

Contributions to the Discussion on Electronic Publication II

Introduction

This is the second instalment of comments on the ICZN proposed amendment on electronic-only publication. If the proposed amendment passes review from the IUBS and then a vote from the Commission, it will allow publication of nomenclatural acts on exclusively electronic media to be valid and available. The proposed amendment is available in the BZN 65: 265–275, several other sources, and online at http://www.iczn.org/electronic_publication.html. We are eager for input from all stakeholders in this process, including taxonomists, publishers, archivists, database experts and the wide range of users of nomenclatural information. Before the Commission's vote there will be one more opportunity for input through the BZN in our subsequent issue and we encourage continued debate through listservers (e.g. ICZN listserv (<http://list.afriherp.org/mailman/listinfo/iczn-list>) and Taxacom (<http://mailman.nhm.ku.edu/mailman/listinfo/taxacom>)) and the various journals that have published the proposed amendment.

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Electronic publication of nomenclatural acts is inevitable, and will be accepted by the taxonomic community with or without the endorsement of the Code

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Abstract. The recent description of the fossil primate *Darwinius masillae* in the online journal *PLoS ONE* exemplifies an increasingly common problem: nomenclatural acts in non-print venues that are not considered 'published' under the Code's Articles 8.6 and 9.8. Although the name *Darwinius* was subsequently validated by the publication of hardcopy offprints of the electronic paper, other zoological names have been published electronically in this and other online journals, and the broader taxonomic community's acceptance of these invalidly published names suggests that it is the Code itself that is outdated in refusing to recognise names accepted by everyone else. If the Code is not quickly changed to accommodate electronic publication, it will become marginalised and ignored, to the detriment of sense and stability in nomenclature. The increasing prevalence of electronic publishing leaves only a small window of opportunity in which the Code can act to regulate nomenclatural acts in these venues. Fears regarding the conservability of electronic documents are not justified, as the ability to quickly and cheaply make abundant perfect copies makes an electronically published paper impossible to eradicate. Likewise, worries about the

unsuitability of the ubiquitous PDF format for long-term conservation are largely groundless now that the PDF archival format, PDF/A, is an international standard. The world has changed, and in order to remain relevant the Code must serve the world as it actually is, not as we may wish it was.

Keywords. Nomenclature; taxonomy; publishing; electronic publishing; nomenclatural acts; *Darwinius masillae*; PLoS; PDF.

Background: the availability of the name *Darwinius masillae*

The description of the basal primate *Darwinius masillae* on 19 May 2009 (Franzen et al., 2009) generated a great deal of publicity and controversy. Leaving aside issues of the new taxon's phylogenetic affinities, its brief nomenclatural history highlights an important trend. The initial publication was in the online-only journal *PLoS ONE*, a journal of the Public Library of Science (<http://plos.org/>): therefore, as pointed out by various people and summarised by Zimmer (2009a) the day after publication, the name *Darwinius masillae* is not available under Article 8.6 of the Code. Article 9.8 explicitly states that 'none of the following constitutes published work within the meaning of the Code: [...] text or illustrations distributed by means of electronic signals (e.g. by means of the World Wide Web)'.

After consultation between the journal, the Commission and the Secretariat (described in Zimmer, 2009b), a way forward was found: within one further day, the situation was remedied by the publication of fifty printed copies of the paper, which were made available for a nominal fee of \$10 by mail order. These printed copies are identical to the original publication apart from the addition of a cover sheet stating that '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' (Zimmer, 2009c). Thus the name *Darwinius masillae* was validly published for nomenclatural purposes two days after initial publication. It is not clear whether or how the two publications, electronic and printed, can be cited unambiguously, but at least now the Code is satisfied and the name is safe from nomenclatural claim-jumping. We will refer to this approach of publishing hardcopy offprints after an initial electronic-only publication as 'the *Darwinius* solution'.

In the wake of the *Darwinius* debacle, lessons have been learned: a more recent paper in *PLoS ONE* (Hocknull et al., 2009) named three new monospecific dinosaur genera: *Wintonotitan*, *Diamantinasaurus* and *Australovenator*, and that paper contained a statement that printed copies of the paper were made available, simultaneously with electronic publication, in order to satisfy Article 8.1 of the Code. This is more satisfactory than the after-the-event repairs enacted to save *Darwinius*, but two issues remain.

First, the *Darwinius* case, while high-profile, is not unique: other new taxa recently named in *PLoS ONE* include the theropod dinosaur *Aerosteon* (Serenó et al., 2008), the primitive whale *Maiacetus* (Gingerich et al., 2009) and the ancestral sauropodomorph dinosaur *Panphagia* (Martínez & Alcober, 2009), none of which

names was available under the Code. (Following *Darwinius*, these names have since been validated by the subsequent production of offprints.) The PLoS journals are not alone in publishing new names electronically: for example, in *Proceedings of the Royal Society B*, the stegosaurid dinosaur *Miragaia* was published online on 25 February 2009 (Mateus et al., 2009a), nearly three months before the printed version followed on 22 May (Mateus et al., 2009b). Other recent names published electronically in *Proceedings B* before printed publication include the basal sauropod dinosaur *Antetonitrus* (Yates & Kitching, 2003), the basal suchian *Effigia* (Nesbitt & Norell, 2006), the burrowing ornithopod dinosaur *Oryctodromeus* (Varricchio et al., 2007), the basal ornithischian dinosaur *Eocursor* (Butler et al., 2007) and the theropod dinosaur *Austroraptor* (Novas et al., 2008). Electronic publishing of new names has arrived.

Second, is the Code, as currently established, serving nomenclature? Or is nomenclature serving the Code? While the case of *Darwinius* shows that band-aid solutions can be applied to solve some of the problems of electronic publishing, such solutions arguably put the cart before the horse by requiring legalistic adherence to rules that a changing world has rendered obsolete. Paul van Rijckevorsel (2009), in a message on the ICZN listserver, spoke for many when he expressed distaste for the *Darwinius* solution by writing that ‘With print shops in every town that will turn out booklets on demand, cheaply and fast, surely no prestigious journal (online or not) would feel comfortable in making do with a mere stapled set of printed sheets? Impress on them how silly it looks to be remembered for all time by a stapled set of printed sheets’. But the truth is that the journal, the authors and the taxon will not be remembered by the stapled set of printed sheets – they will be remembered by the freely available PDF that every interested zoologist has downloaded, read, added to their repositories, backed up using their various private schemes, and sent to their friends. The reality is that nobody outside of the ICZN and its associated listserver cares about the printed copies – so far as the rest of the world is concerned, they are nothing more than a box-checking exercise.

The Code is in danger of becoming an irrelevance

While the *Darwinius* solution is obviously not ideal, it is not clear that the case of *Miragaia* (and other new taxa published in *Proceedings B*) is much better. Although the journal no doubt intended the online and printed versions of the *Miragaia* paper (Mateus et al., 2009a, b) to be two manifestations of the same work, the fact that only the latter is validly published for nomenclatural purposes means that careful discussion must treat them separately. While the Code insists that the name *Miragaia* did not become valid until May 2009, the vertebrate palaeontology community treated the name as valid from its initial online publication three months earlier. Although technically a three-month window existed during which the new stegosaur was vulnerable to ‘retro-scooping’ by any worker unethical enough to apply a new name to the specimen in a printed publication, there is very little chance that such a name would have been recognised by the community: the reality, whatever the Code says, is that for most working zoologists, electronic publication is sufficient to establish priority. Even in the case of the three new Australian dinosaurs published in *PLoS ONE* (Hocknull et al., 2009), for which printed copies were made available from the date of electronic publication, the Code’s insistence that only the printed

copies that no-one has are 'real', and the globally distributed electronic copies are not, does not serve the community, and is unlikely to be honoured in future citations of the new names.

In light of the mismatch between the rules laid down by the Code and those followed in practice by increasingly many working zoologists, it is far from clear that the Commission has the power to enforce rules perceived as obsolete by the broad and diverse community of zoologists. Regarding the initial unavailability of *Darwinius*, much online discussion ensued: comments such as the following, from Dr Adam Yates of the University of the Witwatersrand, are representative:

'It seems to me that the code is in danger of becoming an irrelevance. Its very existence depends on the community agreeing to respect and adhere to its rules. I strongly suspect that people will simply ignore the restriction on electronic publications and continue to cite and use *Darwinius*, *Panphagia*, etc. [. . .] as valid taxa. And if people use them as valid taxa, well then [. . .], Code or not, they ARE valid taxa.' (Yates in Parker, 2009)

In another comment on the same article, Dr Andrew Farke of the Raymond M. Alf Museum commented:

'I think that among many, the code *will* become an irrelevance on account of issues like this. Even if some opportunist renamed taxa like *Maiacetes* and *Darwinius* and *Panphagia* in a 'valid' format (which would likely mean an obscure journal of limited circulation), I suspect that people would ignore these sorts of papers in favour of the original description. I know that I would!' (Farke in Parker, 2009)

It is important to understand that these opinions, and others like them, are not those of uncredentialed commenters, but of qualified, professional, publishing zoologists.

More disturbing still for the Code is the position adopted by the journals. For example, the cover sheet of the initial online publication of *Miragaia* (Mateus et al., 2009a) stated that 'Advance online articles are citable and establish publication priority', explicitly disclaiming the ICZN rule that only printed publications are significant for establishing priority. Again, it is important to note that *PLoS ONE* and *Proceedings B* are reputable journals run by respected scientists, not low-budget in-house publications or the work of amateurs in basements with inkjet printers. In particular, *Proceedings B* is currently on volume 276, and has been published since 1800 by the oldest learned society in the world – not a body that one would normally expect to leap unthinkingly onto bandwagons. That the Royal Society of London is embracing the electronic publication of nomenclatural acts should give pause to all who consider electronic publication to be a dangerous and transitory fad.

Paper journals are going away

The problem of electronic nomenclature is only going to become more ubiquitous as more journals convert to electronic-only formats. This trend is already observable, and will inevitably accelerate due not only to the cost benefits but also to the additional possibilities offered by electronic formats – high-resolution figures, video, etc. An increasing proportion of nomenclatural acts will therefore not be represented in published form to the satisfaction of the Code, but if current practice is a good guide, will nevertheless be recognised by the community. In a carefully argued blog post, Dr Matt Wedel of Western University of Health Sciences wrote:

‘Most online publications are hampered by having to be identical to the dead-tree versions (no links, no embedded video, no rotating 3D PDF images, etc.). Eventually people will realise that it is counterproductive to keep hobbling the new medium to make it as slow, flat, and inefficient as the old medium. Once one journal takes the hobbles off, others will do the same rather than lose contributors to cutting-edge outlets. A few boutique journals may still produce flattened, gutted versions of the online publications on paper. People still fly biplanes, too. Paper-based journals will never be popular again and their existence will not stop people from doing whatever technology allows them to in the online venues.’ (Wedel, 2009)

And Dr Bora Zivkovic, Online Discussion Expert for PLoS, wrote:

‘At this point in time it makes no difference if the paper exists only online, or if it was printed by a traditional publisher, or if the online publisher printed out 50 copies of the PDF, or if it was printed by a user at home on a personal computer printer. With the printing costs high, more and more journals will be online only and the physical dead-tree paper will become an anachronism pretty soon [...] Thus, the medium – paper vs. Web – is completely irrelevant for the purpose of ranking outlets at this moment in history, and will become increasingly so in the near future as all journals stop printing and move online. [...] I guess ICZN is keeping the taxonomy literature behind the times, insisting on paper. [...] Perhaps *Darwinius* sped up the process at which ICZN will move forward and taxonomy journals will then follow and join the rest of the world?’ (Zivkovic in Taylor, 2009)

As a member of the Palaeontological Association and the Society of Vertebrate Paleontology, I receive printed issues of those societies’ journals, *Palaeontology* and the *Journal of Vertebrate Paleontology* – yet in recent years I have hardly ever referred to them: I flick through each issue when it arrives, then shelve it. Most issues never come down from the shelf again, as the PDFs available from the society web-sites are so much more convenient: portable, searchable, containing extractable images. An informal straw-poll conducted across a representative sample of my colleagues showed a 50-50 split between those who read papers primarily in printed form and those who prefer electronic form. But, significantly, the younger workers – the next decade’s establishment – prefer electronic publications much more strongly than their older colleagues. It is not difficult to sense which way the wind is blowing.

The time to act is now

In light of the inexorable move towards electronic publishing either ahead of printed publication (as in *Proceedings B*) or instead of it (*PLoS ONE*), the question is no longer whether electronic-only publications *should* be recognised for nomenclatural purposes. That issue is settled: they *are* recognised in much of the zoological community, and are making further inroads. The remaining question is: will they be recognised under the governance of a revised Code, or without a code? Even if it’s true, as some have argued, that electronically published works are less conservable than those on paper (concerning which see below), that would not stop zoologists from publishing nomenclatural acts in electronic-only journals; and those acts are, and will continue to be, recognised by everyone except a hard core of increasingly isolated nomenclature specialists. Those of us who care about sense and stability in nomenclature must act on the basis of how the world actually is, not how we wish it was.

Right now, the Code has a window of opportunity in which it can ensure that electronic publication is done under its governance and therefore on its terms. If this opportunity is not taken, then electronic publication of nomenclatural acts will continue anyway, but without a code: the result may be anarchy, e.g. no requirement of permanence of published works, no recognition of the importance of immutability, and no respect for priority. The Code exists to prevent such chaos: but it will not be able to do so if it is widely ignored because of its denial of basic realities.

Electronic documents are different from electronic media

Among those who oppose the recognition of electronic publishing for nomenclatural purposes, the most commonly expressed reason is fear that electronically published works are less able to be conserved than printed works – for example ‘Paper is proven to last hundreds or thousands of years, and electronic media are notoriously ephemeral’ (Beccaloni in Michel et al., 2009). This is an important issue which deserves to be addressed. Several points can be made here.

1. Whether or not electronic documents are less persistent than printed documents, they will continue to be published and will continue to contain nomenclatural acts which the taxonomic community will accept as valid. Any impermanence of electronic documents is simply a problem that we have to solve: disengaging because the problem is hard is not an option if the Code is to remain relevant.

2. The concept of ‘electronic information’ has changed dramatically in the last two decades. Not long ago, electronic information was always embodied on a physical medium (floppy disk, quarter-inch cartridge, CD-ROM, etc.) which was vulnerable to degradation and obsolescence. Now that the Internet is ubiquitous in developed countries, electronic documents have their own existence independent of any particular medium on which they are written. Concerns about persistence must be evaluated in this context. Thus the current Article 8.6 (‘Works produced after 1999 by a method that does not employ printing on paper’), as generally understood, is no longer relevant.

3. It is very cheap, very quick and very easy to make arbitrarily many perfect copies of an electronic publication, and to distribute them anywhere in the world: therefore, persistence of electronic publications may be sought not only in carefully preserving a few copies in well-known places, but also in encouraging proliferation of copies. Consider a paper that is conserved by placing copies in six large, well funded archives, each with only a 1% chance of failing; another paper distributed to careless individuals who each have a 50% chance of losing their copies requires only forty such individuals to have a better overall chance of survival ($0.5^{40} < 0.01^6$).

4. Electronic publications that are freely available and unencumbered by copyright restrictions (‘open access’) routinely proliferate from computer to computer and so are effectively archived in hundreds or thousands of locations around the world. To pick a topical example, the *Darwinius* paper now exists in many tens of thousands of identical electronic copies. With or without LOCKSS, Portico and other such systems, there is no chance whatsoever of that publication becoming impossible to track down in the future.

5. Electronic publications that are *not* freely available proliferate anyway, despite the publishers’ wishes, by various clandestine means (email attachments, bulletin boards, USB drives, etc.). A paper, once published on the Internet, is a genie that’s

been let out of the bottle: it cannot be prevented from replicating even by a publisher that would like to suppress it; far less can it be lost inadvertently. (Music publishers are finally accepting this in respect of MP3s of popular songs, years after everyone else realised; academic publishers are learning the same lesson now, although some remain in denial).

6. Persistence of electronic publications is best and most cheaply achieved by allowing and encouraging copying between individuals rather than by maintaining complex, expensive official archives. (This is not to say that official archives have no role; but they are not necessary for a publication to live forever.)

7. Given a printed publication, it is difficult and time-consuming to create an electronic copy by scanning; conversely, given an electronic publication, it is easy and quick to create a hard copy by printing. Libraries are at liberty to print electronic publications on archival paper and conserve the printed copies; proliferation of electronic copies will make this easy to do where artificial copyright barriers do not impede librarians from taking this approach.

We must come to terms with the ubiquity of PDF

Some on the ICZN listserver have argued that while electronic publication would be acceptable in an appropriate format, the currently ubiquitous PDF format is not suitable for preservation because of its supposedly obscure specifications, and its perceived dependence on a single commercial vendor. Instead, an XML-based format is often advocated as a better choice. The problem is inertia: the utter ubiquity of the PDF format in contemporary electronic publishing renders any proposal to deprecate it moot. In light of journals' existing investment in PDF-based publishing pipelines, trying to enforce the use of a 'better' XML-based format, while a noble aspiration, would be a doomed strategy – like trying to replace QWERTY keyboards with more ergonomic alternatives. It simply will not happen. PDFs will continue to be used, whether we like it or not; so solutions must be found to whatever problems beset PDFs.

As it happens, these problems are nowhere near as severe as sometimes portrayed. Criticisms of PDF fall into three main areas, all of them easily addressed:

PDF is often described as a proprietary format, the use of which is dependent on the goodwill of Adobe. Although it was originally a closed format, the PDF specifications are now a matter of public record and have been codified as an international standard, ISO 32000–1:2008.

A fear is sometimes expressed that when Adobe stops supporting Acrobat, PDFs will become unreadable. This is incorrect because of the large number of PDF-reading programs written and maintained outside Adobe. For example, installations of the free operating system Ubuntu GNU/Linux come with copies of xpdf, GhostView, ePDFView, Evince and Okular, all of them open-source software. Eleven open-source readers are listed and linked from <http://pdfreaders.org/>. This software exists on literally millions of computers, and is not going to go away.

The PDF format encompasses many variants, so that a PDF that is readable by one program may not be readable by another. This difficulty is ameliorated by PDF/A, a subset of PDF specifically intended for long-term archiving, which is defined by the international standard ISO 19005–1:2005. Some journals' PDFs are

already PDF/A-compliant, and therefore good candidates for long-term archiving; journals currently producing other PDF dialects would not find it onerous to convert to PDF/A.

In summary, most fears regarding the long-term preservation of PDF files are unfounded or outdated. But even if this were not so, it would not change the fact that journals do publish PDFs and will continue to do so for some time yet, and that zoologists will continue to recognise them. Any problems that this may cause will simply have to be solved.

(In the longer term, a move to a more structured format is indeed desirable – in part, in order to facilitate automatic processing of nomenclatural acts and opinions. Such a change may be facilitated by providing PDFs alongside the structured form during the transition period. PubMed Central has gone some way towards making this possible by establishing a standard XML format which it recommends for depositions (the NLM Journal Publishing format, <http://dtd.nlm.nih.gov/publishing/>). Papers published in PLoS journals are available for download in this format as well as PDF.)

The current rules are too hard to get right

The respected online journal *Palaeontologia Electronica* (sponsored by the Palaeontological Society and the Society of Vertebrate Palaeontology among others) has published new names including the sauropod dinosaur *Karongasaurus* (Gomani, 2005). As described by the journal's nomenclature statement (Anonymous, 2007), ten copies of each issue are printed and deposited at ten archive libraries, which meets the requirements of the Code. However, this is done for the benefit of the ICBN, which does not recognise CD-ROM as a valid medium of publication under any circumstances, as the journal covers palaeobotany as well as palaeozoology. The nomenclature statement says that 'the CD-ROM issue of *Palaeontologia Electronica*, to be deposited at a minimum of five archive libraries, provides a permanent record that meets the requirements of the ICZN (Article 8.6) for valid and effective publication'. In fact, articles such as Gomani (2005) are not validly published, as the individual articles in *Palaeontologia Electronica* do not contain the necessary statement about copies being lodged in five named libraries. The statement continues, 'the ICZN recommends that formal nomenclatural citations should be made to the CD-ROM edition because of the inalterability of that medium', but in fact the CD-ROM edition is not published at all according to the requirements of Article 8.6.

This may seem a fine point, but it illustrates the larger issue that the current rules regarding electronic publication appear complex and arbitrary, and are difficult to get right even for journals that make the attempt. We have already seen how *PLoS ONE*, until recently, simply ignored the Code's provisions regarding electronic publications, and how the *Proceedings of the Royal Society B* continues to publish names online ahead of their subsequent valid publication in print. We now see that *Palaeontologia Electronica*, wishing to fulfil the requirements of the Code in good faith, nevertheless inadvertently recommends citation of a manifestation of its papers that are, according to the Code, not published. The upshot is that almost every citation of names published in *PLoS ONE*, *Proceedings B* and *Palaeontologia Electronica* is technically incorrect. This being so, we must ask ourselves: are all these journals really in error? Or is it the Code itself that is out of alignment with modern reality?

Conclusion

While we were looking the other way, the digital revolution has happened: everyone but the ICZN now accepts electronic publication. The Code is afforded legitimacy by workers and journals only because it serves them; if we allow it to become anachronistic then they will desert it – or, at best, pick and choose, following only those provisions of the Code that suit them. Facing this reality, the Code has no realistic option but to change – to recognise electronic publishing as valid.

I have no detailed recommendations to make regarding the recently proposed amendments to the Code (ICZN, 2008). Instead I ask only this simple question: will the Code step up to the plate and regulate electronic publications as well as printed publications? Because this is the only question that remains open. Simply rejecting electronic publication is no longer a valid option.

Let's not be overtaken by the rush of events. Eyes open, face into the wind. Let's go.

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Comment on the proposed Amendment of Articles of the *International Code of Zoological Nomenclature* to expand and refine methods of publication

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A list of 39 additional signatories can be found at http://www.iczn.org/Welter-Schultes_et_al_Additional_signatories

We have a critical view on the proposed Amendment of Articles of the *International Code of Zoological Nomenclature* to expand and refine methods of publication.

1. Electronic publications are not sustainable (technically yes, but not practically) and should not be accepted for nomenclatural acts, no matter which file format or version.

We have come to the conclusion that it is currently not possible to reliably maintain electronic data. Zoological nomenclature cannot work without the availability of printed original publications. From our experience we know that consulting 200–300 year old original literature is indispensable for taxonomic work. We cannot rely on secondary sources (see also 3). Some of us work almost exclusively with electronic files, but in most cases the file is a copy of a printed book.

AnimalBase is part of the consortium of the BHL-Europe project (Biodiversity Heritage Library for Europe), where IT technologists are currently trying to develop strategies for sustainable archival systems for electronic literature data, with the most modern methods and funded with millions of Euros by the European Union. Sustainable archiving consists of 3 components: ingest (= input), storage and digest (= consumption of data or output). Printed books are able to cover all three components. Since the mid-1450s this has accounted for successful long-term archiving and has minimised information loss. In digital environments these components must be strictly separated. If this is not understood, massive losses of information can result, as for example in the case of NASA's moon mission files, which are still present but that nobody can read any more, so that the information collected was almost entirely lost. The same applies to 20 % of the data saved in the Voyager spacecraft missions from the end-1970s. The problem is not necessarily of storage media, financial power, lack of IT specialists or early stage of information technology. Lack of an appropriate strategy, unawareness of the need to use a well selected storage format, unawareness of the need of metadata standards (the moon mission files were saved without metadata), and, very important in our case, sociopolitical issues, are the major threats to sustainable archiving.

In the proposed Amendment (Article 8.1.3.1) 'widely accessible electronic copies with fixed content and format' is mentioned as the only technical criterion to be

satisfied, and PDF is mentioned as an example. Nothing is mentioned about metadata requirements. Nothing is mentioned on strategies for storage format issues. PDF is an almost pure digest format that can currently be decoded because reader software is commercially available. All IT technologists working in the BHL-Europe project agree that PDF is not an appropriate format for storage. No one can guarantee us that in 20 years PDF will be the commonly used format, and that in 100 years a librarian will know at all what a PDF format was. In other words, relying on e-only publications in PDF format alone – without providing a strategy to solve the storage problem – bears the threat (or perspective) of irreversible and massive data losses in the future. LOCKSS and Portico, mentioned by the Commission as examples for permanent archives for electronic journals, have no strategies involving thoughts on sustainable storage formats and we do not consider them as promising approaches to solve the problem.

The storage component in an electronic archival environment is not trivial. The strategies currently developed in the BHL-Europe project involve building a gigantic computer terminal in England as a repository, in collaboration with leading IT companies such as Microsoft, IBM and others, and also the presence of administrative bodies encharged with replacing the storage formats in due time, without information loss, with new formats. We are currently in a situation in which the first steps for sustainable archiving are being developed. Long-term preservation of electronic information continuously requires high financial inputs, and it is still unclear who will pay the costs in the future. The problem is much less of a technical than of a sociopolitical nature. We are at the very beginning of a new age, and at a stage where we cannot predict that it will be possible to successfully preserve electronic biodiversity literature. The problem that, due to high costs, we will have only very few central repositories (only U.K. is funded, U.S.A. and China are planned) remains unsolved.

2. CD-ROMs and DVDs should not be regarded as published work, no matter when they were issued. This should also apply to CD-ROMs and DVDs issued after 1999 under Article 8.6 of the 4th edition of the Code. All authors who published on CD-ROMs and DVDs should be obliged to publish their nomenclatural acts on printed paper, and the publication dates would be that of the first publication on printed paper.

Firstly, CD-ROMs and DVDs cannot be read anymore after 100 years. There can be no doubt that the files will have become corrupted and there will be no machines to read them. Secondly, no name established since 1999 can have become so long-accepted as to provide a threat to the stability of nomenclature. And thirdly, authors who violated the Code's expressed Recommendation (8B) cannot expect that their actions will be protected for all eternity.

3. To be published, a work should obligatorily have been printed in a minimum of 100 paper copies. Publications issued after 1985 in less than 40 copies should not be regarded as published work. Works of which no original is available anymore should not be recognised as published work.

This would reflect current practice in zoology, where doctoral and diploma theses issued in a few offprints are usually not accepted for nomenclature. Doctoral theses in countries where 50 paper issues were required to be given to a public library are probably recognised by most taxonomists as published work. The Code does not currently reflect taxonomists' behaviour in this regard and there is an urgent need to

update the Code to comply with recent technological developments. Since home printers became available it has become technically possible to print out 2 sheets and declare this as Code-compliant published work. A minimum number of required copies is urgently needed in response to technical progress. In AnimalBase we are currently not aware of a single case where it is certain that a printed work is not available anymore. We know some cases cited in secondary sources where some taxonomists suspect that the originals were manuscripts, and others argue that these had been publications.

4. Journals publishing primarily electronically should contain a statement printed at least once in each issue that printed copies on durable paper of every issue are deposited in a minimum of 30 major libraries which are identified by name in the volume itself. The issues should also actually be deposited in these libraries.

The need to meet this obligatory requirement would be helpful for taxonomists to select journals for submitting papers with nomenclatural acts. Zoologists working in certain fields can subdivide their publications, to publish bioscientific contents in e-only journals and nomenclatural acts in paper-based journals. In botany this is the same situation. We see advantages in a slightly reduced number of journals in which nomenclatural acts can be published. Nomenclatural acts should preferably not be published in non-taxonomic journals, the reviewers of which are not necessarily skilled to evaluate correctness in nomenclatural matters.

5. The Commission should not have the power to declare unpublished work (including electronic publications) as published work; neither should it have the right to issue Declarations on the matter of what constitutes published work.

6. The Official Register should not be mentioned in the Code.

We personally appreciate very much the efforts to establish ZooBank, but it should only be officially included in the Code after one or several decades of positive experience, showing how such a system would be maintained running effectively without any financial background provided by the zoological community. We need to see its powers, its limitations and its acceptance by the whole zoological community, including those who do not speak English and who do not participate in international discussions.

7. In particular, we recommend consideration of the following suggestions regarding the proposed modifications of the Code:

The proposed new Articles 8.1.3.1 and 8.1.3.2 should not be included. Article 8.1.3. should be modified: *'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, and it must be extant in at least one surviving original copy.'*

Article 8.5 as proposed should not be included. Article 8.5 should be modified:

'Article 8.5. Works issued after 1985. To be published, a work must have been printed on durable paper (by either letterpress or offset printing, newspaper and similar paper quality is excluded) in a minimum of 40 copies. Works issued after 2010 must have been printed on durable paper in a minimum of 100 copies.'

Article 8.6 should be modified:

'Article 8.6. Works issued and distributed electronically. All works produced by a method other than printing on paper, including works issued and distributed electronically in digital formats, are not regarded as published work. This applies expressly also to CD-ROMs and DVDs issued after 1999 under Article 8.6 of the 4th edition of

the Code. To be recognised as published work, journals publishing primarily electronically (including open access journals) must contain a statement printed at least once in each issue that printed copies on durable paper of every issue are deposited in a minimum of 30 major libraries which are identified by name in the volume itself. The issues must be deposited and obtainable in these libraries.'

The proposed new Article 8.6 should not be included.

Article 9 should not be modified as proposed, except 9.9 which could be modified as proposed under Article 9.10.

Article 9.8 should be modified:

'9.8. information issued and distributed by means of electronic signals'

The proposed new Article 10.8 should not be included.

To promote stability of a widely used and well-known name established on CD-ROM or DVD after 1999, the Commission has the right to make available such a name from the next occasion when the name was published on paper after the CD-ROM was issued and where the explicit statement that this was a new species (violation of Article 16.1) is lacking.

The proposed new Article 10.9 should not be included.

The proposed new Article 21.8.3 should not be included.

The proposed new Article 21.9 should not be included.

The proposed new Article 78.2.4 should not be included.

Lots of Copies still need the focal function of libraries

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'Lots of Copies keeps stuff safe' has been the argument in principle and suggested specific mechanism (www.LOCKSS.org) for archiving electronic-only publications.

Libraries have served the archival role and journals the multiple identical copies so well for so long that they have been taken for granted. Electronic publications are clearly elbowing out print journals, but their longevity and unchangeability are not so certain (notwithstanding the opinions of some active contributors to the ICZN online discussions; despite requests, the archiving industry has yet to comment on this lively discussion). The framers of the 4th edition of the Code, seeing change on the horizon, allowed for publication of nomenclatural acts on CDs, while prohibiting them online. This was probably seen as a sort of link with print and likely permanency in that there was a physical object. We now know that CDs are less permanent than had been thought, and so part of the amendment currently being considered is to prohibit them henceforth as a medium for nomenclatural acts. Of at least as great concern is archiving. This is also relevant to the use of CDs because many libraries have no provision for archiving one-off CDs in the way ICZN4 stipulates. As for electronic products in general, it may be true, as many contributors to the ICZN online discussions have argued, that with so many copies out there, continued existence of electronic publications is not at issue, and so libraries need no

longer be a consideration. But one of my concerns is how a scientist new to a field can find the publications.

Presumably that person has to know who holds the most complete library of electronic copies (disregarding whether they are PDFs, Word documents, or in some other format). There is a precise analogy in the print world – many of us have extensive personal reprint collections, which have never been proposed as replacements for libraries. Libraries are gathering places, central points for finding information. The electronic world is dispersed, and we have all heard stories about what large proportion of relevant information search engines miss, so the focal function of libraries is another piece of the nomenclatural puzzle (and a reason a central register for names is being considered). We are in early days, and there is as yet no obvious equivalent for many of the multiple roles libraries have performed that were so much taken for granted they were not even mentioned in the Code! Now we have to recognise explicitly what we need and how to go about organising our science and information in this new world.

Open access publications and archiving

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In the area in which I work (biology of salticid spiders), the major taxonomic references are already online (Platnick AMNH, Prószyński, see <http://www.peckhamia.com> for links).

Increasingly, documentation by photographs rather than only preserved specimens is becoming important, and we have open questions about this. Jerzy Prószyński (<http://www.gsd-salt.miiz.waw.pl/salticidae.php>) has taken the lead in this area, and he and I have been trying to resolve related questions. What we really want to be able to do is serialise (collection; serial number) these photographs for standard reference. We have issues to work out. I think we need a standard repository for serialised photographs, and I think that all accepted photographs need to be placed in the public domain at the time that they are posted, so that they can be freely referenced and incorporated into future work. It's that simple.

If you review some of the earlier taxonomic work (as I have recently, in considerable detail), you find that all descriptions and drawings carried a significant measure of ambiguity (e.g. what is really meant by 'testaceous' or 'rufous?') that is resolved in photographs. Photography is now generally available and highly affordable (major change). Preserved specimens also lose many details (posture, coloration) as they are 'rubbed,' and are more difficult to link to field work than are photographs of living specimens. We also have the ability, with photography and computers, to produce almost unlimited depth of field in photographs of specimens. Peer review does not have to take place before posting or 'publication'. It is an ongoing process in science, as more information becomes available. We have no problem with the dynamic process here. Even the taxonomic work of 'highly authoritative experts' gets reversed as more knowledge becomes available. That is fine. In the trade-off, we want more interest and participation in field zoology, not

less. Right now, instead of a handful (about 10) people with an interest in the identification of jumping spiders (SALTICIDAE), we are getting the interest and participation of hundreds of people worldwide, many close to remote localities and equipped with very sophisticated digital cameras. The ‘old systematics’ never had these tools or this broad participation.

‘Private’ publications (not owned by journals or publishers) have always been a reality. Some of the best and most motivated work can be found here. The problem is not private publication itself but commercialisation and control, even by ‘non-profit’ societies. All new species descriptions, naming, and opinion should be posted or published under ‘no copyright, open access’ terms, in free repositories. The few places where I have had an issue with private publication are where the publishers wanted to charge for access to their work (in some cases it is even hard to know that this work exists). I don’t think that names published under these conditions should be acceptable. The ICZN should open a limited, five-year window for all *older* scientific names to be re-filed (with reference to older publications) in an open-access repository, but at the same time require all new scientific names and related publications to be posted in a new open-access archive. I am confident that the international community that studies jumping spiders would enthusiastically support this window.

Naming is a very large, multi-year project. This should be viewed as a *collaborative* project in the future, not as a source of private ownership of related works. Naming exists so that we can all communicate with each other.

On the proposed amendment of the Code

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I strongly agree with this amendment. As pointed out in the proposal, archiving technology is now in place to ensure the survival of electronic data, even if no paper copies are available. I do not agree with Welter-Schultes et al. that electronic data are so ephemeral that their survival is much more dubious than paper copies.

Comment on the Commission’s proposal to amend the Code to expand and refine methods of publication

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As for the Commission’s Proposal to amend the Code concerning allowed publication methods (BZN 65: 265–277), I basically share the objections lodged by Welter-Schultes et al. (this issue): the currently available electronic archiving solutions are still in their initial technical stages and thus neither the physical

permanency of the storage media nor the long-term readability of the archived files by future software and hardware is ensured.

Almost every present-day zoologist will recall 'floppy disks' and punch cards. Has anybody tried to find technical devices to read them recently? Even larger libraries or archives will fail to provide the necessary technology. Today, diskettes and even CDs or DVDs are following these forerunners on their way to oblivion, and there is little reason to believe this technical development has stopped. As for the number of copies available, it is without doubt substantially bigger in the case of popular music tracks than in, say, the proceedings of a zoological conference of the early 1990s. But even if we found the file and the machinery to read it, we would need the right software to open it. PDF/A is the first software designed to be 'self-contained' (not needing additional software) and may possibly become a standard for the future. However, at present we see that none of the common online journals makes any consistent use of PDF/A. They may indeed have good reasons not to do so, e.g. the large size of each data file, however, for the challenging purposes of taxonomy their approach must be deemed insufficient. Even if almost all of the taxonomical community agreed with this viewpoint it wouldn't stop publishers of online journals feeling that their publications do already fulfil the requirements of the suggested amendment to the Code, for their contents would exhibit 'fixed content and format' (proposed Article 8.1.3.2). The Commission named PDF/A only as an example for good reasons, since other archival formats are likely to be developed—however, this necessary wording obviously opens the door for arbitrary interpretations.

Even if we could solve most of the storage, transformation and reading problems technically, these solutions would always depend on human beings willing and able to finance and execute such steps. Printed works have been available and readable for centuries, and present-day prints can be expected to be likewise for at least as long. The work of archiving printed books or journals is certainly a much less demanding task than preserving data files and keeping them accessible. However, nobody would doubt the advantages that modern information technology provides to science, and we biosystematists would not like to do without it. The question therefore is not whether one should print works 'traditionally' or instead distribute them electronically. Rather one has to find the best way of combining the advantages of both kinds of technology. For the time being I would strongly suggest that printed publications should form the main reference for zoological systematics, given their huge advantage of storing data as published more or less permanently and also of providing easy access. Currently it would be premature to include any kind of digital publication as a taxonomic reference in the Code.

Electronic publications are encouraged for the benefit of science, however, in order to address taxonomic matters, any such work must be available in print, with only the printed version providing the taxonomic reference. With technologies such as print-on-demand, which could be used to comply with the Code, the cost of producing a smaller print-run based on an existing electronic dataset is very low, so this would not provide any major impediment for the organisations publishing online journals. Each electronic version should contain detailed information on its identity and, if the printed edition of the paper is already available, a concise reference to this fact should also be given. It would be desirable, however, and not difficult to ensure that the print and electronic versions of the paper were published simultaneously so

that each of them could include a statement like: ‘This paper has been published (in the journal *XYZ*) on 1 April 2010 in accordance with the requirements of the International Code of Zoological Nomenclature.’ Such information could be checked sporadically perhaps by ZooBank or another suitable body within a short period of time, e.g. one year, and where publishers could not then verify their statement, the journal or book would be considered unavailable.

I would not follow the suggestion of the Welter-Schultes et al. to have special conditions for the print edition of electronic journals which, as in their suggested revision of Article 8.6, would make both the practical procedure and the Code unnecessarily complicated. I would also modify their suggested Article 8.5 on another fundamental point: whereas there are no technical specifications for publications issued after 2009 other than the use of durable paper, for earlier publications all printing technologies apart from ‘letterpress or offset printing’ are excluded. This *inter alia* applies to print-on-demand technologies, which I referred to above quite positively. Print-on-demand publications can be produced with an initial print run large enough to fulfil the requirements of the Code, and a statement that they are in accordance with the Code can easily be included in the publication. In its original Proposal the Commission rightly noticed the possibility of silent changes, however, if the editors / publishers are recommended by the Code not to allow these and to name modified versions appropriately e.g. as secondary editions of the respective work, I don’t see any particular reason for concern about the issue. In general I approve of the Commission’s proposal to accept any printing ‘using ink or toner’ (Article 8.4.1), although I would add the word ‘durable’ before ‘paper’ and again before ‘ink or toner’.

Although CD and DVD publications were allowed by the recent edition of the Code it is now understood that this was a mistake. Given the deterioration rate of these media, some of the CDs and DVDs of that period are by now damaged and unreadable, whilst others are not expected to survive for more than a century. Thus it is not in the interest of stability of zoological nomenclature that these media should be regarded as available publications any longer. However, since some such publications do exist, we can not merely regard them as unavailable, as Welter-Schultes et al. propose. I would suggest that the Commission invites all authors so affected to redescribe the taxa they originally published electronically within a limited period of, say, two years. This should be done with a publisher’s statement that this new description is deemed to replace an older one made public electronically only, and that s/he has personally seen this original publication. The Commission should rule that such replacement descriptions are considered available with the date of the print publication and should be accepted as valid names even if they are pre-dated by descriptions of the same taxon published between the dates of the original and replacement publications. However, in the event of the stated date for the electronic publication being shown to be wrong in that it actually post-dated the additional description, this declaration would not come into force and the earlier printed publication would become valid. In such cases a separate ruling of the Commission would be necessary given a time limit of, say, five years to apply for such a ruling. In order not to overstress the Code I suggest that the Commission deals with the issue in a separate declaration and not in any Article of the Code. Therefore I would prefer it if the present Article 8.6 were omitted in its entirety.

Generally, however, I consider it problematic for the Code to be changed a posteriori, as Welter-Schultes et al. propose (cf. the obligatory numbers of prints mentioned in their Point 3). One may doubt whether the suggested number of 100 copies is ideal for future publications. While this would better ensure preservation of copies, many under-financed scientific organisations publishing their own small journals might prefer a smaller number such as the Commission's suggestion of 25 copies.

For the time being, I would suggest printed publications to remain the only acceptable reference for zoological systematics. Currently it would be premature to include any kind of digital publication as taxonomic reference in the Code.