

Delayed Open Access: An Overlooked High-Impact Category of Openly Available Scientific Literature

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Delayed open access (OA) refers to scholarly articles in subscription journals made available openly on the web directly through the publisher at the expiry of a set embargo period. Although a substantial number of journals have practiced delayed OA since they started publishing e-versions, empirical studies concerning OA have often overlooked this body of literature. This study provides comprehensive quantitative measurements by identifying delayed OA journals and collecting data concerning their publication volumes, embargo lengths, and citation rates. Altogether, 492 journals were identified, publishing a combined total of 111,312 articles in 2011; 77.8% of these articles were made OA within 12 months from publication, with 85.4% becoming available within 24 months. A journal impact factor analysis revealed that delayed OA journals have citation rates on average twice as high as those of closed subscription journals and three times as high as immediate OA journals. Overall, the results demonstrate that delayed OA journals constitute an important segment of the openly available scholarly journal literature, both by their sheer article volume and by including a substantial proportion of high-impact journals.

Introduction

Open access (OA) is a term widely used to refer to unrestricted online access to articles published in scholarly journals. Scientists started experimenting with open access journals in the early 1990s, but the term itself was coined around the year 2000. There are a number of semiofficial definitions of OA, but the most widely quoted is the one included in the declaration of the Budapest Open Access Initiative meeting in 2001 (BOAI, 2001):

By “open access” to this literature, we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. The only constraint on reproduction and distribution, and the only role for copyright in this domain, should be to give authors control over the integrity of their work and the right to be properly acknowledged and cited.

The BOAI definition is rather liberal in that it grants users a great deal of freedom to do what they want with the published content. OA is, however, not a simple on–off phenomenon in which a publication either is OA or is not. Ideally, an article is open from day one, directly through the publisher’s own website and provided with extensive and well-defined usage rights (known as *libre OA*), which are often defined by referring to a Creative Commons license. Less ideal forms restrict specific usage of the published content (e.g., no redistribution, human reading only), limit openly available copies to nonfinal manuscript versions, or delay the open availability through an embargo period. In an attempt to provide an overview of the key variables involved, Figure 1 lists some criteria according to which OA can be classified. The categories applicable to this study are listed in italics.

Earlier efforts at identifying and labeling different aspects of OA have been made; recognizing the complexity of the phenomenon is nothing new. In his seminal book, Willinsky (2005) describes 10 flavors of OA, including delayed OA. Figure 1 includes within its scope both what in the OA debate is commonly called *gold OA* (provided by the publisher) and *green OA* (manuscript copies provided by the author and other parties). Interestingly, gold OA is by definition always immediate, whereas green OA includes delayed articles, resulting from publisher embargoes or delays in self-archiving. Thus gold and green OA are not two opposite concepts; rather, gold + delayed OA should be contrasted with green OA.

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Availability	Prior to publication	Immediately at publication	<i>Up to 12 months after publication</i>	<i>In excess of 12 months after publication</i>
Version	<i>Original publication</i>	Personal version	Preprint version	
Usage rights	Libre	<i>Gratis</i>		
Provider of OA copy	<i>Publisher</i>	Funder or employer	Author	Third-party
Setting	<i>In fully free journal</i>	Individually opened		
Location	<i>Publisher's site</i>	<i>Subject-repository</i>	Institutional repository	Homepage or other
Permanency	<i>Permanently OA</i>	Temporarily OA		
Legal status	<i>Legal copy</i>	Illegal copy		

FIG. 1. OA classification table: Scope of study in italics.

By the strict BOAI definition, the term *delayed OA* is something of an oxymoron. On his FAQ pages concerning the Budapest Open Access Initiative, leading OA advocate Peter Suber answers the question “Is open access compatible with an embargo period?” in the following way:

No. Open access is barrier-free access, and embargo periods are barriers to access. Many of the benefits of open access are not achieved when embargoes are in place. However, while delayed free access does not serve all the goals of the BOAI, it does serve some of them. Just as open access is better than delayed access, delayed free access is better than permanently priced access. (Suber, 2011)

Because this study is not bound by the BOAI definition and adopts a more inclusive perspective, the term *delayed OA* is used to refer to this category of journals.

The usefulness of different types of OA varies, but it can be argued that any kind of access is better for prospective readers than restricting access to only subscribers or pay-per-view customers. If a web search is done for the full texts of a large number of randomly selected scholarly articles in a setting with no subscription access, the copies found are most likely a mixture of different OA categories. However, OA background variables such as usage rights, provision mechanisms, type of copy, and when the article was made openly available are not likely to be key concerns for a reader just wishing to read the article; obtaining a full-text copy of the article is most likely the highest priority.

In a broader perspective, the value of different types of OA can also be seen as a function of the typical readership patterns and citing behaviors of academic researchers. Recently published literature is mostly read in what can be called “current awareness” reading, in which scholars rapidly scan the tables of contents of particularly interesting journals that they follow, often prompted by table-of-contents e-mails. Various web tools have also become increasingly important sources for tracking when relevant articles matching specific interest profiles have been

published. Articles published in earlier years are more likely to be encountered via keyword searches, by citations, or by recommendations from colleagues. For such cases, delayed OA is as good as immediate OA. For instance, King et al. (2009) found that roughly half of all scientific articles read are at least 1 year old. One could argue that the value of reading an article tracked down through a reference is higher in terms of impact on scholarship than the average current awareness reading.

The benefit of delayed OA (as defined for his study, excluding delayed green OA) being provided in the original version directly through the publisher is also of relevance. In a survey distributed among U.K. scientific societies, 52% of the survey respondents said they would not opt to access green manuscript copies even when they do not have access to the published version (Morris & Thorn, 2009). Some answers suggested that the integrity of self-archived author manuscripts is questioned, whether the content is fully identical to the actual published version. In some fields of science, it is also important to be able to cite specific pages in publications, which can be problematic with manuscript copies.

Previous Research

As delineated in the Introduction, this study focuses on publisher-provided delayed OA of original subscription publications. Most studies providing quantitative measures of the prevalence of OA have overlooked this part of the OA spectrum. This is due partially to the fact that there is no comprehensive index of such journals similar to the service that the Directory of Open Access Journals (DOAJ) provides for immediate OA journals and partially by the divided opinions concerning delayed OA as a valid form of OA. In a discussion about the lack of an aggregating index, Jacsó (2011) suggested that delayed OA journals should be added to the DOAJ as a separate category, motivated by the fact that the population is made up of many widely read and cited journals with a combined historical archive exceeding 2 million articles. To emphasize this point, it is worth mentioning that five of the 10 most cited journals in the Web of Knowledge during 1999–2009 provide delayed OA (Sciencewatch, 2009).

Among the few quantitative studies available, that of Björk, Roos, and Lauri (2009) is the first to explore delayed OA article volumes and embargo lengths as part of a larger OA study. By sampling article volumes for delayed OA journals listed in HighWire Press, the authors found that 234 delayed OA journals published an estimated 47,499 articles during 2006. The embargo distribution among the articles was 11.5% 2 to 6 months, 81.2% 12 months, and 7.3% with an embargo of 24 months or longer. Based on an approximation for the total number of articles published during 2006, these delayed OA articles made up 3.5% of all published articles.

In contrast to Björk et al. (2009), who used journal annual article volume data as the base data for analysis, Björk et al. (2010) used a bottom-up methodology in which

the metadata of randomly selected articles were used to estimate the open availability of the total body of scholarly articles published during 2008. Through a manual web search for the individual articles included in the sample and classification of found full text hits into specific OA types, the authors were also able to estimate the prevalence of delayed OA, which was 1.2% of the total OA rate of 20.4%. This low result compared with the earlier study highlights the challenge to correctly identify delayed OA for random individual articles, because many journals do not explicitly state their delayed OA policy on their web pages, much less directly within the full-text articles.

In a study commissioned by the Association of Learned and Professional Society Publishers, a survey was sent out to the main contact persons of a large number of scholarly journals, including delayed OA journals webhosted by HighWire Press (Kaufmann-Wills Group, 2005). An interesting question in the survey focused on which groups had influenced the decision to offer delayed OA. The most frequently reported groups were full OA proponents, society members, authors, publishing oversight bodies, and the journal publisher. The study also included 22 in-depth case studies of journals, some of which offered delayed OA. A general finding was that delayed OA was relatively common among society journals. Society journals seemed to have found a working recipe for continuing as subscription journals while not fearing too much loss of revenue even though they open up the e-versions after an embargo period. Society publishers, while recognizing the importance of protecting their revenue and continuing high-end publishing services, also might value OA as an important part of their "mission."

Waltham (2005) provides a rare insight into the financial aspects involved in implementing delayed OA for previously subscriber-only journals. The study reports figures for delayed OA influence on journal subscriptions for 10 Oxford University Press journals. Compared with the subscriber figures prior to providing delayed OA, two journals with an embargo period of 6 months saw an average subscriber decrease of 6% and eight journals with a 12-month delay a reduction of 2%. These results show some degree of reduction in subscription income; however, with a sample so small, the conclusions should not be extensively generalized.

Aim of This Study

The aim of this study is to identify scholarly peer-reviewed journals continuously providing OA to full issues after a set embargo period and to collect data regarding embargo lengths and articles published during 2011. By analyzing these data, we can estimate the total volume of delayed OA and provide an analysis of article volumes per embargo length.

A retrospective longitudinal study of the development over time of delayed OA would require accurate records for when individual journals have started or ceased publishing

the OA volumes. This was found to be excessively labor intensive, so the study was limited to articles published during 2011.

In addition to the volume of delayed OA articles, another aim was to measure the scientific impact, in terms of average citation rates compared with closed journals and immediate OA journals. The aim was not to attempt an estimate of the influence of the open availability on the number of citations (the so-called citation effect of OA) but to measure the effect of delayed OA on the availability of cited articles. The method for this was developed in a recent study (Björk & Solomon, 2012), and some data from that study could be reused.

Methods

Data collection was set up as a two-stage process. First, a list of delayed OA journals was composed by combining data from multiple sources. In addition to journal title, publisher, and embargo length, the ISSN/eISSN codes were considered essential data for enabling cross-analysis with major publication indexes during the later stages of data analysis. Second, the annual article volumes for the identified journals were collected by retrieving data available in major publication indexes or by manually visiting the web pages for individual journals. Data were collected during May and June 2012. Details for how both steps in the process were conducted is provided in the remainder of this section.

The first step of the process, compiling the aggregate list of delayed OA journals was largely explorative, because there is currently no comprehensive pre-existing listing or database that could be used for the purpose. The goal of the data collection was to identify journals publishing content openly on the web with a delay from the original publication date, thus excluding full immediate OA journals from the scope. In the end, journals were identified from six main sources: HighWire Press, PMC, Elsevier, the Wikipedia page for delayed OA journals, delay OA journals discovered during a previous study (Björk et al., 2010), and additional individual journals known to the authors.

HighWire Press, a division of the Stanford University Libraries, provides online access to a large number of journals as well as other scholarly literature. Although the majority of the 1,349 journals listed in HighWire Press at the time of the study were subscription or pay-per-view only, 38 were self-reported as full immediate OA and 240 journals as offering delayed OA with the added criterion of having published at least one volume between the years 2005 and 2011 (HighWire Press, 2012). Although exact historical records for the increase of delayed OA journals in HighWire Press are not available, it can be derived from chart data provided by Waltham (2005) that there were about 85 such journals in 2001 and about 170 journals in 2005, and this study places the number at 240 for 2011.

PMC, a free full-text archive of biomedical and life sciences journal articles, provides access to full journal volumes as well as individual articles or manuscripts of articles published in subscription journals. As this study focuses on delayed OA of complete journal volumes, individual articles made available in PMC were not included in the calculations. Some publishers deposit articles stemming from NIH grants directly into PMC, usually with a delay, rather than having the authors self-archive the manuscript versions, but such articles were not included in the study. The total journal count of PMC at the time of the study was 1,564 (PubMed Central, 2012); however, after removing journals registered as depositing only selected articles, full immediate OA journals listed in the DOAJ, journals that did not published anything during 2005–2011, and journals that are listed as not depositing any new content to the repository, 186 delayed OA journals remained.

Elsevier, a major publisher of scientific journals, provides a convenient list of journals for which they provide delayed OA. At the time of the study, this list contained 73 titles (Elsevier, 2012). The Wikipedia page for the category of delayed OA journals included 60 journals for which the web pages were active and available for article counting at the point in time of the study (Wikipedia, 2012). Through a previous study in which the availability of randomly selected articles and the OA model through which they were delivered were studied (Björk et al., 2010), we had previously collected information about eight individual journals providing delayed OA. Five other journals of which the authors were aware were also added.

Listing all the identified journals together and removing duplicates resulted in 492 unique delayed OA journals. It should be pointed out that this list is conservatively composed; in cases in which there was doubt about the delayed OA status of the journal, it was not added from the source.

For the second step of the data collection process, data were gathered from three different sources. Web of Knowledge provided article volume data for journals included in that index, Scopus provided data for journals not indexed by Web of Knowledge but indexed by Scopus, and finally manual article counting was performed for the remainder of the journals not covered by either index. Because 409 of the journals are included in the Web of Knowledge index, most of the data could be gathered by querying the service with ISSN/eISSN codes. It is worthwhile to note that journals often include editorials, news, book reviews, obituaries, and other nonresearch content. Such material was excluded from all data, both data retrieved from indexes and manually gathered data.

Performing the analysis by article numbers, rather than based on the number of journals, is an important aspect of this study and is similar to methods used in a number of earlier studies from our research group. In this connection, it was particularly important because the average article volume of the delayed OA journals is more than 200, com-

pared with an average of about 110 for all Web of Knowledge journals (Björk et al., 2009) and about 50 for immediate OA journals (Laakso & Björk, 2012). Hence the impact of these articles eventually becoming OA is far greater than the number of journals might initially suggest.

Analysis and interpretation of the data were very straightforward; sampling was not needed, and the data could be processed unweighted because everything is based on absolute numbers. However, one caveat to performing this type of time-sensitive study retrospectively, even for just a single year ago, is the lack of data on when identified journals started providing delayed OA. When such information was unobtainable from the originating data source, the assumption was that a journal currently providing delayed OA did so for the full 2011 calendar year.

Although almost all identified journals provide unrestricted access to articles once the embargo period has expired, there are journals that require readers to register for a free account before granting access to full text content. An example we came across is *Science*, which has an embargo of 12 months, after which registered users can access the journal content. Ultimately, we decided to include such journals as well. One argument for this is the rarity of this requirement; another is that interested readers are unlikely to be hindered by having to sign up if that enables them to access the requested content for free and that the articles, despite the registration barrier, are indexed in most indexing services and findable through web search engines.

Results

Altogether 492 journals were identified, publishing a combined total of 111,312 articles in 2011; 77.8% (86,599) of these articles were made open access within 12 months from publication, with 85.4% (95,109) available within 24 months. Very few journals have embargos exceeding 48 months. Figure 2 shows the embargo distribution among the articles.

During the data collection, all delayed OA publishers were categorized into six major categories based on what kind of organization is publishing the journal. The article volumes output by the six publisher categories is provided in Figure 3, together with a comparison with article volumes of immediate OA journal publishers (Laakso & Björk, 2012). The publisher analysis revealed that 98% of the 111,312 delayed OA articles were published by three of the six publisher categories: 52% by scientific societies or professional associations, 33% by commercial publishers, and 13% by university press publishers. The relative distribution among the publisher categories is more skewed toward the three aforementioned categories compared with publishers of immediate OA articles. The distribution among publisher types is also markedly different compared with scientific journals in general. In 2009, the overall distribution of article output by publisher type of journals included in the Web of Knowledge index was reported to be 64%

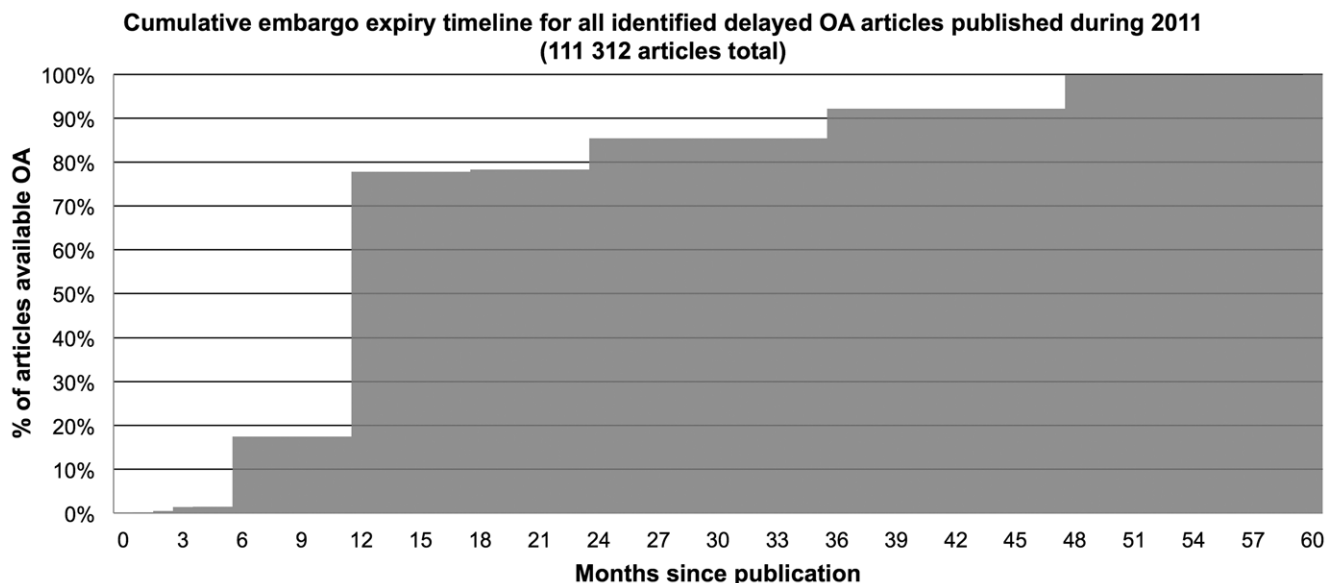


FIG. 2. Embargo expiry timeline for delayed OA articles.

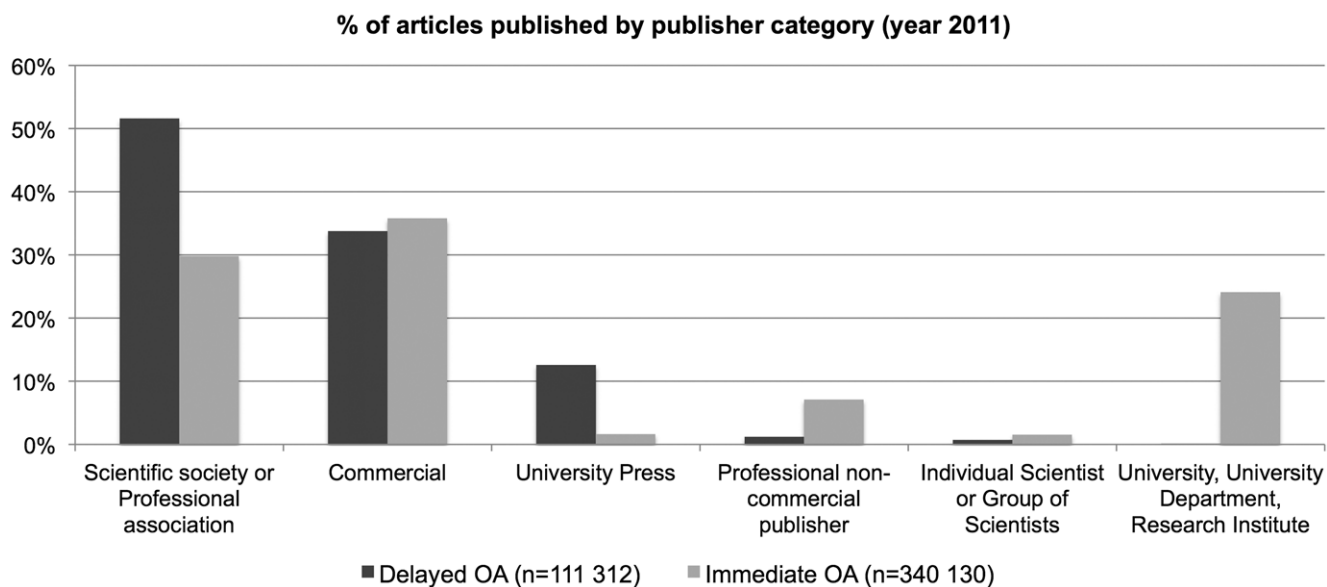


FIG. 3. Publisher category analysis.

commercial (including some proportion of publishing for societies), 30% society publishers, 4% university presses, and 2% other types of publishers (Ware & Mabe, 2009); that is, delayed OA is composed of a higher proportion of society publisher output and a lower proportion of commercial publisher output than journals in general.

Previous studies have indicated that delayed OA journals include many widely cited publications. To study this, a comparison between closed journals, immediate open access journals, and delayed OA journals was performed. Comparing the scientific quality of journals is a challenging task, and the only feasible method in our case was to rely on readily

available data on average journal citation levels (impact factors). The analysis of impact factors for journals included in the Web of Knowledge index (Table 1) shows that delayed OA journals exceed comparable scientific impact averages for closed journals as well as immediate OA journals, calculated on both journal and article levels.

The article volume estimations of this and a previous study (Laakso, & Björk, 2012) can be combined with the average impact factors presented in Table 1 to analyze the accessibility of articles cited in the Web of Knowledge. The analysis is restricted to articles in journals tracked by the Web of Knowledge and of citations in journals included

in the index. The focus is on the citations, not the articles behind them, so an article cited 100 times gets as much weight as the number of citations. The analysis shows that

- 80% of the citations point to articles in closed subscription journals. Some of these can nevertheless be found as self-archived manuscript copies (green OA) and about 1% as individually opened articles in hybrid OA journals.
- 6% point to articles in immediate OA journals.
- 14% point to articles published in delayed OA journal with embargo periods of 12 months or less.

The distribution is of importance, inasmuch as citations in a sense constitute the votes of the global scientific community on which articles, from a scientific viewpoint, provide the most valuable reading.

Because of space limitations, the full list of delayed OA journals cannot be provided within this article. However, to

illustrate the high-quality nature of many delayed OA journals, Table 2 lists some attributes of the 19 delayed OA journals that are among the top 50 journals in Google Scholar's list of top publications. The Google Scholar ranking is based on a Hirsch index for citations to a journal during the past 5 years.

Conclusions

OA is not a straightforward on-off phenomenon; rather, there are many degrees and shades of OA. Immediate publisher-provided OA with a liberal reuse license is the ideal form, but any form of OA is better than closed access. What this study demonstrates is that delayed OA, which is provided mainly by society and commercial publishers and university presses, is important both in volume and in granting access to highly cited scholarly articles. It is interesting to note that the yearly volume of delayed OA articles (111,000) is almost 10 times as large as the number of individually freed articles in so-called hybrid journals (12,000; Björk, 2012) and that the total number of citations of delayed OA articles in the Web of Knowledge exceeds the number of citations of articles in full OA articles.

A concrete suggestion following from this study would thus be for the DOAJ to also start indexing delayed OA journals and their embargo periods. Most of the journals belonging to this category are mature, with technologically advanced web pages facilitating automated indexing even on an article level. Compared with the more heterogeneous lot of web pages for immediate OA journals, complete article-level coverage would be more easily realized. Perhaps the

TABLE 1. Two-year citation averages for Web of Knowledge—indexed immediate open access journals, delayed open access journals, and closed journals, calculated using 2010 impact factors.

Journal type	Journals (<i>n</i>)	Journal level		Article level	
		Mean	<i>SD</i>	Mean	<i>SD</i>
Closed	7,609	1.97	2.95	2.81	3.31
Immediate open access	610	1.50	4.02	2.04	2.28
Delayed open access	409	4.42	5.05	5.93	6.39

Note. Data for closed and immediate open access journals from Björk & Solomon (2012).

TABLE 2. Delayed OA journals (*n* = 19) within the Google Scholar top 50 ranking.

Google Scholar journal rank	Google Scholar h5-index	ISI impact factor 2010	No. of articles 2011	Embargo length (months)	Journal title
2	274	53.5	687	6	<i>New England Journal of Medicine</i>
3	265	31.4	1,718	12	<i>Science</i>
5	195	32.4	441	12	<i>Cell</i>
6	189	9.8	3,342	6	<i>Proceedings of the National Academy of Sciences USA</i>
11	159	14.4	703	12	<i>Circulation</i>
13	141	10.6	1,592	12	<i>Blood</i>
14	140	7.4	2,472	12	<i>Astrophysical Journal</i>
15	139	14.3	469	12	<i>Journal of the American College of Cardiology</i>
25	120	8.2	744	12	<i>Cancer Research</i>
28	117	14.0	410	12	<i>Neuron</i>
31	115	24.2	205	12	<i>Immunity</i>
32	114	14.8	216	6	<i>Journal of Experimental Medicine</i>
35	113	16.7	246	6	<i>Annals of Internal Medicine</i>
41	110	5.3	4,291	12	<i>Journal of Biological Chemistry</i>
42	110	7.3	1,821	6	<i>Journal of Neuroscience</i>
45	106	12.9	237	6	<i>Genes and Development</i>
47	104	5.8	1,406	12	<i>Journal of Immunology</i>
48	103	14.2	367	12	<i>Molecular Cell</i>
49	103	26.9	165	12	<i>Cancer Cell</i>

Note. Google Scholar 9th July 2012 (http://scholar.google.com/citations?view_op=top_venues&hl=en). Nonjournal entries removed from list and ranking adjusted accordingly (RePEc, arXiv, Social Science Research Network, NBER Working Paper Series, Cochrane database of systematic reviews). h5-Index is the h-index for articles published in the last 5 complete years. It is the largest number *h* such that *h* articles published in 2007–2011 have at least *h* citations each.

list assembled for this study can offer a starting point for improved coverage for delayed OA journals in the future.

Having such a centralized service for delayed OA journals would also facilitate OA prevalence studies using robotized tools, which usually perform the searches with metadata of articles published at least 1 year old (Gargouri, Larivière, Gingras, Carr, & Harnad, 2012). With such a list with ISSN numbers, the copies found could more easily be split into immediate OA, delayed OA, and green copies.

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