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Science Societies, Publication and Open Access Mandates

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One Sentence Summary: Government interdiction of embargoes could threaten $8B annual support for the science enterprise

Like hundreds of other scientists worldwide, I was recently president of a scientific society (ASLO). This means that, along with thousands of volunteer scientists in similar associations, I helped to govern a non-profit corporation whose mission is, broadly, to support and enhance the science enterprise and help to support the career development of the next generations of scientists. Among the valuable services ASLO and other science societies offer are scholarly meetings and conferences, early career support and mentoring, support of increased diversity in the STEM workforce, career-enhancing recognition and awards, unbiased outreach and public information, a politically neutral science-policy interface, independent educational resources, and, of course, many of the world's most respected and reliable scientific publications. Whether they know it or not, there is hardly a scientist on Earth whose career, discovery, and value to society has not been enhanced by one or more scientific societies like ASLO. Although for-profit publishers also make significant investments in the editing, production, and distribution of science content, and many science societies have strong and helpful partnerships with them, science societies, by their nature, reinvest all their excess publication revenues entirely in enhancing the productivity and future of science around the globe.

Over the last decade, there have been increasing calls to make all government supported scientific publications and data freely available, with shortened embargoes (Baum and Coen 2019; Brainard 2019; Dal-Re 2019). Embargoes provide incentives for libraries and others to help support the costs of scientific publication. Subscription payments mean the subscribers will have immediate access to the newest science. The proposed Plan "S" in the European Union is one government-mandated open access plan. The *National Institutes of Health* and other US federal funding agencies have called for increasingly short access embargoes for scientific publication, and there is a rumor that an Executive Order from the White House (apparently delayed by COVID-19) will mandate the elimination or severe reduction of embargoes on all publications and data created using federal support (Subbaraman 2019).

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Some calls for immediate open access are promulgated on a narrative suggesting that those who send money to scientists (i.e., tax payers) should have access to the product, so it should be available freely worldwide. Notwithstanding the fact that this *non sequitur* ignores the origin of ideas, experimental designs, research plans, intellectual property, massive time investments and the costs borne by the institutions that housed the inquiry, the act of bringing the science to a reliable and sustainable outlet and making it available in perpetuity is a costly venture. Shifts toward greater open access should be approached with care. The consequences of missteps in altering the publication landscape are potentially grave because errors or forced agendas jeopardize the fundamental currency of risk, tribute, and reward in science (Albert et al. 2008; Egbert 2018). Some important concepts for science and society to contemplate are how to sustain a publication system that rewards scientists for productivity, while distributing the fraction of access rights accruing to funders, scientists and others who participate in the creation, publication, and curation of new knowledge.

Logical disconnects aside, most open access mandates, although perhaps well-intentioned, make no additional funding available to support free and open publication. In fact, if science support was received at all, much of the writing and publication of new knowledge often occurs outside of the period during which financial support was received. The policy expediency of simply saying that open access fees would be allowable research expenses in federal grants, without boosting funds to granting agencies, would also lead to reduction in the net funds available for scientific inquiry and student training if the open access mandate comes with no additional funding stream.

Another potential repercussion of these unfunded mandates is that smaller publishers like ASLO and other scientific societies could be eliminated from the science publication landscape. Without additional federal funding for open access publication, scientists would be forced to seek the cheapest outlets for their work. These would likely be housed in larger for-profit publishers because those corporations could afford to work on slimmer margins and are backed by stockholders and by heavy and increasing bargaining power (Fox and Brainard 2019). When I analyzed data from Web of Science in 2011, triaging science society partnership publications from for-profit journals, I found that 80% of all citations in the aquatic sciences already accrued to articles published by for-profit publishers and 92% of those were owned by only five corporations (Downing 2013). A coalition of 126 publishers and societies have recently signed a letter indicating that reduction of the embargo period for federally funded science below the current 12 months would make the publication of much science economically unfeasible and force the closure of publications supported by science societies (https://preview.tinyurl.com/wecjctx). A lack of diversity in the science publication environment could lead to instability and unreliability in the supply of valid science and the loss of publication revenue for societies could force many to close.

For full disclosure, as a moral principle, I would like science to be as open and freely available as possible. A close family member, for example, an Internet designer, voraciously reads the medical literature to help guide the recovery of another family member with long-term, chronic illness. He often encounters pay-walls and embargoes that make it difficult for him to find the most recent literature so that he can be an informed consumer of health care. Even at my Research 1 university, my searches of the non-medical literature often dead-end with materials that I cannot access due to lack of library subscription, obscurity of content, mobile pay-walls, or errors in online access. I would love as much science as possible to be openly available to me, my family, and others. Before I gained some understanding of the publication landscape during my scientific society presidency, I wanted all science publication to be available openly and without charge. When I was first asked if I would run for the ASLO Board as an early career scientist, my nomination was campaigned against by the then managing editor because I mentioned that I thought page charges were stifling early career publications. Early in my ASLO presidency, I even wrote a publication supporting more economical open access.

"Free access" to quality science is, however, not "free". The cost of editing, reviewing, formatting, publishing and curating scientific information and data is large and needs to be paid by someone, at least until we invent, test, and validate new and innovative ways of doing it differently (e.g., Tenorio-Fornes et al. 2019). For example, in preparation for a session on Future Publication Models at a Workshop of the *Council of Scientific Society Presidents*, I made dozens of phone calls and sent many emails, trying to find someone to give me a quotation on storing and curating 1 Tb of data to be readable and uncompromised over the next century. Nobody would give me a quote. Although the complexities of storage of scientific data are becoming clearer (Johnson et al. 2018), this suggests to me that the value of curation and storage of scientific knowledge, a part of publication that many ignore, is infinite at worst and inestimable at best.

As a former scientific society president and current or former member of at least 12 science societies I am particularly concerned about unfunded mandates to reduce permissible embargo periods to zero. This is because scientific publication revenue is fundamental to the business models of nearly all science societies whereby revenues resulting from the efforts of volunteer scientists are reinvested in the science enterprise. I recently reviewed the public annual and financial reports of 30 science societies to determine how lost publication revenue could impact the funding of services offered to scientists by science societies (see Fig. 1). These science societies ranged in gross annual revenue from $440,000 to $583M ($US; average $75M; median $12M). For comparison, ASLO, at <$2M was the second smallest science society in my sample in terms of gross revenue. Although science societies vary substantially in their approaches to member services, only a few lack publication revenue, while the average fraction of gross revenue represented by publication was 38% (median 33%). This is higher than the 26% found some years ago for learned societies in the UK (Johnson and Fosci 2015) and compares with an

average 21% from meetings and conferences and 8% from membership dues (Fig. 1). The fraction of gross revenues deriving from publications for ASLO was the seventh highest in my sample. The dues of the average member of these 30 science societies, therefore, is leveraged around 5-fold by publication revenues. On average, nearly 40 cents on every dollar spent on meetings, networking, early career development, STEM diversity programs, etc., derives from support from publications. With a brusque shift to zero embargo, the total publication revenue at risk in this small subset of 30 societies is about $1.23B that may not be available to sustain and build the science enterprise. Since there are at least 200 science societies operating in the US (see Fig. 1) my sample contained only about 15% of the scientific societies and organizations, suggesting that the cost to US science of government policies to reduce publication embargo periods to zero for federally supported research could be closer to $8B annually (see also Johnson et al. 2018).

Finally, those of us who long for a world of free and open access to scientific publications should be very cautious about what we wish for. It is my opinion and that of the *Council of Scientific Society Presidents* (CSSP 2020) (https://doi.org/10.6084/m9.figshare.11663259.v1) that scientific societies play a key role in maintaining a vigorous scientific enterprise by reinvesting publishing revenues in the scientific workforce and the next generation of scientists. Well-intended policies altering the publishing environment, coupled with large publishers' contractual work-arounds (e.g., Read & Publish) without considering their impact on science societies, could compromise societies' support of scientific productivity and their diverse benefits to science and scientists. Avoiding negative effects on scientific productivity requires a gradual change, stable, alternative funding streams for open access, and inclusive publication options. Further, we also need a fresh and creative look at new and emerging innovative platforms for scientific publication, and recognition and valuation of intellectual and material investments made by scientists, institutions, and science societies, beyond the support supplied by government funding agencies.

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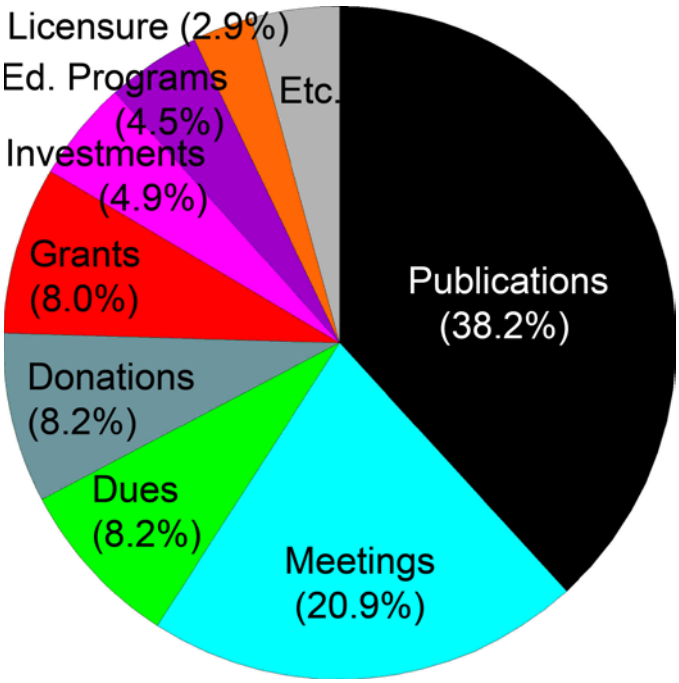
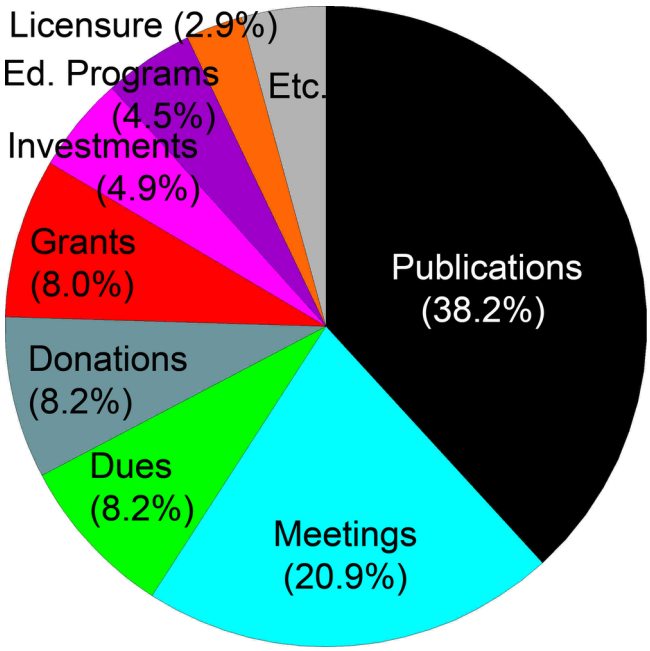
Figure Legend:

Fig. 1. Sources of gross revenues for the average of 30 science societies. Data derive from public annual reports (see SOM) of these societies. Annual reports were all published within the past decade although most were published in the past 3 years. Publication revenues include subscriptions, purchases, royalties, and other sources. The sum of grant income includes contracts. Investment income does not include increased value of holdings but does include

rental income in some cases. “Ed. Programs” includes education and training programs that take place outside of other meetings or are paid separately by participants. “Licensure” includes licensing or certifying expertise in members and non-members. “Etc.” includes data products, job listings, professional insurance, advertising, quality assurance, setting standards, product sales, advocacy revenues, mailing list sales, and “other”.





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