# The promise of community-driven preprints in ecology and evolution

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# Introduction

Publishing preprints – papers communicating non-peer-reviewed research findings – is now an entrenched practice across a multitude of scientific disciplines[1]. Preprints in biology have had a slower uptake relative to other disciplines[2], but new discipline-specific preprint servers, such as *EcoEvoRxiv* (https://ecoevorxiv.org), provide a means by which ecologists and evolutionary biologists can disseminate research findings. Preprints attempt to break down barriers to scientific publishing by: 1) increasing the visibility of research and the speed at which research findings become available, which can lead to more citations [e.g., 3,4]; 2) helping establish the precedence of research findings; 3) removing financial barriers to open access publication; and 4) enabling feedback from the research community[5–7]. Ultimately, preprints can facilitate the rapid sharing of scientific knowledge that can have significant impacts on fundamental and applied knowledge globally[8].

Preprint servers can empower researchers to make their research findings more accessible, open, and transparent but only if they are used as forums for spreading and discussing findings within a research community. However, significant barriers to the widespread adoption of preprints remain, ranging from a lack of clarity around preprint policies in journals[9] to a stigma within the research community that preprints are of poor quality[10] (but see[11]). Nonetheless, we lack an understanding of the factors that influence preprint use in ecology and evolution. Such an understanding may help improve current initiatives (see below), inform future ones and allow us to work harder in further breaking down barriers to scientific publishing.

*EcoEvoRxiv* is one of the few community-driven preprint servers that has paved the way for new initiatives, by accepting multilingual preprints, registered reports, and non-traditional research reports. *EcoEvoRxiv* also promotes peer review and community discussion in the hopes of improving the quality of preprints and speeding up their peer-reviewed publication (e.g., Peer Community In – PCI[12]). Peer Community In allows for fast, constructive peer review around a preprint with peer reviews being transparent and published online[12].

Here, we explore the first preprints uploaded to *EcoEvoRxiv* to characterise preprint practices in ecology and evolution. We aim to understand: 1) in what countries authors who use *EcoEvoRxiv* are located; 2) the taxonomic diversity of study systems across preprints; 3) whether preprint server use depends on career stage and gender; 4) the extent to which authors make use of preprint servers for reports and community-driven peer review; 5) the extent to which data and code are shared in preprints; and 6) how many preprints remain unpublished, and for those that are published, how long it took for them to become published. In the process, we also provide a summary of what makes *EcoEvoRxiv* distinct from other preprint servers to help further clarify the benefits of using community-driven preprint servers to disseminate research findings.

# Getting to know your *EcoEvoRxiv* preprint server

*EcoEvoRxiv* is run by the Society for Open, Reliable, and Transparent Ecology and Evolutionary Biology (SORTEE)[13]. Originally launched in 2018 on the Center for Open Science preprint platform, *EcoEvoRxiv* has become a popular preprint server for ecologists and evolutionary biologists. The server has since been adopted by the California Digital Library (CDL). Editors are ecologists and evolutionary biologists from across the globe who volunteer their time to screen papers and push new initiatives in the preprint space. *EcoEvoRxiv* allows authors to post both preprints and postprints (also known as author-accepted manuscripts). While preprints are versions of manuscripts posted by authors before peer-review, postprints are versions of peer-reviewed and accepted articles but without typesetting and formatting by a journal. The main reason for publishing postprints on a preprint server is to ensure published articles are openly accessible

to everyone without a paywall (i.e., green open access). Postprints can be published anytime, provided that journals allow it (which most do; see https://www.sherpa.ac.uk/romeo/).

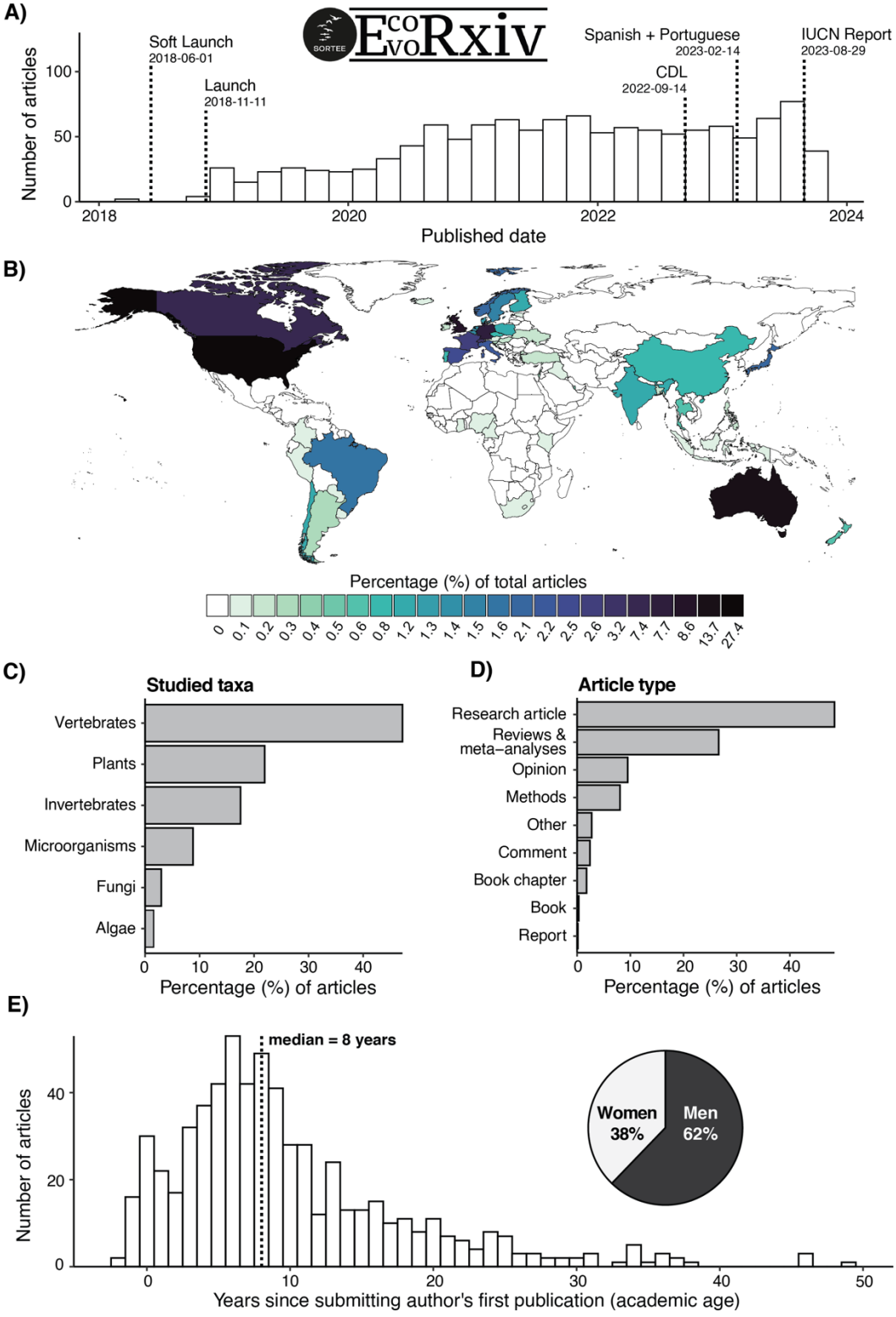


Figure 1- Summary of articles posted to *EcoEvoRxiv*. A) Number of articles (preprints and postprints) published on *EcoEvoRxiv* between 2018 and 2023. *EcoEvoRxiv* was established in June 2018 before the launch in November 2018. Notable milestones include *EcoEvoRxiv* transitioning to the California Digital Library (CDL), the acceptance of preprints and postprints in Spanish and Portuguese, and the acceptance of the first IUCN Red List Ecosystem report; B) Geographic origin of the preprints and postprints uploaded

to *EcoEvoRxiv*, inferred from the country of affiliation of the submitting author; C) Taxa used/covered in the articles posted to *EcoEvoRxiv* (n = 1080 articles); D) Types of preprints accepted on *EcoEvoRxiv* (n = 620 articles). E) Academic age of authors posting to *EcoEvoRxiv* along with the gender of the submitting author. Values lower than zero are indicative of authors who uploaded preprints before their first scientific publication in a journal. Map base source: R Package "maps" v.3.4.2. Shapefile: Natural Earth https://www.naturalearthdata.com/about/terms-of-use/.

## *Overview of EcoEvoRxiv preprints (and postprints)*

To better understand preprint (and postprint) use on *EcoEvoRxiv*, we downloaded metadata on the articles available on *EcoEvoRxiv* as of 2023-09-30 (see Supplement for more details on methods). We consider both preprints and postprints as 'articles'. After removing five duplicate titles – suggesting that a few authors created multiple submissions for the same preprint rather than updating the existing submission – we had data for a total of 1216 articles with ~55–60 preprints published approximately monthly in the last two years (Figure 1A). *EcoEvoRxiv* hosts articles from authors based in 56 countries, with 90% of the articles coming from just 17 countries. North America, Australia, and European countries upload the most preprints, with many fewer coming from countries in Africa, Central America, and parts of Asia (Figure 1B). Articles covered all major taxonomic groups, with the most common being vertebrates (47.2%), plants (21.9%), and invertebrates (17.5%) (Figure 1C).

## *Diversifying article types on EcoEvoRxiv: overcoming the 'grey literature' problem*

Accepting a greater diversity of article types allows *EcoEvoRxiv* to help deal with the 'grey literature' problem, whereby data that are relevant for research syntheses are not published in typical peer-reviewed journals[14,15]. *EcoEvoRxiv* has made a concerted effort to diversify the types of articles accepted. This is reflected by 5% of the articles on *EcoEvoRxiv* being books, book chapters, reports, and other research output types, which are typically considered 'grey literature' in ecology and evolutionary biology. As a result, articles on *EcoEvoRxiv* are more diverse than those on preprint servers which have more restrictive submission policies. For example, *bioRxiv* only accepts research articles (https://www.biorxiv.org/submit-a-manuscript).

Typical research articles are still the most common type of preprint on *EcoEvoRxiv* (48.4%), followed by reviews and meta-analyses (26.6%) and opinion papers (9.5%) (Figure 1D). Currently, *EcoEvoRxiv* does not host many reports, particularly from government or industry, but has formed fruitful partnerships with the International Union for Conservation of Nature (IUCN). For example, IUCN Red-list Ecosystem Reports are now posted to *EcoEvoRxiv* and our community has been able to work closely with the IUCN to ensure these documents meet the IUCN requirements. We would encourage authors to consider posting books, book chapters, and reports to ensure that they are openly accessible and more easily found. *EcoEvoRxiv* articles are given a unique DOI and are indexed on Google Scholar.

## *Breaking down language barriers to scientific communication: improving diversity and data representation globally*

A significant barrier to the communication of research findings is the fact that they are primarily communicated in English[16–18]. Research communication through a single language has major consequences for the global distribution of knowledge, resulting in knowledge gaps across some of the most biodiverse and threatened regions in the world[19,20]. Such gaps also impact research syntheses and meta-analyses because they create a distorted picture of our knowledge base that can affect future research, policy development and decision-making[20–23].

*EcoEvoRxiv* is the only preprint server to date that breaks down language barriers to scientific communication by accepting English, Spanish, Portuguese and French articles. *EcoEvoRxiv* plans to expand

to other languages as new non-English editors become available. Such initiatives are incredibly important if we are to begin filling global voids of scientific knowledge. However, multilingual initiatives have been slow to take off on *EcoEvoRxiv*, with only a few Spanish articles, and a single Portuguese article, posted since starting to accept non-English articles in 2023. Part of the challenge in getting authors to submit non-English articles is the lack of awareness of *EcoEvoRxiv* in non-English speaking countries, cultural differences in the perception of preprints, and a strong reliance on traditional publishing models that typically mandate publishing in English[24].

## *Generational and gender-based gaps in preprinting practices*

Research papers can take a while to be published (see below). However, Early and Mid-Career Researchers (EMCRs) (~10 years post-PhD) are under pressure to publish rapidly to be competitive in job applications, promotions, and obtaining grants to progress their careers[7,25]. Preprints are one way EMCRs can achieve faster dissemination and greater visibility[4]. As such, EMCRs may be expected to make use of preprints more than colleagues at later career stages. We collected data on the 'academic age' of submitting authors by looking at Google Scholar profiles of authors (when available) and recording their first year of publication in a peer-reviewed journal. While this is a rough estimate of career stage, there was evidence that the number of preprints posted decreases with later career stages (negative binomial glm: year slope = -0.1, SE: 0, $p <$ 0.001, n = 42 years). Most preprints were submitted by authors who published their first paper in the last ~10 years (Figure 1E), with the median year since first publication being 2013 (mean = 2010.6; SD = 9.9, n = 1214). These patterns support the expectation that EMCRs may use preprints to make their work more visible and disseminate their findings more quickly. However, we acknowledge that validating this conclusion does require more rigorous experimental approaches.

Gender differences in preprint use and publication outcomes have also been observed in several research fields, including ecology and evolutionary biology[26,27]. Therefore, such discrepancies are expected to manifest in preprint use on *EcoEvoRxiv*, but it is unclear to what extent. Understanding gender publishing patterns is challenging with observational data such as ours because we cannot know the gender of authors for certain, but we can use a data-driven approach to ascertain the probability that a particular name is of a given gender (man or woman). To obtain a rough idea of an author's gender, we used the R package *gender* (v.0.6.0;[28]) to predict the most likely gender of the submitting author of a preprint. We only used algorithm-assigned names where the gender was identified with 95% certainty. For the remaining names, we performed manual searches to determine gender based on the pronouns and photographs from professional and personal websites. We acknowledge that our approach does not capture self-assigned and non-binary genders. As such, our assumptions about an author's gender identity may be incorrect. Our data on gender had only two missing values–one where the first name of the submitting author was missing and the other one for a collective submission. As expected, we found that women were less likely to publish on *EcoEvoRxiv* compared to men (women: 37.8%), which may reflect the broader publishing disparities between male and female scientists[26].

# Following the journey of a preprint on *EcoEvoRxiv*: from submission to publication

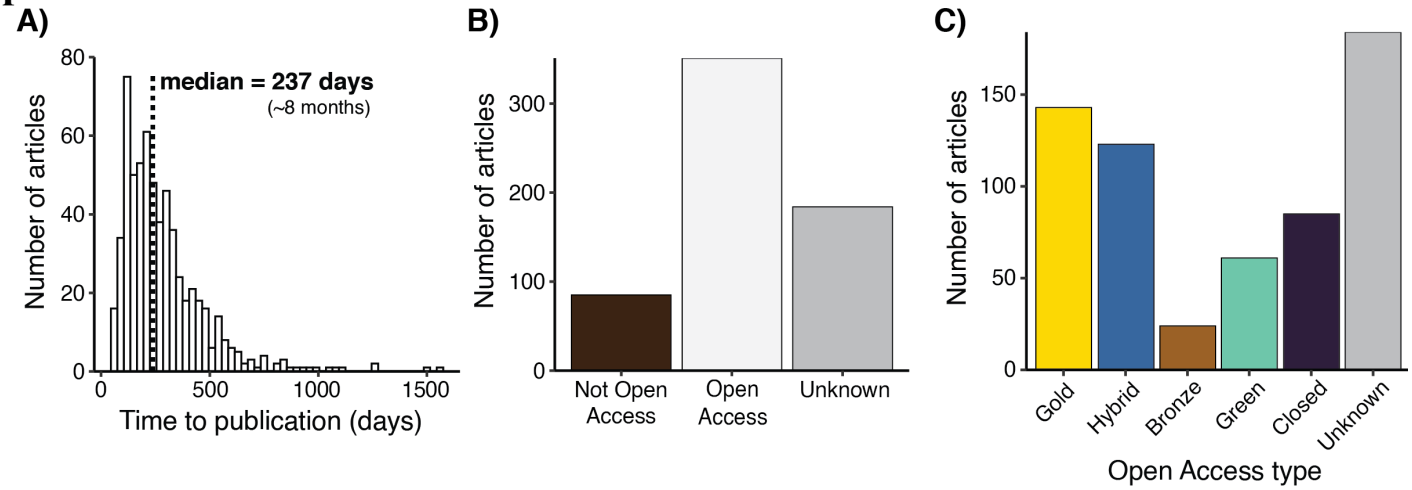


Figure 2- Summary of the publication status of articles on *EcoEvoRxiv*. A) Time between uploading an preprint to *EcoEvoRxiv* and its publication as a peer-reviewed journal article. Articles that were published within 2 months (60 days) of being submitted are considered postprints and are not included in this figure. B) Access status of articles linked to *EcoEvoRxiv* preprints classified as "Open Access" or "Not Open Access". "Unknown" status is for articles not explicitly identified as being open access or not on the Unpaywall platform. C) Sub-types of open access status of articles linked to *EcoEvoRxiv* preprints. For full details on the meaning of each category see https://support.unpaywall.org/support/solutions/articles/44001777288-what-do-the-types-of-oa-status-green-gold-hybrid-and-bronze-mean-.

## *Science takes time, but publication could take longer*

Increased competition in science has raised the bar with respect to the amount of data required for publication[7]. This requirement is a good outcome if it results in higher-impact research that better clarifies our understanding of the natural world, but it does come at a cost for the speed of research dissemination[7]. Preprints have been proposed as a way to disseminate research more quickly as it can take a long time before results are ultimately published[6,7]. However, data on the time to publication is needed to quantify the real benefit of preprints in this context.

We estimated how long it takes to publish a research paper in ecology and evolution by recording the time between when an article was first posted on *EcoEvoRxiv*, and its final acceptance in a peer-reviewed journal. In total, 383 papers remained unpublished (31.5%, n = 1,216) at the time when these data were collected. Not all of these papers, however, are anticipated to be published in a peer-reviewed journal (e.g., reports). Nonetheless, the median time to publication for preprints was 237 days (8 months) (mean = 286.4; SD = 193.9 days) with the maximum time to publication being 1,549 days or 4.2 years (Figure 2A). Our results largely confirm the extended timeframes that most authors experience between writing their research papers and their publication.

## *Cautious 'open'-mindedness of research in preprints*

In addition to speeding up dissemination, preprints and postprints can also be a useful way to ensure that research remains open and accessible to the research community irrespective of the accessibility of the final peer-reviewed paper[6,7]. We evaluated whether articles hosted at *EcoEvoRxiv*, and that were also published in a journal, were published open access. The open access status of each published article was obtained using the R package *roadoi* (v.0.7.2) to connect to the Unpaywall platform[29]. Most of the published articles were

238 open access [80.5% ($n$ = 351 out of 436 where the status was known); Figure 2A]; however, 19.5% ($n$ = 85)
239 were published behind paywalls. For articles published in open access journals, the type of open access also
240 varied widely (e.g., Gold, Hybrid, Green OA etc., Figure 2B).

241 Data and code sharing are also key components of open science[30]. In the spirit of 'openness', we expected
242 data and code sharing among preprints to be greater than in many papers published in research journals[30,31].
243 Despite this, we found that 54.1% ($n$ = 232) of articles relying on data on *EcoEvoRxiv* did not share data, and
244 56.9% ($n$ = 246) did not share code (counting only data-based articles, i.e., excluding reviews, commentaries
245 or theoretical works).

246 Authors may be reluctant to share data and code for preprints because of the perceived concern that others
247 may acquire and use their data and code before publication in a journal. Authors of 28.7% ($n$ = 123) of
248 articles that did not share data at the preprint stage did ultimately share data when the article was published;
249 whereas authors of 35.2% ($n$ = 151) never shared data. However, 36.1% ($n$ = 155) shared data at both stages.
250 The same was true for code. Overall, 16.8% ($n$ = 72) preprints had no open code at the preprint stage but did
251 at the published article stage and authors of 45.2% ($n$ = 194) preprints did not share code at either stage.
252 However, 38% ($n$ = 163) shared code at both stages. Relatively low code and data-sharing practices in our
253 sample is consistent with analyses of sharing practices for published articles (e.g.,[31]), even for journals with
254 strict public data archiving policies[30].

255 # Paving our future to open, transparent and community-driven science

256 Our analysis has allowed us to better understand preprinting/postprinting practices in *EcoEvoRxiv*. Overall,
257 *EcoEvoRxiv* articles are diverse but with primary research articles on vertebrates comprising most of the
258 articles posted. North America, Europe and Australia use *EcoEvoRxiv* the most with very few non-English
259 language articles to date. Submitting authors who were earlier in their career and more often with 'male-
260 associated names' tended to use *EcoEvoRxiv* the most. Articles posted to *EcoEvoRxiv* tend to take up to 8
261 months to become published with many articles not being open access. Code and data sharing was also
262 relatively uncommon at the preprint stage. At the same time, we attempted to collect data on community
263 discussion around preprints no such data was found on preprint landing pages, likely reflecting inadequate
264 functionality and cross-linking with sources where such discussion is occurring. Based on the insights from
265 our analysis, we provide recommendations to authors and the scientific community on ways they can further
266 promote open and transparent research through preprints:

267 - First, share your data and code at the preprint stage. Sharing data and code early can help improve the
268 quality of research, establish precedence, and improve the transparency and computational
269 reproducibility of scientific findings[25]. Reassuringly, sharing data and code is rarely associated with
270 the 'scooping' of research findings[32]. If authors are worried about data being used unintentionally,
271 clear information surrounding its reuse can be included in a license (see https://choosealicense.com).
272 Data can also be archived with an embargo on its reuse[33].
273 - Second, take advantage of peer-reviewing services such as Peer Community In (PCI). The time
274 between posting a preprint and publication is still quite long (~8 months). One possible explanation is
275 that preprints are not being sent to suitable journals or are struggling to get into, slowing down
276 constructive feedback that can improve the quality of a paper. Using PCI circumvents editorial
277 decisions without review, yet only 1.6% ($n$ = 10) used PCI. Using such services will ensure that
278 authors receive faster feedback on a paper. Ninety-three journals currently accept PCI reviews and
279 recommendations when considering a paper for publication (https://peercommunityin.org/pci-
280 friendly-journals/).
281 - Third, seek out and contribute to constructive feedback on preprints[6]. While it is clear that preprints
282 help establish precedence and allow findings to be openly accessible, it still seems rare that
283 constructive discussions form around preprints in an open forum (e.g. bioRxiv[34]). Unfortunately, the

*EcoEvoRxiv* website does not provide opportunities for discussion given the limitations of the web server at this point in time. As such, we could not accurately assess how much discourse around a given preprint occurs. Clearly, as a community, we need to provide better platforms that document discussions around preprint findings. Such discussions help authors improve their work and communicate their findings more effectively (when done constructively, of course). One way to facilitate such discussions may be to use open preprint peer-review services such as *Peer Community In* (PCI) or *PubPeer* (see also[35]) to provide feedback on preprints.

- Finally, keep your preprints updated. While most preprints get seamlessly connected and merged with their published version, some remain 'disconnected' as separate articles. Incorrect cross-linking by indexing platforms (e.g., Google Scholar) can create confusion and lead to frustration among authors. Thankfully, the reasons for unmatched preprints and publications are well-understood and easily rectified. They often result from a mismatch between preprint and published metadata (e.g., titles and author details). For example, nearly one-third of articles changed their title from preprint submission to publication [32.3% ($n$ = 199)]. We found that mismatched metadata almost always contributed to preprints and published articles not being matched automatically in Google Scholar. We recommend that authors update their preprints with the publication DOI when accepted to journals, especially if their title has changed. This is very easy for authors to do on *EcoEvoRxiv* and ensures that the preprint is correctly linked to the published article and citations are appropriately merged. Adding DOIs will also create a link between the final preprint and the published paper so that, no matter the open access status of the publication, the research findings will remain openly accessible, saving costs for authors (i.e., by not having to pay open access fees) and improving the visibility and use of research.

Despite the early successes of the new initiatives taken by *EcoEvoRxiv*, as described above, much work remains to be done to improve the understanding and use of pre- and postprints within our community. We view this perspective piece as a small step towards achieving that goal. We hope that readers are more familiar with the benefits of using community-driven preprint servers and the unique initiatives they can pursue. Community-driven preprint servers can set their own agenda and are driven by the needs and desires of the community. Supporting these initiatives should be a priority for all researchers. Volunteers at *EcoEvoRxiv* are encouraged to remain open to new and innovative ways to improve publication and open science practices. We believe that the future of preprints is bright, and community-driven initiatives, such as *EcoEvoRxiv* will play a crucial role in the future of scientific publishing.

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# Data and Code Availability

All data and code can be found on GitHub at: https://github.com/daniel1noble/ecoevo_1000

## Conflict of Interest

The authors would like to acknowledge competing interests on the perspectives presented in this paper given that many (DWAN, SN, ML) are founding members of *EcoEvoRxiv* and/or are part of the *EcoEvoRxiv* committee.

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