a public and permanent scientific record, in accordance with Article 8.1 of the Code. The separate print-only edition is available on request from PLoS by sending a request to PLoS ONE, 185 Berry Street, Suite 3100, San Francisco, CA 94107, USA along with a check for $10 (to cover printing and postage) payable to 'Public Library of Science'.
In addition, this published work and the nomenclatural acts it contains have been retrospectively registered in ZooBank (http://www.zoobank.org/), the proposed online registration system for the ICZN. The ZooBank LSIDs (Life Science Identifiers) can be resolved and the associated information viewed through any standard web browser by appending the LSID to the prefix http://zoobank.org/.
The LSID for this publication is:
urn:lsid:zoobank.org:pub:0357A28C-0547-4423-8E5C-A069128DF888.
The LSIDs for the Nomenclature Acts are:
Darwinius
urn:lsid:zoobank.org:act:117EE2BF-DCAD-4311-973A-91366AB04003.
D. masillae
urn:lsid:zoobank.org:act:C246EC77-E90B-4FB4-B6CB-ADB473A40320.
No competing interests declared."

Such cases are different from those described above in (Po2), which were based on a misinterpretation of Article 8.6. Here, Article 8.6 is not mentioned and the printing of paper copies was not limited to five. Article 8.1 alone was mentioned and, contrary to BMC which does not send original printed copies of its works to customers and encourages them to print the PDFs from their personal computers, PLoS is ready to provide paper copies of all its works upon request—thus complying with Article 8.1.2. Although, according to the *ZooBank* website, no distinct ISSN was registered for these print copies, the latter seem indeed to qualify as publications in the meaning of the *Code*. However, we must precise that, so far, we have not yet seen a single sample of such printed copies. If such printed copies indeed exist, they qualify as publications and provide availability to the nomenclatural novelties they may contain, but the date of this availability is that of their first distribution as printed versions, not as electronic publications: i.e., 22 May 2009 instead of 4 February 2009 for Gingerich *et al.* (2009), and 21 instead of 19 May 2009 for Franzen *et al.* (2009).

(Po4) After 22 May 2009, the printing of "numerous copies" and their availability for customers was

announced in the online PDF itself, and the printing was stated to have been made on the very same day as the online accessibility of the PDF (e.g., Brochu *et al.* 2010). In this case the situation was almost the same as that of journals like *Zootaxa*, but for the absence of a special ISSN for the paper version. In such cases, if such printed copies have indeed been distributed, the availability of the work seems clear.

(Po5) The next step, in 2012, was a combination of the previous system (printed copies available on request) with preregistration in *ZooBank* (e.g., Glaw *et al.* 2012; Yang *et al.* 2012). As the 2012 amendment is retroactive to 1 January 2012, the availability of such works is provided both by the printed copies and by the online version. It remains to be checked whether they were distributed on the same date or not, but if they were not the valid publication date is the earliest one.

(Po6) Later in 2012, the mention of the possibility to order paper copies was removed, and the only evidence given for availability was the mention of preregistration in *Zoobank* and of electronic archiving, with the incomplete note: "*The electronic edition of this work was published in a journal with an ISSN*", but without mention of this ISSN (e.g., Abella *et al.* 2012: 6, Grohé *et al.* 2012: 3; Sharaf & Aldawood 2012: 3). As Article 8.5.3.2 states that the ISSN number "*is not required to appear in the work itself*", such works are available.

As this brief survey shows, even within the same journal and over a short period of time (2006–2013), at least six different publishing policies were used, which have different nomenclatural consequences: unavailability in (Po1) and (Po2); probable availability (if "*numerous printed copies*" were indeed produced and at least a few of them distributed) in (Po3) and (Po4); availability in (Po5) and (Po6). Therefore, in order to know whether a given work and its nomenclatural novelties are indeed available, it is not enough to know in which e-journal it was published (as is the case for all journals that clearly have a printed edition with its own ISSN), but *the work itself* must be examined carefully to check the information it provides on the conditions of publication.

Other examples

The recently launched *European Journal of Taxonomy* presents also a complex situation. Its website states: "*EJT is an international, fully electronic, Open Access journal in descriptive taxonomy, covering subjects in zoology, entomology, botany, and palaeontology.* (…) *EJT is published and funded by a consortium of (European) natural history museums* (…)*. Printed versions of EJT papers are stored in the institutions making up the consortium and distributed to some major natural history museums and institutions to comply with the rules of the different nomenclatural codes.*"

Despite this latter statement, before September 2012 the paper version of this journal did not comply with Article 8.1.2 of the 2012 amendment, which requires that, to be available, a work "*must be obtainable, when first issued, free of charge or by purchase*". On the *EJT* website, there is no clear and public indication that a paper-printed copy of any work published in this journal may be ordered by anyone (individual or organisation)—in contrast with the situation in periodicals like *Zootaxa*, *ZooKeys* or even *PLoS One* (see above). A single ISSN, which applies to the online version of the journal, is provided on the *EJT* website: 2118-9773. For additional information, on 24 January 2013 our colleague Irene Schatz (Innsbruck, Austria) wrote to the editorial office of *EJT* to inquire about the conditions needed to receive a printed copy of a paper published in *EJT* (Ryvkin 2012), but she never received any reply.

Therefore, the paper printed version of *EJT*, which has no proper ISSN and is not obtainable free of charge or by purchase, does not qualify as an available publication for the purpose of the *Code*. These printed copies of PDFs qualify as facsimiles which, according to Article 9.12, do not provide by themselves availability to the nomenclatural novelties they contain, just like for the BMC and some of the PLoS works discussed above. However this nomenclatural availability is provided for the works published online by this periodical after 1 January 2012 whenever these works were registered in *ZooBank* and contain evidence of this registration by giving the LSID registration number of this work, thus complying with Article 8.5.3 of the 2012 amendment.

In summary: (1) the four works published online by *EJT* in 2011, despite deposition of facsimiles in libraries, are nomenclaturally unavailable according to Articles 8.1.2 and 8.5.1; (2) the 18 works published in *EJT* in the first months of 2012, until the issue **22** of 20 September 2012 of the periodical (work of Durante 2012), which did not mention registration of the work in *ZooBank* and did not provide an LSID for this registration, are nomenclaturally unavailable according to Articles 8.1.2 and 8.5.3 (even for those that have been subsequently registered there, as is the case for that of Durante 2012); (3) the works published in *EJT*, starting with issue **23** of 27 September 2012 of

the periodical (work of Sidorov & Palatov 2012), are available, but only through their online versions, not through their facsimiles deposited in libraries, because they were duly registered in *ZooBank* and their LSIDs were provided in the PDF itself. Just like for the works of BMC and PLoS discussed above, the nomenclatural novelties that the papers of categories (1) and (2) will therefore have to be made available *a posteriori* by proper publication, either on paper or online, following the prescriptions of the 2012 amendment.

Thus, in the case of *EJT*, as no independent paper printed version of the journal, with its own ISSN, has existed and been obtainable, when first issued, free of charge or by purchase, by any interested customer, no nomenclatural availability was provided by printed copies, but availability was provided by the online version as soon as *ZooBank* registration and its LSID were mentioned in the papers. The reverse is true in the case of the periodical *Snudebiller*, for which the website of the Curculio Institute (Mönchengladbach, Germany) states:

> "*The edition of the* Weewil News *is finished after 13 years (2000–2012) at the end of 2012. All first descriptions, new scientific names and nomenclatural acts that were published* ***first*** *as print version (on paper) in the past, can be directly ordered from the Curculio Institute also in future. These print articles were sent out—immediately after its publication— to over 30 major publicly accessible libraries all over Europe. In addition, all articles were published on* Snudebiller CD ROM *(ICZN § 8.6) in the past and will be available indefinitely in the freely accessible* Weewil News *archive on Internet!*
> *From 1 January 2013 onwards all articles appear regularly—in an interactive, web-based form—in the* Snudebiller*. As it did in the past, all first descriptions, new scientific names and nomenclatural acts will be published—with fixed content and format—in the* Snudebiller *journal first as* ***print version*** *(on paper)* ***and*** *only then on Internet as PDF/A (§ 21.9. ICZN-Amendment of 4 September 2012). In addition these articles will be archived—as in the last decade—on the* Snudebiller CD ROM *for the subscribers and our members of the Curculio Institute at the end of the year. Furthermore, all editions of the* Snudebiller *are archived retrospectively on the Internet (*Snudebiller archive*) and are made accessible to everyone for a small fee.*
> *First descriptions and nomenclaturally relevant studies should be accompanied by 'Electronic Comments' in every* Snudebiller *edition, in which illustrations with a high scientific and technical quality should be offered to the readers. These separate articles, which allow an extensive image documentation of empirically established hypotheses to the reader, cannot be realised on paper ('... by printing on paper using ink or toner'; § 8.4.1 ICZN-Amendment)—not even approximately. The rapid scientific advancement in publishing taxonomically significant works during the past 10 years has been accompanied successfully and adequately by digital interactive presentations (e.g., a very large number of pictures, scroll pictures, focus stacking, microphotography, computer tomography and videos). One of the core tasks of the Curculio Institute has always been the support of new scientific illustrations and digital innovations in entomology. With our 'Electronical Comments' we will continue to pursue this way also in future!*" (Sprick & Stüben 2012).

In this case, nomenclatural novelties will be provided by the print version, which, according to this text, will be published before the online PDF, but not by the online version, as it does not seem that registration of the *ZooBank* of the works in this journal is foreseen by the publisher.

As we have seen above, new nomina of taxa published in the online-only journal *Palaeontologia electronica* appeared as early as November 2000. This journal claims to have published 200 CD-ROM copies of the works at stake (Gee 2000), which were "*produced at the same time as the on-line version*" (Polly 2013: 2). If this true, ***and*** if these CD-ROMs indeed "*contain a statement naming at least five major publicly accessible libraries in which copies of the optical disc were to have been deposited*" (Article 8.4.2.2 of the 2012 amendment), the nomenclatural availability was provided by these CD-ROMs but not by the online publication. But anyway this possibility exists only until the end of 2012 (Article 8.4.2). Polly (2013: 3) also wrote: "*We have also registered in ZooBank all 95 zoological names that we published since 2000*". However, as the 2012 amendment requires *ZooBank* preregistration, such *a posteriori* registrations cannot provide nomenclatural availability. This applies to all new nomina published in this journal from December 2012 to May 2013, as the works at stake were not properly preregistered. Preregistration of the nomina in *ZooBank* started only after May 2013, and should, if it is complete, provide them with nomenclatural availability.

Biota Neotropica is an e-journal edited by the "Fundação de Amparo à Pesquisa do Estado de São Paulo" (FAPESP), one of the most important institutions for funding research in Brazil. *Biota Neotropica* was first issued in 2001 and since 2004 nomenclatural acts have been regularly published in this journal. According to its website,

Biota Neotropica is only published online. Nevertheless, a small number of issues were printed up to 2012, allegedly to comply with the requirements of the different nomenclatural Codes. Nineteen libraries are listed on the *Biota Neotropica* website as depositories of these printed copies [http://www.biotaneotropica.org.br/v13n3/en/libraries]. According to information provided by Mr. Tiago Egger Moellwald Duque Estrada on 16 September 2013, the printed version was produced in limited quantities (20 copies, 10 in English and 10 in Portuguese), in order just to attend the specific libraries chosen as depositories. The original information available on the journal's website on 16 September 2013 was (translated from Portuguese): "*Aiming to comply with the requirements of the botanical and zoological codes of nomenclature, 20 printed versions of* Biota Neotropica *are deposited in reference libraries in Brazil and overseas. Authors of new names or new combinations must verify if this procedure satisfies the specific rules of their taxonomic group before submitting their manuscript, since the Editorial Commission will not be responsible for this verification.*" [http://www.scielo.br/img/fbpe/bn/pinstruc.htm]. Although having distinct ISSNs (1676-0603 for the online Portuguese edition, 1676-0611 for the online English edition, 0102-8650 for the online Spanish edition, 1678-6424 for the printed Portuguese edition and 1806-129X for the printed English edition), the printed editions were never produced aiming at wide distribution, even on sale. Thus, the nomenclatural acts published in the printed versions of *Biota Neotropica* were never available because they were not "*obtainable, when first issued, free of charge or by purchase*" and ought to be considered as unavailable facsimiles of the online PDFs. The journal discontinued the printed version from 2013 on, advising its authors that "Biota Neotropica *does not publish papers that include description of new species of taxonomic groups [for] which Nomenclatural Code requires printed copies. Authors are responsible to check the specific requirements of the Nomenclatural Code of the organism they are working with. If your taxonomic group does require printed copies of your publication you should look for another journal to submit your paper. From volume 13 (2013) onwards the production, and deposit in reference libraries, of the printed version of* Biota Neotropica *will be discontinued*". Nevertheless, nomenclatural novelties were still being published in the 2013 edition of the journal, without respect for the criteria that should be met to make them available under the 2012 amendment of the *Code*, such as preregistration of the works in *ZooBank*. We found 61 nomina introduced for new taxa published from 2004 to 2013 in this journal, 56 for species-series taxa and five for genus-series taxa. All these nomina are unavailable under our interpretation that, in order not to be considered a facsimile, the printed version should have been obtainable, when first issued, free of charge or by purchase. At any rate, under any interpretation, this consequence is unescapable for the nomina introduced in 2013, because they lack both printed versions and *ZooBank* preregistration.

Every year, many new online-only periodicals are launched. Some proudly announce on their website that they do not produce printed editions and exist only on the Web: e.g., *Herpetologia brasileira*, launched in 2012 [http://www.sbherpetologia.org.br/herpbras/]. As long as they do not publish nomenclatural novelties, this poses no nomenclatural problem, but if they once decide to do so, they will have to follow strictly the new Articles 8.1 and 8.5 to ensure availability of these novelties.

These examples show that the details of every case must be scrutinised in order to know whether a work published electronically qualifies as a publication as defined in the 2012 amendment. It is quite doubtful that all authors and users of taxonomic publications will indeed do such a work. It is therefore quite predictable that nomenclatural problems will appear in electronic-only published periodicals, at least in the first years after September 2012. The example of BMC periodicals, examined in detail above, shows that even one year after publication of the 2012 amendment, its Rules are not yet followed by some major e-publishers. Taxonomists should be vigilant to identify these problems as soon as they are published, in order to correct them immediately and not leave them become widespread and thus prone to be "protected" on the pretext of "usage".

APPENDIX 2. A NOTE ON THE IMPACT OF ELECTRONIC PUBLICATION ON THE SCIENCE OF TAXONOMY

Many supporters of online publications have expressed the idea that concentrating taxonomic publication in a small number of "big" journals, distributed electronically only, would be a positive step for taxonomic research. This is part of a general trend in modern scientific research towards more and more concentration of the tools—but also of the "positions of power" within the scientific community—that lead to a growing control of the scientific activity of researchers and to a limitation of their freedom of thought and action. We forcefully reject this idea. We think a reasonable (although not excessive) diversity of journals is preferable in taxonomy as it is in other fields of research: there is reason to defend a diversity of approaches and ideas and to avoid the "silencing" of some authors who do not share the "dominant" ideas of an epoch, or who have or have had conflicts with some "leading specialists" in the groups that they study. Diversity and freedom of thought are crucial for the progress of science, and should not be threatened by putting all the controls in a few hands. A plea for the persistence of a diversity of taxonomic journals (Dubois 2008*d*) is justified and should be supported.

The impressive development of online taxonomic publications and electronic databases, sites and applications in the recent years may have given to some the impression that our discipline can do now without paper-printed journals and books. For various reasons that would be too long to discuss here (uneven access to Internet in different countries for technical, cost or political reasons; risks of voluntary or accidental destruction or perturbation of electronic databases; use of languages other than English in some countries; need of publications for the career evaluation of biologists; see Funk *et al.* 2005, Dubois 2010*a*), this is not true[48]. Electronic communication is highly technology-dependent and therefore vulnerable in case of conflict or troubles. In contrast, paper publications have proved their ability to successfully survive, virtually unaltered, over centuries or more, even through wars and revolutions. *Duplicating* our paper archives to electronic databases and *spreading* them in the form of many electronic copies worldwide are certainly of *highest utility* to the whole scientific community, but deciding all of a sudden to *abandon* paper publication, without even a several-decade experience, as suggested by some, would be as inadvisable and potentially dangerous as climbing a mountain with a single hand.

In short, it is already obvious that, *at present*, online (Internet) documents and data have a relatively moderate degree of security and permanence, although future technical progress might improve the situation significantly. Internet pages and their URLs are ephemeral for an important proportion of them. Veronin (2002) indicated that a web page has an average life of about 77 days—ironically, the Internet source he cited for this datum has disappeared (Brown *et al.* 2008). URLs cited in publications have been shown to become inaccessible for 27 % to 40 % of them after a few years at most (Carnevale & Aronsky 2005; Dimitrova & Bugeja 2007; Saberi & Abedi 2012). This ephemeral character is likely to apply at some point to Internet pages of online scientific publications as well, and even more so to their Supporting online information which is separate. Issues of conservation and permanence of online articles are still being raised (Robinson 2006; Gould 2009). Supports of online data are generally in the form of batteries of refrigerated hard drives, and the latter components each have a longevity of five to 10 years only (Hourcade *et al.* 2010). Recently, "cloud computing" emerged and allows more reliable durability of data storage, but significantly less than 100 %, and regularly files are irremediably lost (Hourcade *et al.* 2010). Academic journals widely use external services of private providers of storage space (Gould 2009) which present similar risks. Furthermore, if a journal becomes extinct (as has always been occurring), published articles are much less well preserved online only, whereas libraries are full of old articles of paper journals that no longer exist. Once an online journal disappears, all of its earlier articles online are at high risk for reasons evoked above. Here a useful distinction can be made between storage and archiving, following Hourcade *et al.* (2010). Currently massive amounts of data can be stored on the Internet, but their archiving (over decades or centuries) is highly problematic. Biological nomenclature is concerned not primarily with storage, but with archiving. Paper publications have been successful for archiving for centuries and more, whereas important interrogations persist regarding the Internet.

Some supporters of online publications put misleading emphasis on rapid descriptions of new taxa and introductions of new nomina. The core of taxonomy however is not there. It is in *monographic revisions* of higher taxa (genera, families, etc.), with re-examination of all type-specimens, resolution of all synonymy and homonymy

48. See also in this respect the "Introduction" of Löbl & Smetana (2011) and of all other volumes of this series.

problems, complete descriptions, detailed iconography, comparisons between taxa, phylogenetic, distributional and biological data. Such works are much more important for taxonomy *as a solid*, *long-term science* than mere descriptions of so-called "new taxa" and coining of new nomina—a significant part of which will later prove to have been unwarranted. Nonetheless it is clear, as we mention above, that many species in numerous groups remain to be described and named and there are certainly conservation reasons for doing so.

In recent decades, revisions and monographs have become less numerous, both in direct and proportional counts relative to the other taxonomic publications (Tancoigne & Dubois 2013). Where are monographic revisions published? In the current publication system, such long, mostly descriptive, heavily illustrated papers including often long tables of data are definitely not to be published in mainstream journals, and especially not in the "best rated" ones (with high "impact factor") in the hands of commercial publishers, many of which tend to be published only electronically and to limit *a priori* the number of pages of the papers they publish. Traditionally, many taxonomic papers have always been scattered over many small journals published by non-professional editors and non-commercial publishers, in various countries of the world, and in several languages. In the current system of "evaluation" of researchers and teams, such journals are low-rated, which discourages the publication of monographs by taxonomists, as the ratio "effort of work produced / efficiency for career" is too low. A few exceptions like *Zootaxa* do accept to publish long monographs but are not sufficient to reverse this tendency.

These natural history periodicals, except for a few, especially those supported by major European and North American museums, are currently having a difficult time. The imperialism of "impact factors" on students and researchers leads them to abandon these journals, thus resulting in a shortage of manuscripts and reduction in subscriptions received. The development of very costly subscription packages to online versions of most "major" journals, with high "impact factors", has important negative consequences for libraries. They entail suppression of many subscriptions to paper versions of other journals now considered "subsidiary". This also restricts exchanges of periodicals, and either eliminates binding (crucial for long-term conservation) or reduces the budgets for binding. The combination of these and other factors leads to the extinction of more and more journals, including some very old and famous ones.

The development of online publication, if considered as the alternative to paper publication, and not as parallel and additional to it, may well prove to be the final blow for these periodicals. Some would probably welcome this evolution, but this would have detrimental effects on our research. If all these journals were to disappear, would the electronic publishers be ready and able to *really* publish (i.e., not as "online supplementary material") yearly the thousands of pages, descriptions, figures, contained in these journals nowadays, and dealing with all kinds of organisms including the most obscure ones, not only with new big mammals or birds and fossils of dinosaurs or anthropoids? This would not only require money and storage capacity, but also editorial competence, knowledge, skill and work, which currently exist, but scattered in many journals in many countries and various languages.

Editors of journals play a major role in allowing taxonomists, many of whom as we have seen are not paid for this work, to improve the standard of their work in order to produce papers acceptable for publication. But, for several reasons, it is unlikely that all the editors of such journals, especially in languages other than English, who often work locally and in contact with their professional and amateur colleagues, would join this international, English-speaking community, at least in the short run.

In taxonomy, contrary to other research fields, the tradition of publication in national journals and in the local language is still lively. In some countries or parts of the world (e.g., China and South America), this tradition does not show signs of regression—much to the contrary. Who could seriously believe that all taxonomists worldwide would accept to *suddenly* stop publishing all their research in their countries and in their language? And would it be beneficial to taxonomy? The diversity of taxonomic journals is a guarantee against cliques, scientific imperialism or governmental pressure on taxonomists[49].

Do we want a single taxonomic and nomenclatural community, for all zoologists worldwide, or several? Do we want a given species of beetle, of parasite or of mushroom to bear different nomina in the USA, Brazil and China? It seems clear that we should aim to have a single, universal nomenclature for animals and plants, whatever the

49. This occurs for example when a government urges taxonomists in the country to treat some junior synonyms as valid because the earlier name does not "please" the government (e.g. Anonymous 2005*a–b*, Ahmed 2010: 118; and also Morgan 2009)—but also whenever several influential scientists decide to block publication in the journals that they control as publishers, editors or referees, of papers using a different "philosophy" from theirs, or more simply different opinions (a process that most of us have experienced).

languages we use and whatever the ideas we may have about taxonomy. For example, what will be the long-term fate of America- and Europe-centered taxonomic publications in China, where thousands of taxonomic papers are going to be published, in the Chinese language, in this century?

Rather than struggling *against* these numerous periodicals in the aim to accelerate their extinction, electronic publication could, and indeed should, *help* them to exist, develop and become known and accessible to all. One possibility could be to create a consortium providing a cheap online subscription package, for all interested taxonomic periodicals worldwide, whatever their country and language, without asking them to follow any standard imposed from outside regarding their format and content. It is likely that commercial providers of such packages would not be much interested financially in this, as the download rate for many papers would no doubt be low. But such a project, viewed as a *non-profit* endeavour, could be supported by the international community of taxonomists, for which it could prove very useful.

Periodicals deciding to join such a project would increase their visibility and access, and receive financial support from part of the relatively cheap subscription fee paid by users. It could counterbalance the unavoidable loss in paper subscriptions to such journals, and allow them to continue their paper publication, at least in terms of a minimum number of copies distributed to a number of major libraries worldwide and to a few interested customers. This might help these journals, not only to continue to exist, but to become more clearly members of an international community, to improve their standards and to share aims. This would appear a positive step for taxonomy at the beginning of the century of extinctions, at the time when biology is facing a new paradigm: the urgent need for collection, study and description of the still unknown biodiversity of our planet, before it is made extinct right before our eyes, as discussed above.

APPENDIX 3. A NOTE ON BOTANICAL NOMENCLATURE

Introduction of electronic-only publication in botanical Rules (*International Code of Nomenclature for Algae, Fungi and Plants*, McNeill *et al.* 2012; formerly *International Code of Botanical Nomenclature*, McNeill *et al.* 2006) was adopted in July 2011, at Melbourne's XVIII International Botanical Congress. At the nomenclature session of this Congress, 11 amendments on electronic publication, provided by an *ad-hoc* committee (Anonymous 2010; Chapman *et al.* 2010) were accepted. These amendments modify three articles (Articles 29, 30 and 31) and two recommendations (Recommendations 29A and 30B). Despite the delay in editing the new volume of botanical rules (McNeill *et al*. 2012, published in November 2012), the new Rules became active as of 1 January 2012. Knapp *et al*. (2011) summarised the new Rules in an article widely duplicated and translated. Additionally, by September 2012, the International Association for Plant Taxonomy made available online the definitive text for the chapter on effective publication (Articles 29–31). We checked whether the problems highlighted above for zoological nomenclature also concern botanical nomenclature. For clarity of what follows, the concept called "*publication availability*" above, which applies to zoological nomenclature, corresponds roughly to "*effectivity of publication*" in botanical rules.

Among the problems of zoological publication availability listed above, some do not concern effectivity of publication in botanical nomenclature. This is the case of the problems related to publication between 1985 and 2013 on optical discs: as such a way of publication had never been allowed in the botanical *Code*, no nomenclatural novelty occurring in such support is effectively published. Similarly, regarding the problems (Pa1) to (Pa5) described above (p. 24) for online publications, not all are concerned here. Thus, (Pa5), which deals with publication on websites, databases or forums applies here as such publications are not regarded as effective and any new nomen or new combination appearing there cannot be considered (for priority for example).

As concerns the problems (Pa1) and (Pa2), dealing with electronic-only publication before 1 January 2012 or after 31 December 2011 but under an inappropriate format, the new botanical Rules state that such publications are either not effective (Pa1), or that the nomina in such publications are not validly published (Pa2). Registering nomina in a database is not mandatory in botanical Rules, except for fungal nomina as of 1 January 2013. Table 4 summarises the various situations when printed and/or electronic material exist, and which version may be considered effectively published.

An important difference between the zoological and botanical *Code* concerns the criteria of availability/ effectivity of publication of paper-printed works. Whereas Article 8.1.2 of the former requires that the work "*must be obtainable, when first issued, free of charge or by purchase*", without mentioning any limitation among the persons or institutions potentially interested in obtaining the work, Article 29.1 of the botanical *Code* (unchanged in the Melbourne version; see Knapp *et al.* 2011: 2) states that "*Publication is effected, under this* Code*, by distribution of printed matter (through sale, exchange or gift) to the general public or at least to botanical institutions with libraries accessible to botanists generally*". The mention "*at least*" introduces a distinction that does not exist in the zoological *Code*: in botanical nomenclature, a printed publication may be effectively published *even if* it is not obtainable by "*the general public*" but only distributed to a few libraries. Furthermore, except in Example 11 of Note 2 of Article 30.5, dealing with theses and dissertations (works produced "*for the purpose of obtaining a degree*"), the botanical *Code* does not mention the fact that facsimiles of unavailable works are also unavailable, as stated in Article 9.12 of the zoological *Code*. Therefore, in botanical nomenclature, the deposition of a few such facsimiles (e.g., printouts of online distributed PDFs) is enough to provide effectiveness of publication to a work. In fact, we suspect that this major difference between the two Codes was overlooked by all the persons who, both in botany and in zoology, have been at the basis of the famous deposition of printed copies in five libraries: such a practice was acceptable in botany, but not in zoology, and apparently none of the zoologists that were involved in the establishment of this practice in 2008 (see Appendix 1) realised that, under a careful reading of zoological *Code*, it did not provide availability to the works at stake.

In botany like in zoology, whenever the printed matter (printed version in Table 4) is a preliminary version of an electronic publication, its distribution may challenge the determination of the date of effective publication. This problem could be solved by introduction in the botanical *Code* of a Rule like "*distribution of printed matter based on a preliminary version of an electronic publication is not considered effectively published*".

TABLE 4. Criteria of effective publication under the *International Code of Nomenclature for Algae, Fungi and Plants* (McNeill *et al.* 2012) according to whether the work was published as a printed version (lines) and/or an electronic version (columns).

		Electronic version considered final		
		Distributed before 01.01.2012	Distributed after 01.01.2012	Not distributed
Printed version	Distributed before 01.01.2012.	(A1) Simultaneous distribution: printed version effectively published, not the electronic one. Date of effective publication: date of distribution of printed version. (A2) Non simultaneous distribution: printed version effectively published, not the electronic one. Date of effective publication: date of distribution of printed version.	(B) Both printed and electronic versions effectively published. Date of effective publication: date of distribution of printed version.	(C) Printed version effectively published. Date of effective publication: date of distribution of printed version.
	Distributed after 01.01.2012.	(D) Printed version effectively published, not the electronic one. Date of effective publication: date of distribution of printed version (Article 29.1, Example 3).	(E1) Simultaneous distribution: both printed and electronic versions effectively published. Date of effective publication: date of distribution of both versions. (E2) Non simultaneous distribution: both printed and electronic versions effectively published. Date of effective publication: earliest date of distribution between printed and electronic version.	(F) Printed version effectively published. Date of effective publication: date of distribution of printed version.
	Not distributed	(G) Electronic version not effectively published (Art. 29.1, Note 1).	(H) Electronic version effectively published. Date of effective publication: date of distribution of electronic version.	(I) Neither printed nor electronic version effectively published (Art. 29.1).

Only a few publications have been published in electronic-only journals before 1 January 2012. The first and deliberate such publication, where four new *Solanum* species were described, was made by Knapp (2010). As clearly stated in the paper, the electronic version "*does not represent a published work according to the International Code of Botanical Nomenclature*", and "*copies of print-only editions*" of the article were distributed to 11 libraries of botanical institutions. In addition, in the "Comments" of the article, photographs of stamped envelopes were provided. Inderbitzin *et al.* (2011) did exactly the same as Knapp (2010), with mention in the text and photographs in the "Comments". Among the other botanical nomina published in PLoS journals before 1 January 2012, printed versions of Evans *et al.* (2011) and of Liu *et al.* (2011) have been distributed (according to the authors themselves) and these nomina may be considered effectively published. However, according to the information provided in the article by Hu *et al*. (2011), this work cannot be treated as effectively published as there is no mention of distribution of printed copies. In addition, even if such printed copies were distributed, the absence of explicit type designation (Article 37.6) and of Latin diagnosis or description (Article 36.1) make Hu *et al*.'s nomen invalidly published.

From this small dataset, it appears that most botanical authors publishing in PLoS journals have been aware of the new botanical Rules. For BMC journals, publication of new botanical species nomina seems to be rare. In Wang *et al.* (2007), there is no internal evidence for distribution of printed copies and the publication appears not to have been effectively published, whereas for Rydin & Friis (2010), such a distribution was clearly mentioned.

From this small survey, it appears that problems similar to those listed for zoological nomenclature can also occur with electronic publication under botanical Rules. It seems that the number of problems is currently quite low. But it should be remembered that, in botany, it is not only new nomina or new combinations that are concerned, but other nomenclatural acts such as lectotypification.