Open Access Principles and Practices Benefit Conservation

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ABSTRACT Open access is often contentious in the scientific community, but its implications for conservation are under-discussed or omitted entirely from scientific discourse. Access to literature is a key factor impeding implementation of conservation research, and many open access models and concepts that are little-known by most conservation researchers may facilitate implementation. Conservation professionals working outside academic institutions should have more access to research so that conservation is better supported by current science. In this perspective, I present elements missing from current discussions of open access and suggest potential pathways for journal publishers and researchers to make conservation publications more open. There are many promising avenues for open access to play a larger role in conservation research, including archiving pre-prints and post-prints, more permissive "green" open access policies, and increasing access to older articles. Collectively supporting open access practices will benefit our profession and the species we are working to protect.

1 INTRODUCTION

Conservation research is a vital tool in our attempts to solve global conservation crises, but research is of little use if it does not lead to sound science-based policy. Rapidly translating conservation research into policy is a core goal of conservation biology (Soulé 1985; Robinson 2006) but is nevertheless a complex and difficult process, and failures abound in our efforts to do so (Whitten et al. 2001; Salafsky et al. 2002; Balme et al. 2014). These failures have themselves formed the foundation for a quasi-subdiscipline within conservation biology, spurring a litany of critiques (Knight et al. 2008; Arlettaz et al. 2010; Matzek et al. 2014) and even more suggestions for how to address spaces between implementation and research (Shanley & López 2009; Sunderland et al. 2009; Esler et al. 2010; Braunisch et al. 2012; Toomey et al. 2017).

There are many reasons that conservation professionals are unable to implement conservation research, and reasons vary among the many different conservation problems we face. Regardless, access to scientific results is necessary for translating research into policy (Fuller et al. 2014; Gossa et al. 2015). If conservation professionals are unable to access the best current literature, they cannot integrate that science into practice no matter how hard they strive. Nevertheless, most scientific literature is locked behind paywalls (Harnad et al. 2008; Gossa et al. 2015), which impedes conservation practice. For example, around half of conservation professionals surveyed in one study did not use peer-reviewed conservation literature to aid decision-making, primarily because they could not easily access scientific literature (Pullin et al. 2004). In a more recent study, around 40% of non-forestry conservation professionals cited lack of access to scientific literature as a reason why they do not read primary literature (Fabian et al. 2019). Integrating conservation research into conservation practice requires scientific evidence to

be accessible to inform decisions made by conservation professionals on the ground. Open access publishing makes that information available.

2 WHAT OA IS

Simply put, open access (OA) is free, unrestricted online access to articles published in scholarly journals (Laakso et al. 2011). There are multiple methods of achieving this goal. Most researchers are familiar with "gold" OA, in which the final formatted version of a scientific article is freely available on a journal website. *Conservation Letters* is among the many journals that publish conservation research under this model, and non-OA journals also usually offer gold OA publishing options (i.e., the "hybrid" model of OA). Gold OA is often associated with certain copyright licenses, which are legal documents that dictate the copyright terms for an article. Most gold OA articles are covered by Creative Commons (https://creativecommons.org/) CC-BY licenses—which allow anyone to use articles provided that they attribute them in their work—or CC-BY-NC licenses—which allow anyone to use articles for non-commercial purposes provided that they attribute them.

There is also a "green" model of OA, in which authors receive permission to archive publications for public access on personal websites and institutional repositories. This permission may be restricted by an embargo, where authors cannot post public versions of their paper within some time period after publication. For conservation journals, this is usually 1 year. Authors are also often barred from posting the publisher's formatted PDF. "Green" OA can be achieved via preprints, versions of manuscripts that are posted prior to peer review and typically updated as manuscripts are revised (Desjardins-Proulx et al. 2013; Berg et al. 2016; Sarabipour et al. 2019). Most conservation journals allow authors to archive preprints on repositories such as *bioRxiv*

(https://www.biorxiv.org/) and *EcoEvoRxiv* (https://ecoevorxiv.org/) for early dissemination and potentially outside peer review before final publication. While preprints are the norm in some disciplines (e.g., physics) and rapidly growing in popularity in the biological sciences at large (http://www.prepubmed.org/monthly_stats/), relatively few conservation researchers currently archive preprints.

3 WHAT OA IS NOT

In addition to distinguishing alternative OA funding and dissemination models, it is important to distinguish OA *per se* from editorial practices often associated with OA journals. One such practice is acceptance of all methodologically sound articles, without consideration of expected future impact. Under this model, reviewers are obligated to review the introduction to ensure that it properly frames the study, methods to ensure soundness, conclusions to ensure they are supported by evidence, and references to ensure they hold up to scrutiny, exactly as reviewers for any journal must do. The only difference is that reviewers in these journals do not advise acceptance or rejection based on perceived impact.

A second such practice is expedited review to hasten the time from submission to publication. Expedited review has potential to reduce the quality of review, but that is not inevitable, and no rigorous studies have demonstrated this. Expedited review also carries great advantages, especially for early career researchers for whom a few timely publications can drastically alter career trajectories. Many non-OA journals are thus also working to expedite review timeframes.

A third such practice is online-only publication, which reduces publishing costs. Lower publishing costs enable online-only journals to reduce author fees (e.g., APCs and page fees)

while still maintaining financial viability. Formatting and uploading articles to websites still requires personnel and time, but electronic publication eliminates or drastically reduces material, printing, and distribution costs.

A fourth such practice is the article processing charge (APC), a funding model in which authors pay a fee to publish an article in a journal. The advent of online-only publication enabled flat fees for publication because article length and color printing no longer imposed substantial additional costs on publishers. However, this funding model is similar to page fees, and is not the only way to pay for OA. Other funding models of OA include institutional subsidy, society subsidy, lifetime author subscriptions, university library support, or some combination of these (Bolick et al. 2017).

Although these four practices are commonly associated with OA publication, none are inherent characteristics of OA, which should be evaluated on its own merits rather than common but tangential features. Impact-neutral editorial decisions, quick review turnaround, electronic-only dissemination, and article processing charges have nothing to do with OA *per se*.

4 WHY OA MATTERS

Conservation professionals are particularly vulnerable to the problem of restricted access to scientific literature because we need literature to inform our work, but relatively few of us can access literature. OA is often framed in terms of benefits to researchers from countries outside North America and western Europe (Fuller et al. 2014; Gossa et al. 2015; Romesburg 2016; Bolick et al. 2017), but the problem of restricted access to scientific literature is pervasive everywhere. Many (if not most) conservation professionals have no easy and legal way of accessing most relevant scientific literature, including those who work for organizations that lack

funding for journal subscriptions (e.g., non-profit organizations, environmental consultants, media companies, community colleges, teaching-focused universities, and many local, state, federal, and tribal agencies), are unemployed (e.g., seasonal technicians between jobs), or work independently from larger conservation organizations (e.g., independent researchers and science journalists). Speaking personally, I receive regular requests for literature from colleagues, know graduate students at small universities who lack access to papers they need to write theses, and know Ph.D. graduates requesting adjunct status to maintain access to literature after getting jobs with organizations that lack funding for journal subscriptions. Restricted journal access harms too many conservation professionals.

Even among those who currently have access to most relevant journals, it is likely that many organizations that currently maintain access to subscription journals will eventually be forced to reduce the number of subscriptions they maintain. The cost of journal subscriptions has risen much faster than inflation (about 6% per year since 2012; Bosch et al., 2018) and is unlikely to slow unless many institutions forego subscriptions. There is no guarantee that conservation professionals who can currently access subscription journals will continue to maintain access.

Restricted access is especially damaging because individual journals are not adequate for remaining abreast of current knowledge. Conservation professionals need research published in many journals, and maintaining access to all of them is not feasible without an employer who provides it. This problem is further compounded because it is far harder to contribute knowledge to the field via publication without access to all previously accumulated knowledge.

Furthermore, conservation research is inherently valuable and of interest to broad audiences, and conservation benefits from broad distribution of articles beyond the small

population of scientific researchers. Giving the public, citizen scientists, and science communication professionals greater access to new research could promote awareness and support for conservation across society, while providing conservation practitioners more access to research will improve conservation practice even if it does not show up in citation statistics or advance scientific research *per se*.

5 POTENTIAL DRAWBACKS OF OA

Despite its benefits, OA can have real drawbacks that conservation researchers and publishers should consider carefully as they contemplate how to move forward in a changing publishing landscape. These challenges are far from insurmountable, but moving toward a more open future without careful consideration could lead to real harm.

First, many publishers (including professional societies) fear that switching publishing models could reduce revenues (though this is not guaranteed). Professional societies often take great pride in the services they provide to members, and societies depend on journal revenues to subsidize those services, including conferences, professional certification programs, financial support for graduate students and early career professionals, political activity, and networking platforms.

Furthermore, APCs—which are used to fund most major OA journals—are problematic as a funding mechanism as they exacerbate access barriers for many prospective authors with limited funding (Bolick et al. 2017; Burgman 2019; Peterson et al. 2019). However, barriers already exist at many journals in the form of page fees, and the same techniques publishers use to minimize barriers created by page fees (e.g., waivers and reduced fees for members, graduate

students, and researchers outside North America and western Europe) can be applied to APCs. APCs for many journals are also likely unnecessarily high (discussed below).

Finally, the gold model of OA has been exploited by unethical "predatory" journals (Beall 2012). These journals accept all submitted articles, often without performing even cursory peer review. However, most professionals should quickly spot the vast majority of predatory journals by the shoddiness of their work. These journals are usually characterized by abominable attention to detail in both style and substance (poor spelling, grammar, and formatting).

6 PATHWAYS TO A MORE OPEN FUTURE

Two primary groups have the most potential to increase access to conservation research: journal publishers (including professional societies) and individual conservation professionals. There are several ways both of these groups can make their research more open (Table 1), but members of each group often harbor reservations that keep them from doing so. Journal publishers have understandable concerns about their continued financial viability in a changing publishing landscape, and individuals often lack funding to cover APCs.

However, journals must still change their operating models to make themselves more open (particularly given increasing pressure from funders; Rabesandratana, 2018), and there are several ways journal publishers can integrate OA concepts with little financial risk. Publishers should carefully consider benefits and costs of these options as they plan for the future.

6.1 Publishers

First, publishers can ensure that their journals participate in the Online Access to Research in the Environment (OARE) initiative (oare.research4life.org), an IUCN program that

allows researchers in low-income countries to access journals for free. This does not completely solve the problem of restricted access for researchers outside North America and western Europe but can meaningfully alleviate it. It may also increase a journal's impact factor by broadening its readership without impacting journal finances (because researchers in these countries cannot subscribe to expensive journals).

Second, publishers can allow more open access under the "green" model by loosening embargos on archiving articles published in their journals. Self-archiving research articles increases their citation rates (Gargouri et al. 2010), and several publishers and journals have made permissive archiving policies work for them. *Proceedings of the National Academy of Sciences* and each of the Ecological Society of America's journals allow immediate archiving of the publisher's copy of an article upon publication. *Proceedings of the Royal Society B*, *Oryx*, *Landscape Ecology*, *Forest Ecology and Management*, and *Canadian Journal of Zoology* all allow immediate archiving of the author's copy at publication. These journals appear to be financially viable despite permissive "green" access models. Other journals can and should follow their lead.

Third, publishers can open access to articles that are older than some threshold. These articles are still useful, but opening access to them would not significantly reduce subscription incentives for institutions that need to maintain access to all issues of a publisher's journals. *PNAS* does this for articles older than six months, *Science* and *Current Biology* for articles older than one year, and British Ecological Society journals for articles older than two years. Publishers would not have to go as far as these journals—they could open access to articles more than 5-10 years old and still make a substantial difference.

Fourth, publishers can publish one or more gold OA journals or partner with existing ones. Demand obviously exists for these in the field of conservation. *Conservation Letters, Ecosphere, Conservation Science and Practice,* and *People and Nature* are just four of many gold OA journals that publish conservation articles. Publishers should not necessarily convert existing journals into gold OA journals; new OA journals could be beneficial, or journals can develop partnerships with existing gold OA journals, including submission cascades in which manuscripts deemed scientifically sound but unlikely to meet a journal's impact threshold are automatically referred to a sister journal with lower impact metrics.

Fifth, publishers can reduce the cost of gold OA in their publications. It can cost $3,000 or more to purchase gold OA in most publications. However, it costs much less to publish OA in many journals that publish ecology and conservation research—$1,000 (for ASN members) in *American Naturalist,* $1,250 (for ESA members) in *Ecosphere*, $1,260 (for ASM members) in the *Journal of Mammalogy*, $1,260 in *Royal Society Open Science,* and $1,480 (for SCB members) in *Conservation Letters*. These journals appear to be financially viable despite these lower fees, indicating that publishers have substantial room to lower their APCs if they so desire.

Sixth, professional societies that publish journals can create new membership options with reduced dues for researchers who work outside of North America and western Europe. When societies offer journal access as a membership benefit, this effectively lowers the cost of journal subscription and carries the same benefits as option #1 above.

6.2 Individuals

Individual conservation scientists can also act to make science more open. First, conservation scientists can push publishers to make the changes listed above. Journals depend

heavily on our volunteer labor, so we have substantial power to influence journal policies and practices by leveraging that volunteer labor to spur progress.

Second, conservation scientists can upload preprints of their articles to preprint servers, which ensure that a green OA copy of research is permanently archived and easily accessible. Almost all journals now allow preprints, though some only allow them on non-commercial servers. Preprints and updated versions may also be uploaded at any point before they are accepted by journals, including after revisions.

Third, conservation scientists can self-archive post-prints of all articles according to self-archiving policies of journals. Self-archiving is allowed by nearly every journal after some embargo and carries the benefits mentioned above. Journal-specific self-archiving policies can be found at the Sherpa/RoMEO website (http://www.sherpa.ac.uk/romeo).

Fourth, conservation scientists can preferentially submit articles to journals that have good OA policies. Just as we make consumer decisions while weighing the business practices of companies we purchase goods from, so too can we demonstrate support for OA when we choose where we submit our papers. This includes a wide array of journals: gold OA journals, journals that allow preprints and immediate self-archiving of articles (especially publisher's copies), journals that open access to articles after a short embargo, and journals that participate in the OARE initiative, among others. There are many pathways toward a more open publishing industry, and collectively supporting these practices will bring substantial progress.

7 CONCLUSIONS

As conservation professionals, we should try to ensure that we develop and uphold values that make conservation and science better. Because less access to research leads to fewer

conservation efforts that operate under the best current science, this includes disseminating research as broadly as possible. The best science available is not as good when the best science is not available. While many researchers work hard to do this and some funders have begun to demand this (e.g., the Plan S debate; Rabesandratana 2018), we should strive as a community to work harder to do so and to follow the many pathways toward a more open scientific publishing process. If we do this, conservation professionals and the species we are working to protect will benefit.

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359 **Table 1**. A list of actions that can be taken to make conservation research more available to

360 conservation professionals.

Pathways to a More Open Future	
Publishers	**Individuals**
1. Participate in the OARE initiative	1. Push journals toward OA
2. Shorter self-archiving embargos	2. Upload preprints
3. Make old articles OA	3. Self-archive post-prints
4. New gold OA journals	4. Submit to OA-friendly journals
5. Reduced gold OA costs	
6. Discount society memberships with journal access	

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