

Publication pressure threatens the integrity of palaeontological research

by Nussaïbah B. Raja¹ and Emma M. Dunne¹²

¹GeoZentrum Nordbayern, Department of Geography and Geosciences, Friedrich-Alexander University Erlangen-Nürnberg, Loewenichstr. 28, 91054 Erlangen, Germany, <https://orcid.org/0000-0002-0000-3944> ; nussaibah.raja.schoob@fau.de

²School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK, <https://orcid.org/0000-0002-4989-5904>; dunne.emma.m@gmail.com

Received 12 February 2022. Accepted 10 March 2022



Publications are the de facto currency of academia. Academics, palaeontologists included, are judged by publication metrics, which usually include the impact factor of the journal in which they publish, the number of publications, and the number of citations. However, in the race to publish in high-impact journals and the pressure to increase research productivity, sometimes corners are cut, leading to an increase in scientific and other types of misconduct. In this paper, we demonstrate how ethical, and even legal, transgressions within palaeontology, particularly regarding the provenance of fossil specimens, are inherently related to the pressure faced by academic researchers to publish “novel” studies in high-impact journals. We note how papers in high-impact journals follow a consistent theme of either showcasing novel evidence or methods, or describing charismatic or unusual specimens, often dinosaur-related. We examine notable recent examples of these papers that have been linked to ethical and legal problems, which have ironically been brought to light by virtue of the paper being widely publicised as highly “impactful”. Finally, we discuss the importance of developing an ethical framework for scientific publishing, which currently does not exist; only a handful of professional palaeontological bodies, including societies and journals, have independently developed policies to combat these issues. As long as the culture of “publish or perish” lingers in palaeontology, there will be no incentive for more ethical research that better serves both science and society to prevail.

Raja, N. B. & Dunne, E. M., 2022. Publication pressure threatens the integrity of palaeontology. *Geological Curator* **11** (7): 407–418. <https://doi.org/10.55468/GC1459>

Publication pressure in academic circles

“Publish or perish” has become the expression that describes modern academic culture where academics, palaeontologists included, face increased pressure to boost their research output in the form of publications (Rawat and Meena 2014; Grimes *et al.* 2018; Génova and de la Vara 2019; Niles *et al.* 2020). Publications have become the de facto currency of academia; however, not all publications are made equal and there are several factors that come into play when deciding what gets to be published and where. The journal impact factor (JIF; the yearly mean number of citations received by publications published in a given journal over the two previous years) has been the staple of the academic publishing industry since 1975 (Web of Science 2021), but it was not until the early 1990s that it began being used as a metric for evaluating authors as citation data were made electronically available (Archambault and Larivière 2009). JIF is one of the metrics used to rank academic journals, with scientific journals such as *Nature* and *Science* appearing at the top, and by extension, often being used as a measure of scientific merit or quality (Glänzel 2008; Brembs *et al.* 2013). JIF is not only used to decide where to submit research publications, but also by funding or institutional committees to make decisions on jobs, promotions or grants (Johnston 2013; Bohannon 2016; Moher *et al.*

2018; Tregoning 2018). For these decisions, JIF is often paired with the h-index, a similar metric that measures both the productivity and citation impact of an individual researcher’s publications. Applicants with publications in high-impact journals tend to receive better scores than those with publications in middle or low-impact journals, despite the fact that the delineation between high, middle and low tiers is arbitrary (Tregoning 2018). As a result, early-career researchers are advised not to focus their attention on low-impact publications, as this may affect their future job prospects where high-impact publications are typically one of the criteria used to judge applicants (Johnston 2013; Stephan *et al.* 2017; Coriat 2019). In many European and North American institutions, a list of journals and their JIFs is usually provided to hiring committees to evaluate candidates (Franzoni *et al.* 2011).

Metrics such as the JIF may offer a convenient way to judge applicants, but they are inherently flawed with respect to quality and influence (Stephan *et al.* 2017). To start with, JIF was never originally intended to be used to judge individual researchers, but rather to understand the impact of a journal as a whole over a certain period (Bohannon 2016). Generally, the number of citations of

publications in a given journal follows a highly skewed distribution, with the number of citations of a specific publication being generally lower than the journal's impact factor. As such the JIF does not fully portray the number of citations a particular publication may receive (Larivière *et al.* 2016). In June 2021, Utrecht University in the Netherlands officially announced their decision to move away from JIF and other quantitative metrics in the hiring and promotion process of researchers and instead focus on a multitude of factors such as the impact of an individual's research, academic leadership and open research (Woolston 2021). The newly adopted "Recognition and Rewards" scheme received much support from researchers, especially early career researchers, in the Netherlands (ScienceGuide 2021a). However, several researchers protested against the new scheme stating that it will include more subjectiveness in the process of how researchers are evaluated and will also negatively impact the way in which Dutch research is perceived internationally (ScienceGuide 2021b). This is clear evidence that while JIF-free assessments exist, they have yet to be established and accepted in the wider academic community (Curry 2018; Woolston 2021).

Worryingly, this pressure to publish high-impact papers can result in the publication's projected "impact" trumping other important considerations. Until recently, Chinese universities awarded bonuses to researchers publishing in high-impact journals — a policy that is said to have incentivised researchers to focus on quantity over quality, and to commit malpractices such as plagiarism or citation inflation (Mallapaty 2020). In fact, there is a positive correlation between the journal impact factor and the number of retractions for any given time period, *i.e.* journals with higher impact factors generally face more retractions (Fang and Casadevall 2011; Nature 2014). The primary reason for retractions in scientific disciplines over the last two decades have been scientific fraud (fabrication, falsification, plagiarism) or other kinds of misconducts such as fake peer review (Brainard and You 2018). Pressure to publish "novel" results in high-impact journals has previously been linked to decreased ethical standards (Anderson *et al.* 2007; Serra-Garcia and Gneezy 2021), and may explain how some authors place "publication prestige" above other aspects of their work, such as research ethics and legality.

Retractions are rare in the discipline of palaeontology — only five out of ~23,000 publications were retracted during the period 1990–2021, three of which were published in *Nature* and one in *PNAS*, according to PubMed.gov. In some cases, retraction has followed a genuine unintentional error in analyses that was only noticed post-publication (e.g. Panagiotopoulou *et al.* 2014), but palaeontol-

ogy is not exempt from malpractices. Despite the rarity of retractions, several palaeontological publications in high-impact journals have actually increased the visibility of certain malpractices that occur within the discipline (Yates 2022). In this paper, we demonstrate how ethical, and even legal, transgressions within palaeontology are inherently related to the pressure faced by academic researchers to publish "novel" studies in high-impact journals.

Publication trends in palaeontology

Traditionally, palaeontological research has focused on the discovery, description, form and function of fossil organisms. In more recent decades, palaeontological research has shifted to also encompass broader scale macroevolutionary and palaeobiological analyses of diversity, evolution and extinction through deep-time, particularly following the computational work of Raup and Sepkoski in the 1970–80s (e.g. Sepkoski *et al.* 1981; Raup and Sepkoski 1982). Palaeontological research is most often published in palaeontology-specific journals, for example *Journal of Vertebrate Paleontology* and *Palaeontology* (Figure 1). These journals, which publish a wide range of palaeontological research from species-specific taxonomic descriptions to broadscale macroevolutionary studies, typically have a JIF of less than 5 and may be considered "low-impact" journals (Figure 1). On the other hand, palaeontological studies published in journals with the highest JIFs (*i.e.* *Nature* and *Science*) are most likely to document a newly-acquired fossil specimen or uncover "new evidence" of some aspects of a group's evolutionary history, as illustrated by the titles of these publications (Figure 2), which reflect their editorial criteria to publish on "outstanding" or "influential" scientific topics (Nature 2021; Science 2021). Unsurprisingly, the most "popular" papers in these high-impact journals are on dinosaur specimens, as reflected in the number of social media posts and media reports based on these publications (Figure 3). This is expected given that they are one of the most well-known groups of ancient animals among scientific and non-scientific audiences alike (Black 2014). However, the winning combination in terms of popularity comes in the form of dinosaur related specimens preserved in amber (Figure 3), particularly amber from Kachin State in the northern region of Myanmar. One particular publication in *Nature Communications* that described the feeding behaviour of insects on dinosaur feathers (Gao *et al.* 2019) was picked up by 68 media outlets in multiple countries, and was shared by more than 500 users on Twitter as of May 2021. However, as discussed further in the next section, not all press is good press, as the popularity of some high-impact publications in the media has led to the exposure of certain ethical and legal transgressions (Cisneros *et al.* 2022).

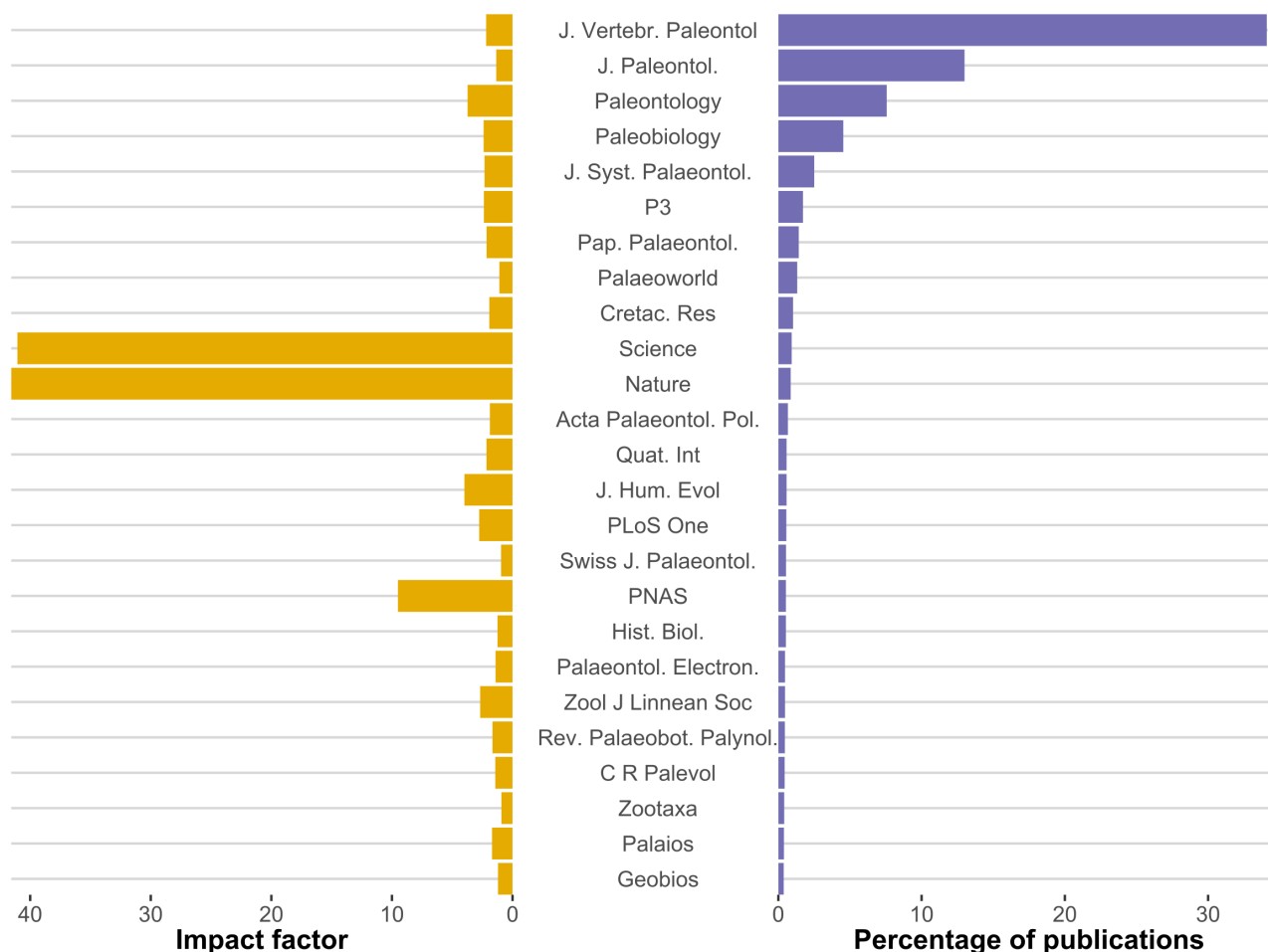


Figure 1. The top 25 journals in palaeontology with their impact factors and the percentage of indexed palaeontological publications published within them. Based on data from the Web of Science (using the following keywords in the search: “paleontology OR palaeontology OR paleobiology OR palaeobiology”). Abbreviations of journal names: *J. Vertebr. Paleontol.*, Journal of Vertebrate Paleontology; *J. Paleontol.*, Journal of Paleontology; *J. Syst. Paleontol.*, Journal of Systematic Palaeontology; *P3*, Palaeogeography, Palaeoclimatology, Palaeoecology; *Pap. Palaeontol.*, Papers in Palaeontology; *Cretac. Res*, Cretaceous Research; *Acta Palaeontol. Pol.*, Acta Palaeontologica Polonica; *Quat. Int.*, Quaternary International; *J. Hum. Evol.*, Journal of Human Evolution; *Swiss J. Palaeontol.*, Swiss Journal of Palaeontology; *Hist. Biol.*, Historical Biology; *Palaeontol. Electron.*, Palaeontologia Electronica; *Zool J Linnean Soc*, Zoological Journal of the Linnean Society; *Rev. Palaeobot. Palynol.*, Review of Palaeobotany and Palynology; *C R Palevol*, Comptes Rendus Palevol.

As the prestige of an academic journal depends, at least partly, on how often the research articles it publishes are cited, “novel” or surprising scientific findings are viewed as more desirable by journals (Brembs *et al.* 2013). This publication bias is pervasive across all scientific disciplines (Dwan *et al.* 2008; Brembs *et al.* 2013), but is especially prevalent in highly competitive fields (Fanelli 2012). In palaeontology, there is a pressure to publish in high-impact journals such as *Science*, *Nature*, and *PNAS*, but only a small proportion of palaeontological studies appear in these journals (Figure 1). The quest for novelty in scientific studies can not only encourage authors to commit various transgressions, but is also a major obstacle to addressing gaps in the literature. In palaeontology, this translates as the increasing rarity of classic taxonomic and systematic work, *i.e.* the description and classification of species, especially of less “charismatic” organisms, and

locality reports or faunal descriptions of existing taxa.

Taxonomic work is essential for nearly all studies in palaeontology, as well as natural sciences more broadly, since species and their anatomy are fundamental units of analyses of evolution, diversity, and extinction (Khuroo *et al.* 2007; Drew 2011; Engel *et al.* 2021). Taxonomy and systematics papers are increasingly treated as obscure specialised publications, lacking the perceived prestige required for publication in high-impact journals (Zeppeolini *et al.* 2021). In fact, JIF has been shown to be inadequate for assessing taxonomic publications. In 2019, the mega-journal *Zootaxa*, which caters for publications on zoological taxonomy, was suppressed (later reversed after the scientific community protested) due to the high proportion of self-citations from the *Journal Citation Report* that publishes statistics about journals including the JIF

shows the inadequacy of JIF in determining the quality of taxonomic publications and how it may instead bring more harm to more localised endeavours by suggesting that this expertise is not valuable.

Ethical and legal transgressions in palaeontology

Some recent palaeontological studies describing new fossil species in high-impact journals have highlighted a number of issues involving ethics, legality, and reproducibility within the field of palaeontology (Cisneros *et al.* 2022; Yates 2022). In several cases, these publications involve violations of national fossil laws and the use of fossil repositories that are not widely accessible to other researchers. In the most extreme cases, these fossil specimens have even been linked to human rights violations.

On 11 March 2020, a paper describing a specimen preserved in amber from Myanmar, thought to be a bird-like dinosaur, was published in *Nature* (Xing *et al.* 2020a). The paper was retracted three months later, on 22 June 2020 after *Nature* launched an investigation following the publication of a preprint (now published in *Vertebrata Palasiatica*) on the bioRxiv server by another group of palaeontologists who reanalysed the original computer tomography data and demonstrated that the specimen in fact showed lizard-like features (Li *et al.* 2020). While the retraction itself was not the result of any apparent fraud (Xing *et al.* 2020b), the publication of this study brought an important issue further into the spotlight: the controversies around Myanmar amber (also referred to as Burmese or Kachin amber), particularly its links to human rights abuses by the Myanmar

military on ethnic minorities in the northern state of Kachin, where most amber from Myanmar is mined (Dunne *et al.* 2021).

The issues around Myanmar amber had been widely known before this 2020 paper was published (Cooley 2017; Sokol 2019). However, as a result of this publication appearing in a high-impact journal, as well as on the cover of that issue (*Nature* 2020), discussions around these controversies were rekindled across the palaeontological community. On the same day as the *Nature* paper was published, an article covering the ethical issues with Myanmar amber was also published in the *New York Times*, featuring one of the authors of the *Nature* publication, who made a case for research on Myanmar amber despite any ethical concerns due to the scientific importance of this material (Joel 2020). This has led to more heightened debates about how such ethical, societal and human rights issues should be handled in palaeontological research. In April 2020, the Society of Vertebrate Paleontology (SVP) released a letter addressed specifically to journal editors calling for them to declare a moratorium on all amber specimens acquired from Myanmar after June 2017, which coincides with the time that the military forces in Myanmar started their campaign to take over the amber mines in the Kachin State (Rayfield *et al.* 2020). This letter was criticised by several members of the palaeontological community (Dunne *et al.* 2021), but was also received positively by some journals such as the *Journal of Systematic Paleontology* (Barrett and Johanson 2020) and *Acta Palaeontologica Polonica* (2020), which are both popular palaeontology journals (Figure 1). SVP

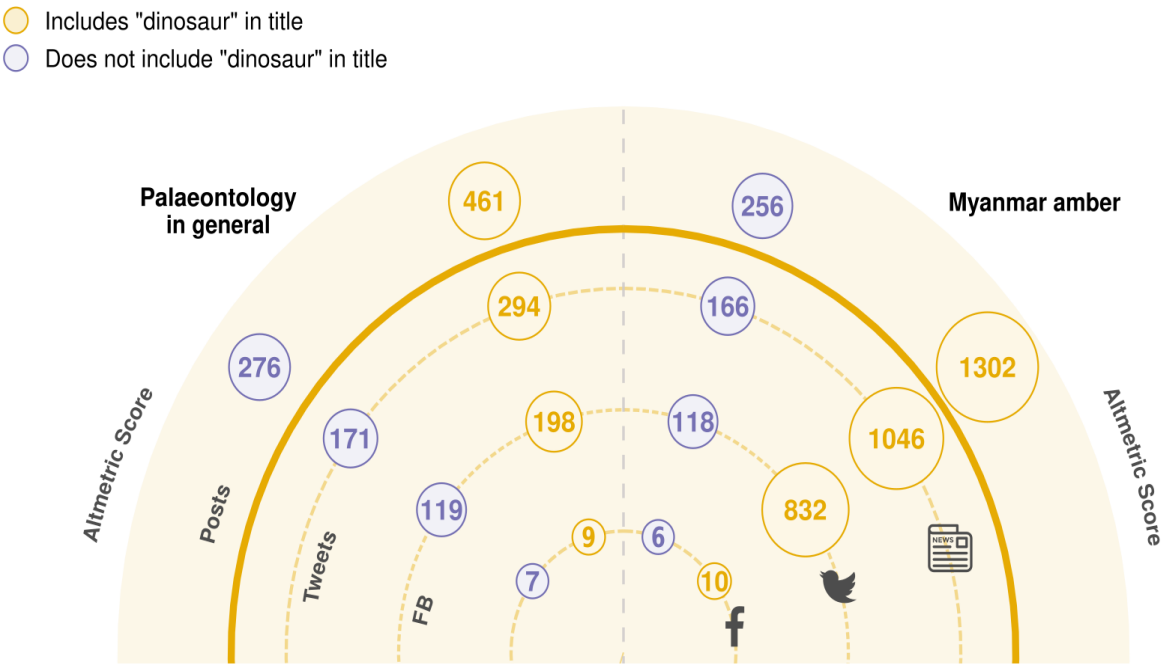


Figure 3. Altmetric scores and the number of blog posts, tweets, and Facebook (FB) posts (as of December 2020) belonging to all palaeontological publications (left) and those on Myanmar amber only (right), published in the *Nature* group and *Science* journals during the period December 2015 to November 2020. The altmetric score is a weighted score of the attention a publication has received in the news and on social media.

released another letter addressed to the paleontological community following the military coup in February 2021, revising the first letter to call a moratorium on amber species acquired after the beginning of the coup (Theodor *et al.* 2021) and updating its guidelines to provide a framework to vet Myanmar amber specimens acquired before February 2021 (See <https://vertpaleo.org/governance-documents/>). Some researchers have also started to refer to ethical and legal issues related to Myanmar amber in their publications although this remains a minority (Dunne *et al.* 2021).

As the palaeontological community continues to debate whether (and how) ethical issues such as human rights abuses should be considered within the scope of research ethics, issues of legality around fossils have been extensively documented, such as Liston and You (2015), Meijer (2016) and Cisneros *et al.* (2022). Over the last two decades, several countries, such as Brazil, China and Mongolia have been cracking down on violations of their existing fossil laws that restrict or outright ban exports of fossil specimens (Cisneros *et al.* 2022). Brazil has banned the export of fossils uncovered on Brazilian soil for over half a century since 1942, and since 1990 requires foreign researchers to work in collaboration with a local scientific institution. As such, when the description of a new Brazilian fossil, *Tetrapodophis amplexus*, was published in *Science*, questions were raised regarding its provenance, as the specimen was reportedly repositied in a private collection in Germany (Cisneros *et al.* 2022). The study had also not involved any Brazilian researchers or institutions, and a legal investigation was launched. More recently, in December 2020, a Brazilian dinosaur specimen named “*Ubirajara jubatus*” was described in *Cretaceous Research* and came under scrutiny for similar reasons. The publication was eventually retracted following an investigation, due to the legal and ethical controversies around the specimen, which the authors failed to clear (Pérez Ortega 2021a). Another controversial specimen, this time a ray-like shark specimen from Mexico named *Aquilolamna milarcae*, was published in *Science* in March 2021. This fossil sparked controversies because it had been purchased and, at the time of its publication, was being housed in a private collection (until a new museum is built; Cisneros *et al.* 2022). Both the purchase of fossil material and housing fossils in private collections, unless registered by the National Institute of Anthropology and History, is prohibited under Mexican fossil laws (Pérez Ortega 2021b; Cisneros *et al.* 2022). After the initial publication, the authors resolved both issues, firstly by moving the specimen to a museum where it will apparently be accessible to other researchers (again, until the new museum is ready), and secondly, by removing information about the specimen having been purchased to the supplementary materials, likely in an attempt to disguise this violation

Cisneros *et al.* 2022).

Myanmar amber is also controlled by the national legislature, but loopholes in the law can and do allow for rampant exploitation. Any fossil specimen leaving Myanmar (e.g. for study or temporary display) requires permission from the necessary authorities and cannot be marketed according to the 1957 Antiquities Act, revised as the The Protection and Preservation of Antique Objects Law in 2015 (Dunne *et al.* 2021). Amber is classified as a gemstone under the Myanmar Gemstone Law and thus can be sold and exported with the appropriate permits. However, neither the Antique Objects Law nor the Gemstone Law addresses the presence of fossils in amber, leaving the acquisition of amber specimens with fossil inclusions within a so far unaddressed complex legal greyzone (Stewens 2021). In many circumstances, this legal loophole is used by researchers to affirm that their amber specimens were legally acquired and that no legal issues exist with regards to Myanmar amber specimens (Sokol 2019; Joel 2020; Yates 2022). However, until this is addressed specifically by the Myanmar government - a very difficult feat given the military coup currently occurring in the country - researchers remain liable for not abiding to national laws in Myanmar, whose penalties include fines and even imprisonment. Until a legal precedent is set, researchers should thus abide by national laws regarding fossils, which state that specimens must be reported to the authorities and repositied in a national repository, or if being exported for study or display, a permit should be acquired (SVP 2022).

Towards building an ethical framework

Research ethics are not new to palaeontology. Palaeontologists, like other scientific researchers, have a responsibility to uphold certain ethical requirements during their research to avoid scientific misconduct. However, what is unclear is what falls under the term “scientific misconduct” within palaeontology. While falsified research or plagiarism unanimously would come under this umbrella, other considerations such as socioeconomic and political issues are less definitive. Many professional societies, such as the Paleontological Society and the Society for Vertebrate Paleontology now have codes of conduct that their members must adhere to, covering both professional and personal conduct, as well as the provenance of fossil material, among other considerations (Society of Vertebrate Paleontology 2015; Paleontological Society 2019). However, these societies seem to be among the very few that have such policies for their members. It must also be noted that these professional societies operate on an honour system and cannot legally enforce these policies.

Similarly, many journals have ethical considerations for their authors, usually informed by, but not restricted to, the Committee of Publication Ethics (COPE), whose aim

is to educate and support publishers and editors on publication ethics (COPE 2021). As of 16 May 2021, only a handful of palaeontological journals, including *Cretaceous Research*, *Palaeontology* and the *Swiss Journal of Palaeontology* and broader (and high-impact) journals including *Nature* and *Science* are members of COPE. However, COPE's core practices only cover ethical issues when the subject of research requires ethical considerations, such as research on animal or human subjects, but not when research is linked to human rights abuses (unrelated to the subject of research) or for matters of legality. Many palaeontological journals, however, have their own editorial policies, at least regarding the latter. For example, *Palaeontology* and *Papers in Palaeontology* require "clear provenance information to ensure full transparency of the research methods" and that specimens collected "from protected sites should include information regarding the requisite permission obtained" (Palaeontological Association 2021). The journals *Journal of Vertebrate Paleontology* and *Journal of Systematic Palaeontology* explicitly state that they do not accept manuscripts based on specimens in amber from Myanmar (Rayfield *et al.* 2020; Barrett and Johanson 2020). Editorial policies at Cretaceous Research state that "fossil material of uncertain or dubious provenance will not be accepted for publication" (Cretaceous Research 2021). These numerous disparate examples point to the fact that these policies are being individually developed without any central ethical framework across the discipline. In the case of *Cretaceous Research*, these policies are not being upheld, judging by the number of publications on Myanmar amber that have appeared in this journal (64 in 2021, excluding review articles, based on a search using the keywords "Myanmar amber OR Burmese amber OR Kachin amber"), even after the controversies around the material was openly known. Until all journals catering for palaeontological research enforce similar policies with regards to ethics and legality, there will always be an avenue for work involving unethical or illegal research practices. Similarly, research institutions and funding organisations, just like professional societies and journals, should also be committed to high standards of ethics. Palaeontological departments and institutions should provide training to their staff and students regarding ethical issues within the discipline. In particular, material related to these issues and their mitigation should be introduced early to all undergraduate students and graduate researchers, to provide them with an informed and ethical foundation for their future research.

The examples we provide here do not represent the full extent of ethical issues within the field of palaeontology and geosciences. Parachute science (where researchers generally from high-income countries go to lower income countries for research purposes without engaging with the local community), lack of diversity, sexual harassment, racism, ableism, and bullying are just some of

the other issues that need to be urgently addressed by the discipline (Hall *et al.* 2004; Bernard and Cooperdock 2018; Black 2018, 2019; Nature 2018; Dowey *et al.* 2021; Raja *et al.* 2022). Often, the reaction of academic institutions to misconducts committed by members of their staff is inadequate, especially when these people tend to be in powerful and influential positions (Wadman 2017; Shattuck *et al.* 2020). Due to their competence in publishing in high-impact journals and winning large grants, thus providing more visibility and resources for the institution, there is considerable institutional support shown to these individuals. Similarly, funders should be more critical of ethical and legal problems persisting in palaeontology. Funding frequently comes from national agencies through taxes. As such, increased transparency from individuals, groups or institutions receiving public funding should be a fundamental requirement. In the case of Myanmar amber, for example, public funding may be contributing to armed conflicts and human rights abuses in the Kachin State through the commercialisation of amber, which is a known source of revenue for the armed military forces inflicting these injustices on the ethnic minorities in the country (United Nations 2019).

Eliminating the "publish or perish" culture

As long as the culture of "publish or perish" remains ubiquitous in palaeontology, many researchers will continue to place publication prestige ahead of ethics and other concerns. Publication metrics should not be the primary criteria by which scientists are judged for career progression, awards, and research grants. An increasing number of publications include spin or "science hype" in their titles, such as the overuse of the words "new" or "novel", to make them more attractive to high-impact journals (Figure 2; Chiu *et al.* 2017; Gandevia 2018). The pressure to publish "novel" or surprising results in high-impact journals is also likely to be exacerbated by the precariousness of scientific careers (Giles 2007), which is particularly pertinent in the wake of the COVID-19 pandemic. Academic metrics also discriminate against marginalised groups that, on average, have fewer publications due to systemic biases and other duties, such as higher teaching load, higher mentorship load, and caring responsibilities (Beaudry and Larivière 2016; Aikens *et al.* 2017; Aguinis *et al.* 2018; Thelwall and Sud 2020). These factors are rarely taken into consideration during assessments for jobs, awards, and grants.

The culture of continuously seeking high-impact publications is deeply embedded within paleontological research and not only leads but also trains early career researchers to focus their work narrowly on output that is most suited for these publications. Creativity in research, which can lead to innovative methods and discourses, does not always have a place in modern scientific environments (Aken 2016). The academic job market has become rigid and narrow, prescribed by the same requirements made

by different departments and overly focused on publications and grants, that academics have no choice but to conform to these standards in order to secure a tenured academic position, which is already limited in terms of number of available permanent positions (Brechelmacher *et al.* 2015). As a result, many researchers are now turning to alternative non-academic platforms not only to voice their concerns regarding the current uncompromising structure of academia, but also to engage in academic discourses in creative ways that traditional academic jobs do not typically allow.

The social media platform Twitter has become a popular space for academics to keep up to date with research, for public engagement, and to build support networks beyond their lab group or department (Choo *et al.* 2015). Many critical conversations in academia, and palaeontology specifically, are being carried out on Twitter, for example, those related to mental health (e.g. #100Voices, @PhD_Balance, #AcademicMentalHealth), decolonisation and social justice (Ghilardi 2020, 2021; Haridy 2021), and diversity and inclusion, particularly in relation to fieldwork (e.g. @AbleismAcademia, @AccessibleGEO, @aapi-geosci, @GeoLatinas, #BlackInStem, @mothersinsci, @sacnas). Yet, these topics are still not considered a priority for many academic institutions or organisations. Twitter is now even being used as an alternative to in-person conferences, where “presentations” are in a series of tweets with accompanying graphics and videos and the official conference hashtag (e.g. #ExOncTC, #WSTC2, #PATC1; Caravaggi *et al.* 2021). Such alternative forms of academic discourses prove that scientific communication beyond publications not only appeals to academic audiences but can also be more effective in terms of public engagement and learning (Knight and Kaye 2016). In fact, it is through social media platforms, especially Twitter and Facebook, that many legal issues within palaeontology have come to light. One recent example is that of the illegal status of the “*Ubirajara jubatus*” specimen through the #UbirajaraBelongsToBR hashtag on Twitter (Cisneros *et al.* 2022).

A researcher should be appraised on the quality of their work, regardless of where it was published. This is one of the general recommendations of the Declaration on Research Assessment (DORA; <https://sfedora.org/>), whose aim is to improve the ways in which research and researchers are evaluated. As of March 2022, 21,275 individuals and organisations, including academic publishing groups, are signatories of DORA worldwide. DORA also notes that research output is not only in the form of scholarly articles, but also as dataset production, software development, science communication and impact on policy, which are all highly relevant to palaeontology. Other factors such as openness and transparency should also play a role in career advancement. This is also imperative not only for PhD programs where there is an early emphasis on publication number as a measure of success (which

can be detrimental to students’ wellbeing and career satisfaction; Coriat 2019) but also in undergraduate courses where many students are first introduced to scientific research. While DORA will not fully solve the over-reliance on JIF and other metrics due to the increased labour for those performing the evaluations (hiring committees or reviewers; Ylä-Herttuala 2015), it is nonetheless a system that would better serve both science and society.

The increasing visibility of unethical and illegal activities within our field not only illustrates the fundamental flaws in our academic system, but also how deeply these practices are rooted in colonialism and how they have remained unchanged for centuries (Cisneros *et al.* 2022), which benefits the already powerful and privileged. As we have shown here, these transgressions are also inherently encouraged by the current system, which relishes publications over other academic endeavours and where good science is being reduced to only how it equates with journal prestige. The ongoing earnest discussions about issues of ethics and legality within palaeontology have only highlighted just how much work we have yet to do; there needs to be a systemic change in the way that palaeontologists operate. Some journals and societies are already ahead of the (slow) curve and have been implementing measures to address certain issues. As more and more organisations follow their lead, there will no longer be a tolerance for these illegal and ethical transgressions. In this rapidly evolving climate, transgressors persisting with their unethical and illegal practices will be the first to fall into the “publish and perish” trap.

Acknowledgements

We thank Jeff Liston for inviting us to contribute to this volume, as well as Juan Cisneros, Davide Foffa, Andrew Farke, Sarah Greene, Eva Herbst, Advait Jukar and Rachel Warnock for invaluable discussions and feedback. NBR was supported by the Deutsche Forschungsgemeinschaft (KI 806/17-1) within the TERSANE Research Unit (FOR 2332). EMD was supported by a Leverhulme Research Project Grant (RPG-2019-365).

Data availability statement

Data and code for the analyses are available from: <https://github.com/paleoscientometrics/paleopubs2021>

References

- ACTA PALAEONTOLOGICA POLONICA. 2020. Burmese Amber and Human Rights. *Acta Palaeontologica Polonica: News*. <https://app.pan.pl/news.html> Accessed 11/05/2021.
- AGUINIS, H., JI, Y. H. and JOO, H. 2018. Gender productivity gap among star performers in STEM and other scientific fields. *Journal of Applied Psychology* 103, 1283–1306.
- AIKENS, M. L., ROBERTSON, M. M., SADSELIA, S.,

- WATKINS, K., EVANS, M., RUNYON, C.R., EBY, L. T., DOLAN, E. L. 2017. Race and Gender Differences in Undergraduate Research Mentoring Structures and Research Outcomes. *CBE—Life Sciences Education* **16**, ar34.
- AKEN, K. L. V. 2016. The critical role of creativity in research. *MRS Bulletin* **41**, 934–938.
- ANDERSON, M. S., MARTINSON, B. C., DE VRIES, R. 2007. Normative Dissonance in Science: Results from a National Survey of U.S. Scientists. *Journal of Empirical Research on Human Research Ethics: An International Journal* **2**, 3–14.
- ARCHAMBAULT, É. and LARIVIÈRE, V. 2009. History of the journal impact factor: Contingencies and consequences. *Scientometrics* **79**, 635–649.
- BARRETT, P. M. and JOHANSON, Z. 2020. Editorial. *Journal of Systematic Palaeontology* **18**, 1059–1059.
- BEAUDRY, C. and LARIVIÈRE, V. 2016. Which gender gap? Factors affecting researchers' scientific impact in science and medicine. *Research Policy* **45**, 1790–1817.
- BERNARD, R. E. and COOPERDOCK, E. H. G. 2018. No progress on diversity in 40 years. *Nature Geoscience* **11**, 292–295.
- BLACK, R. 2014. Dinosaur Culture. National Geographic. <https://www.nationalgeographic.com/science/article/dinosaur-culture> Accessed 19/05/2021.
- BLACK, R. 2018. The Many Ways Women Get Left Out of Paleontology. Smithsonian Magazine. <https://www.smithsonianmag.com/science-nature/many-ways-women-get-left-out-paleontology-180969239/> Accessed 18/05/2021.
- BLACK, R. 2019. Queer voices in palaeontology. Nature DOI: 10.1038/d41586-019-02113-6. <https://www.nature.com/articles/d41586-019-02113-6> Accessed 18/05/2021.
- BOHANNON, J. 2016. Hate journal impact factors? New study gives you one more reason. Science DOI: 10.1126/science.aag0643. <http://www.sciencemag.org/news/2016/07/hate-journal-impact-factors-new-study-gives-you-one-more-reason> Accessed 07/05/2021.
- BRAINARD, J. and YOU, J. 2018. What a massive database of retracted papers reveals about science publishing's 'death penalty.' Science DOI: 10.1126/science.aav8384. <https://www.sciencemag.org/news/2018/10/what-massive-database-retracted-papers-reveals-about-science-publishing-s-death-penalty> Accessed 12/05/2021.
- BRECHELMACHER, A., PARK, E., ATES, G. and CAMPBELL, D. F. J. 2015. The Rocky Road to Tenure – Career Paths in Academia. In T. Fumasoli, G. Goastellec, B. M. Kehm (eds.) *Academic Work and Careers in Europe: Trends, Challenges, Perspectives*. Cham, Switzerland: Springer International Publishing. 13–40.
- BREMBS, B., BUTTON, K. and MUNAFÒ, M. 2013. Deep impact: unintended consequences of journal rank. *Frontiers in Human Neuroscience* **7**. Frontiers.
- CARAVAGGI, A., OLIN, A. B., FRANKLIN, K. A. and DUDLEY, S. P. 2021. Twitter conferences as a low-carbon, far-reaching and inclusive way of communicating research in ornithology and ecology. *Ibis* **163**: 1481–1491.
- CHIU, K., GRUNDY, Q. and BERO, L. 2017. 'Spin' in published biomedical literature: A methodological systematic review. *PLOS Biology* **15**, e2002173.
- CHOO, E. K., RANNEY, M. L., CHAN, T. M., TRUEGER, N. S., WALSH, A. E., TEGTMEYER, K., MCNAMARA, S. O., CHOI, R. Y. and CARROLL, C. L. 2015. Twitter as a tool for communication and knowledge exchange in academic medicine: A guide for skeptics and novices. *Medical Teacher* **37**, 411–416.
- CISNEROS, J. C., RAJA, N. B., GHILARDI, A. M., DUNNE, E. M., PINHEIRO, F. L., REGALADO FERNÁNDEZ, O. R., SALES, M. A. F., RODRÍGUEZ-DE LA ROSA, R. A., MIRANDA-MARTÍNEZ, A. Y., GONZALEZ-MORA, S., BANTIM, R. A. M., DE LIMA, F. J. and PARDO, J. D. 2022. Digging deeper into colonial palaeontological practices in modern day Mexico and Brazil. *Royal Society Open Science* **9**, 210898.
- COOLEY, S. 2017. Dodging rumour and insurgency: the hunt for Burmese amber goes to the heart of Myanmar's turbulent north. <https://financialpost.com/commodities/mining/dodging-rumour-and-insurgency-the-hunt-for-burmese-amber-goes-to-the-heart-of-myanmars-turbulent-north> Accessed 12/05/2021.
- COPE. 2021. Committee on Publication Ethics. <https://publicationethics.org/about/our-organisation> Accessed 16/05/2021.
- CORIAT, A.-M. 2019. PhD merit needs to be defined by more than just publications. *Nature Human Behaviour* **3**, 1007–1007.
- CRETACEOUS RESEARCH. 2021. Author Information. <https://www.elsevier.com/journals/cretaceous-research/0195-6671/guide-for-authors> Accessed 2/05/2021.
- CURRY, S. 2018. Let's move beyond the rhetoric: it's time to change how we judge research. *Nature* **544**, 147–147.
- DOWEY, N., BARCLAY, J., FERNANDO, B., GILES, S., HOUGHTON, J., JACKSON, C., KHATWA, A., LAWRENCE, A., MILLS, K., NEWTON, A., ROGERS, S. and WILLIAMS, R. 2021. A UK perspective on tackling the geoscience racial diversity crisis in the Global North. *Nature Geoscience* **14**, 256–259.
- DREW, L. W. 2011. Are we losing the science of taxonomy?: As need grows, numbers and training are failing to keep up. *BioScience* **61**, 942–946.

- DUNNE, E., RAJA, N. B., STEWENS, P. and THEIN, Z. M. M. 2021. Ethics, law, and politics in palaeontological research: The case of Myanmar amber. <https://osf.io/awjex/> Accessed 8/02/2022.
- DWAN, K., ALTMAN, D. G., ARNAIZ, J. A., BLOOM, J., CHAN, A-W., CRONIN, E., DECULLIER, E., EASTERBROOK, P. J., VON ELLM, E., GAMBLE, C., GHERSI, D., IOANNIDIS, J. P. A., SIMES, J. and WILLIAMSON, P. R. 2008. Systematic review of the empirical evidence of study publication bias and outcome reporting bias. *PLOS One* **3**, e3081.
- ENGEL, M. S., CERÍACO, L. M. P., DANIEL, G. M., DELLAPÉ, P. M., LÖBL, I., MARINOV, M., REIS, R. E., YOUNG, M. T., DUBOIS, A., AGARWAL, I., LEHMANN A., P., ALVARADO, M., ALVAREZ, N., ANDREONE, F., ARAUJO-VIEIRA, K., ASCHER, J. S., BAÊTA, D., BALDO, D., BANDEIRA, S. A., BARDEN, P., BARRASSO, D. A., BENDIFALLAH, L., BOCKMANN, F. A., BÖHME, W., BORKENT, A., BRANDÃO, C. R. F., BUSACK, S. D., BYBEE, S. M., CHANNING, A., CHATZIMANOLIS, CHRISTENHUSZ, M. J. M., CRISCI, J. V., D'ELÍA, G., DA COSTA, LL. M., DAVIS, S. R., DE LUCENA, C. A. S., BEUVE, T., FEERNANDES ELIZALDE, S., FAIVOVICH, J., FAROOQ, H., FERGUSON, A. W., GIPPOLITI, S., GONÇALVES, F. M. P., GONZALEZ, V. H., GREENBAUM, E., HINOJOSA-DÍAZ, I. A., INEICH, I., JIANG, J., KAHONO, S., KURY, A. B., LUCINDA, P. H. F., LYNCH, J. D., MALÉCOT, V., MARQUES, M. P., MARRIS, J. W. M., MCKELLAR, R. C., MENDES, L. F., NIHEI, S. S., NISHIKAWA, K., OHLER, A., ORRICO, V. G. D., OTA, H., PAIVA, J., PARRINHA, D., PAUWELS, O. S. G., PEREYRA, M. O., PREESTANA, L. B., PINHEIRO, P. D. P., PRENDINI, L., PROKOP, J., RASMUSSEN, C., RÖDEL, M-O., RODRIGUES, M. T., RODRÍGUEZ, S. M., SALATNAYA, H., SAMPAIO, I., SÁNCHEZ-GARCÍA, A., SHEBL, M. A., SANTOS, B. S., SOLÓRZANO-KRAEMER, M. M., SOUSA, A. C. A., STOEV, P., TETA, P., TRAPE, J-F, VAN-DÚNEM DOS SANTOS, C., VASUDEVAN, K., VINK, C. J., VOGEL, G., WAGNER, P., WAPPLER, T., WARE, J. L., WEDMANN, S. and KUSAMBA ZACHARI, C. 2021. The taxonomic impediment: a shortage of taxonomists, not the lack of technical approaches. *Zoological Journal of the Linnean Society* **193**, 381–387.
- FANELLI, D. 2012. Negative results are disappearing from most disciplines and countries. *Scientometrics* **90**, 891–904.
- FANG, F. C. and CASADEVALL, A. 2011. Retracted Science and the Retraction Index. *Infection and Immunity* **79**, 3855–3859.
- FRANZONI, C., SCCELLATO, G. and STEPHAN, P. 2011. Changing Incentives to Publish. *Science* **333**, 702–703.
- GANDEVIA, S. 2018. Publication pressure and scientific misconduct: why we need more open governance. *Spinal Cord* **56**, 821–822.
- GAO, T., YIN, X., SHIH, C., RASNITSYN, A. P., XU, X., CHEN, S., WANG, C. and REN, D. 2019. New insects feeding on dinosaur feathers in mid-Cretaceous amber. *Nature Communications* **10**, 5424.
- GENOVA, G. and DE LA VARA, J. L. 2019. The problem is not professional publishing, but the publish-or-perish culture. *Science and Engineering Ethics* **25**, 617–619.
- GHILARDI, A. 2020. Novo dinossauro brasileiro. Fóssil fora do Brasil. Só pesquisador estrangeiro. <https://t.co/WFHObE8aYR>. <https://twitter.com/aline-mghilardi/status/1338177663903690753> Accessed 21/05/2021.
- GHILARDI, A. 2021. “Aline, I’m afraid of being accused of practicing colonialist science without being (or having been) my intention! What should I do?” <https://twitter.com/alinemghilardi/status/1382337179389677571> Accessed 21/05/2021.
- GILES, J. 2007. Breeding cheats. *Nature* **445**, 242–243.
- GLÄNZEL, W. 2008. Seven myths in bibliometrics about facts and fiction in quantitative science studies. *Collnet Journal of Scientometrics and Information Management* **2**, 9–17.
- GRIMES, D. R., BAUCH, C. T. and IOANNIDIS, J. P. A. 2018. Modelling science trustworthiness under publish or perish pressure. *Royal Society Open Science* **5**, 171511.
- HALL, T., HEALEY, M. and HARRISON, M. 2004. Fieldwork and disabled students: discourses of exclusion and inclusion. *Journal of Geography in Higher Education* **28**, 255–280.
- HARIDY, Y. 2021. STORY TIME! Many of you may have read the @nytimes article by @asher_elbein: <https://t.co/iKppqMHX0D> Some of you may want more context as to how “normal” paleo fieldwork became a collapsing museum rescue mission AND case study in how to #DecolonizePaleontology. https://twitter.com/Yara_Haridy/status/1374106598138802176 Accessed 21/05/2021.
- JOEL, L. 2020. Some paleontologists seek halt to Myanmar amber fossil research. The New York Times. <https://www.nytimes.com/2020/03/11/science/amber-myanmar-paleontologists.html> Accessed 11/05/2021.
- JOHNSTON, M. 2013. We have met the enemy, and it is us. *Genetics* **194**, 791–792.
- JOURNAL OF PALEONTOLOGY. 2022. Instructions for authors. <https://www.cambridge.org/core/journals/journal-of-paleontology/information/instructions-contributors> Accessed 9/03/2022.
- JOURNAL OF VERTEBRATE PALEONTOLOGY. 2022. Aims & Scope. <https://www.tandfonline.com/activation/journalInformation?show=aimsScope&journalCode=ujvp20> Accessed 09/03/2022.

- KHUROO, A. A., DAR, G. H., KHAN, Z. S. and MALIK, A. H. 2007. Exploring an inherent interface between taxonomy and biodiversity: Current problems and future challenges. *Journal for Nature Conservation* **15**, 256–261. <https://www.sciencedirect.com/science/article/pii/S1617138107000222> Accessed 07/05/2021).
- KNIGHT, C. G. and KAYE, L. K. 2016. ‘To tweet or not to tweet?’ A comparison of academics’ and students’ usage of Twitter in academic contexts. *Innovations in Education and Teaching International* **53**, 145–155.
- LARIVIÈRE, V., KIERMER, V., MACCALLUM, C. J., MCNUTT, M., PATTERSON, M., PULVERER, B., SWAMINATHAN, S., TAYLOR, S. and CURRY, S. 2016. A simple proposal for the publication of journal citation distributions. Preprint. <http://biorxiv.org/lookup/doi/10.1101/062109> Accessed 07/05/2021.
- LI, Z., WANG, W., HU, H., WANG, M., YI, H. and LU, J. 2020. Is Oculudentavis a bird or even archosaur? <https://www.biorxiv.org/content/10.1101/2020.03.16.993949v1> Accessed 11/05/2021.
- LISTON, J. and YOU, H-L. 2015. Chinese fossil protection law and the illegal export of vertebrate fossils from China. *Journal of Vertebrate Paleontology* **35**, e904791.
- MALLAPATY, S. 2020. China bans cash rewards for publishing papers. *Nature* **579**, 18–18.
- MEIJER, H. 2016. To collect or not to collect: are fossil-hunting laws hurting science? *The Guardian*. <http://www.theguardian.com/science/2016/jul/27/to-collect-or-not-to-collect-are-fossil-hunting-laws-hurting-science> Accessed 11/05/2021.
- MOHER, D., NAUDET, F., CRISTEA, I. A., MIEDEMA, F., IOANNIDIS, J. P. A. and GOODMAN, S. N. 2018. Assessing scientists for hiring, promotion, and tenure. *PLOS Biology* **16**, e2004089.
- NATURE. 2014. Why high-profile journals have more retractions. <http://www.nature.com/articles/nature.2014.15951> Accessed 12/05/2021.
- NATURE. 2018. Ban bullying in science. <https://www.nature.com/articles/d41586-018-07529-0> Accessed 18/05/2021.
- NATURE. 2020. Volume 579 Issue 7798, 12 March 2020. <https://www.nature.com/nature/volumes/579/issues/7798> Accessed 11/05/2021.
- NATURE. 2021. Editorial criteria and processes. <https://www.nature.com/nature/for-authors/editorial-criteria-and-processes> Accessed 23/05/2021.
- NILES, M. T., SCHIMANSKI, L. A., MCKIERNAN, E. C. and ALPERIN, J. P. 2020. Why we publish where we do: Faculty publishing values and their relationship to review, promotion and tenure expectations. *PLOS ONE* **15**, e0228914.
- PALAEONTOLOGICAL ASSOCIATION. 2021. Palaeontology: Information for authors. <https://www.palass.org/publications/palaeontology-journal#for-authors> Accessed 21/05/2021.
- PALEONTOLOGICAL SOCIETY. 2019. Non-Discrimination and Code of Conduct. <https://www.paleosoc.org/non-discrimination-and-code-of-conduct> Accessed 03/04/2021.
- PANAGIOTOPOULOU, O., WILSHIN, S. D., RAYFIELD, E. J., SHEFELBINE, S. J. and HUTCHINSON, J. R. 2014. What makes an accurate and reliable subject-specific finite element model? A case study of an elephant femur. *Journal of The Royal Society Interface* **11**, 20140854.
- PÉREZ ORTEGA, R. 2021a. ‘It’s like a second extinction’: Retraction deepens legal and ethical battle over rare dinosaur. <https://www.science.org/doi/10.1126/science.acx9223/abs/> Accessed 30/09/2021.
- PÉREZ ORTEGA, R. 2021b. Ethical controversy swirls around shark fossil from Mexico. *Science* **372**, 332–333.
- PINTO, Â. P., MEJDALANI, G., MOUNCE, R., SILVEIRA, L. F., MARINONI, L. and RAFAEL, J. A. 2021. Are publications on zoological taxonomy under attack? *Royal Society Open Science* **8**, 201617.
- RAJA, N. B., DUNNE, E. M., MATIWANE, A., KHAN, T. M., NÄTSCHER, P. S., GHILARDI, A. M. and CHATTOPADHYAY, D. 2022. Colonial history and global economics distort our understanding of deep-time biodiversity. *Nature Ecology & Evolution* **6**, 145–154.
- RAUP, D. M. and SEPKOSKI, J. J. 1982. Mass Extinctions in the Marine Fossil Record. *Science* **215**, 1501–1503.
- RAWAT, S. and MEENA, S. 2014. Publish or perish: Where are we heading? *Journal of Research in Medical Sciences : The Official Journal of Isfahan University of Medical Sciences* **19**, 87–89.
- RAYFIELD, E. R., THEODOR, J. M. and POLLY, P. D. 2020. Society of Vertebrate Paleontology: Fossils from conflict zones and reproducibility of fossil-based scientific data. <https://vertpaleo.org/wp-content/uploads/2021/01/SVP-Letter-to-Editors-FINAL.pdf>
- SCIENCE. 2021. Mission and scope. <https://www.sciencemag.org/about/mission-and-scope> Accessed 23/05/2021.
- SCIENCEGUIDE. 2021a. We moeten af van telzucht in de wetenschap. <https://www.scienceguide.nl/2021/07/we-moeten-af-van-telzucht-in-de-wetenschap/> Accessed 01/03/2022.
- SCIENCEGUIDE. 2021b. Nieuwe Erkennen en waarden schaaft Nederlandse wetenschap. <https://www.scienceguide.nl/2021/07/nieuwe-erken-en-waarden-schaaft-nederlandse-wetenschap/> Accessed 01/03/2022.
- SEPKOSKI, J. J., BAMBACH, R. K., RAUP, D. M. and VALENTINE, J. W. 1981. Phanerozoic marine diversity and the fossil record. *Nature* **293**, 435–437.

- SERRA-GARCIA, M. and GNEEZY, U. 2021. Nonreplicable publications are cited more than replicable publications are cited more than replicable ones. *Science Advances* **7**, eabd1705.
- SHATTUCK, S., CHENEY, I. and POTTLE, M. 2020. Picture a Scientist. Uprising Production. <https://www.pictureascientist.com> Accessed 27/05/2021.
- SOCIETY OF VERTEBRATE PALEONTOLOGY. 2015. Member Bylaw on Ethics Statement. <https://vertepaleo.org/member-bylaw-on-ethics-statement/> Accessed 03/04/2021.
- SOKOL J. 2019. Fossils in Burmese amber offer an exquisite view of dinosaur times—and an ethical minefield. <https://www.sciencemag.org/news/2019/05/fossils-burmese-amber-offer-exquisite-view-dinosaur-times-and-ethical-minefield> Accessed 01/04/2021.
- STEPHAN, P., VEUGELERS, R. and WANG, J. 2017. Reviewers are blinkered by bibliometrics. *Nature News* **544**, 411–412.
- STEWENS, P. P. 2021. Burmese Amber: Palaeontology's Blood Diamonds Through the Lens of International Law. *Völkerrechtsblog*. https://intr2dok.vifa-recht.de/receive/mir_mods_00010859 Accessed 26/07/2021.
- SVP. 2022. Myanmar amber: Best Practice Guidelines for Researchers, Research Institutions and Publishers. <https://vertepaleo.org/wp-content/uploads/2022/02/Guidelines-for-Researchers-Research-Institutions-and-Publishers.pdf> Accessed 09/03/2022.
- THELWALL, M. and SUD, P. 2020. Greater female first author citation advantages do not associate with reduced or reducing gender disparities in academia. *Quantitative Science Studies* **1**, 1283–1297.
- THEODOR, J. M., LEWIS, M. E. and RAYFIELD, E. J. 2021. Amber specimens acquired from Myanmar following military coup. Society of Vertebrate Paleontology. https://vertepaleo.org/wp-content/uploads/2021/06/SVP-Letter-to-paleontological-community-on-Myanmar-Amber_FINAL.pdf.
- TREGONING, J. 2018. How will you judge me if not by impact factor? *Nature* **558**, 345–345.
- UNITED NATIONS. 2019. The economic interests of the Myanmar military: Independent International Fact-Finding Mission on Myanmar. UN Doc. A/HRC/42/CRP.3. <https://www.ohchr.org/EN/HRBodies/HRC/MyanmarFFM/Pages/EconomicInterestsMyanmarMilitary.aspx> Accessed 26/03/2021.
- WADMAN, M. 2017. Disturbing allegations of sexual harassment in Antarctica leveled at noted scientist. *Science*. <https://www.sciencemag.org/news/2017/10/disturbing-allegations-sexual-harassment-antarctica-leveled-noted-scientist> Accessed 27/05/2021.
- WEB OF SCIENCE. 2021. The History of ISI and the work of Eugene Garfield. <https://clarivate.com/webofsciencegroup/solutions/the-history-of-isi/>. Accessed 07/05/2021.
- WOOLSTON C. 2021. Impact factor abandoned by Dutch university in hiring and promotion decisions. *Nature* **595**, 462–462.
- XING, L., O'CONNOR, J. K., SCHMITZ, L., CHIAPPE, L. M., MCKELLAR, R. C., YI, Q. and LI, G. 2020a. Hummingbird-sized dinosaur from the Cretaceous period of Myanmar. *Nature* **579**, 245–249.
- XING, L., O'CONNOR, J. K., SCHMITZ, L., CHIAPPE, L. M., MCKELLAR, R. C., YI, Q. and LI, G. 2020b. Retraction Note: Hummingbird-sized dinosaur from the Cretaceous period of Myanmar. *Nature* **584**, 652–652.
- YATES, D. 2022. Dubious dinosaurs, ambiguous amber, and fishy fossils: what creative compliance and neutralization techniques reveal about palaeontological ethics. *Geological Curator* **11** (7): 428–435.
- YLÄ-HERTTUALA, S. 2015. From the impact factor to DORA and the scientific content of articles. *Molecular Therapy* **23**, 609.
- ZEPPELINI, D., DAL MOLIN, A., LAMAS, C. J. E., SARMIENTO, C., RHEIMS, C. A., FERNDANDES, D. R. R., LIMA, E. F. B., SILVA, E. N., CARVALHO-FILHO, F., KOVÁČ, L., MONTAÑA-LERMA, J., MOLDOVAN, O. T., SOUZA-DIAS, P. G. B., DEMITE, P. R., FEITOSA, R. M., BOYER, S. L., WEINDER, W. M. and RODRIGUES, W. C. 2021. The dilemma of self-citation in taxonomy. *Nature Ecology & Evolution* **5**, 2–2.