

S. Loree. Is Citation Analysis Worth It: A Comparison of the Usefulness of Local Citation Analysis, Interlibrary Loan Records and Usage Statistics for Collection Development Purposes in a Special Library. A Master's Paper for the M.S. in L.S. degree. April, 2007. 48 pages. Advisor: David Carr.

This study evaluates local citation analysis in comparison to interlibrary loan records and usage statistics as indicators for collection evaluation and development purposes in a special library setting as evidenced through a case study at the Environmental Protection Agency's Main Library in Research Triangle Park, North Carolina. More specifically, it examines how data gathered from these three tools compare as predictors for future trends in use of journals and as tools for developing parameters and guidelines for anticipatory collection development decisions in a scientific research library. Ultimately, citation analysis is the most successful in predicting the following year's usage.

Headings:

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IS CITATION ANALYSIS WORTH IT:
A COMPARISON OF LOCAL CITATION ANALYSIS, INTERLIBRARY LOAN
RECORDS AND USAGE STATISTICS FOR COLLECTION DEVELOPMENT
PURPOSES IN A SPECIAL LIBRARY

by
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INTRODUCTION

In my current position as a graduate assistant at the Environmental Protection Agency's Main Library (EPA-RTP Library) in Research Triangle Park, North Carolina, I became curious about how collection development decisions are made in special libraries, particularly those with a science focus. After investigating the literature available on this topic, several things became clear: first, collection evaluation is an essential first step; second, there are many ways to evaluate and assess a collection for strengths, weaknesses, and areas for growth; and, third, my assessment needed to focus on journals because of the predominance of periodicals in scientific research.

As I reviewed the existing literature, I discovered many studies examining the accuracy of single indicators, such as circulation statistics, interlibrary loan (ILL) data, or citation analysis, in assisting with collection development decisions within academic institutions. There are also a number of comparative studies of these methods, again focusing on academic libraries. Frequently these case studies conclude that no single indicator offers the complete picture and that a combination of such methods is the only way to capture a comprehensive understanding of collection needs. However, shrinking budgets, small staff sizes, and limited time may make the use of multiple tools unrealistic for special libraries. Further, the level of complexity and time required for each assessment method varies widely. Perhaps predictably, one of the most time-consuming

techniques, local citation analysis, seems to be the front-runner in studies conducted in academic institutions. However, I could find no data on the usefulness of citation analysis in a special library setting.

While the EPA-RTP Library collects a wealth of information on the usage of the collection as well as material requests, local citation analysis data is not currently gathered. Therefore, this study seeks to examine how local citation data compares to electronic usage and reshelving statistics and ILL request records as indicators of user needs for collection development decisions as evidenced through a case study at the EPA-RTP Library. More specifically, it will examine how data gathered from these three tools compare as predictors of future use and as tools for developing projections and guidelines for anticipatory collection development decisions in a scientific research library.

LITERATURE REVIEW

After reviewing the literature detailing the preparation required for collection development decisions, there is little question as to the value of collection evaluation. As Joswick and Stierman find in *The Core List Mirage*, “Local use differs substantially from use in general and, therefore, must continue to be studied if individual institutions are to make informed decisions about their own special needs.”¹ Essentially, no two user groups are identical and each must be assessed independently in order to fully understand local patron needs. Without budget constraints, these tactics may not be so crucial. The ideal scenario would be to provide all relevant journals to meet all potential user needs.

However, “because of the number and high price of scientific and technical periodicals, contemporary libraries catering to a scientific clientele simply cannot subscribe to every periodical their patrons might use.”² Therefore, through collection evaluation, librarians are able to assess how well the current collection meets the needs of their users and to determine priorities for areas of the collection to be strengthened or weeded.³ Connie Van Fleet states the value of collection evaluation succinctly:

Collection evaluation is concerned with determining strengths and weaknesses of a collection of library materials in terms of the level of intrinsic quality, the extent to which that collection supports and furthers the library’s mission and goals, and the value of that collection to the library’s users and potential users.⁴

While in the past many libraries based decisions on the instinct and intuition of experienced staff members, the objective data offered by evaluation methods is becoming increasingly important in the era of tight library budgets.⁵ As Silas Marques de Olivera states, “Library administrators faced with budget cuts and rising book and periodical prices, should base collection development decisions on solid information. Continuous assessment of the library’s holdings is vital to an effective collection development plan.”⁶ RJ Veenstra and JC Wright add that having objective data simplifies the hard collection development decisions, while, “Without such data, collection development tends to follow an uncertain path and library resources may become unresponsive to overall need, with undue emphasis given to the needs of small, vocal groups.”⁷ Thus, the library community fully embraces collection assessment for collection development purposes as an important and necessary step.

Despite all of the positive reasons to complete collection evaluations, Nancy Butkovich points out the one major weakness of evaluations, “... although they can

measure past or current use, they cannot measure future use.”⁸ She goes on to say that collected data can quickly become obsolete, as patron interests and research areas can shift at any time.⁹ Therefore, it is essential to balance the cost of collection evaluation in terms of time and resources with the collection development needs and expectations, so that evaluation can be a continuous process.

However necessary this type of research might be, it may be expensive, especially in terms of the time required for data collection and analysis. Therefore, determining the appropriate tool for assessment is the critical first step in the process. As Brian Baird notes in his introduction to *Library Collection Assessment through Statistical Sampling*, “Assessment is a planning tool, but the assessment itself must also be carefully planned, shaped by the mission of the library, to ensure that the assessment exercise is effective and provides valid, useful information.”¹⁰ Kate Herzog suggests that establishing a clear idea of why the study is being done, what expectations there are for the data, and anticipated outcomes of the study are a good way to identify the correct type of study to complete.¹¹ Keith Swigger and Adeline Wilkes outline several key attributes any method must have, “the method... should have validity (it must measure what it says it measures), it should be reliable (it should give consistent results across cases observed), and it should be economical (if it costs more to study the problem than the problem costs, one has truly wasted resources.)”¹² It quickly becomes clear that collection evaluation must be thoughtfully planned in order to reap the benefits of the analysis.

Unfortunately, there is limited information available that details how the types of data each method offers compare to each other in terms of cost effectiveness, as well as usefulness for special libraries. There is, however, a wealth of information outlining the

strengths and weaknesses of each method within academic libraries, which can be used to better understand collection evaluation practices and methods. The three most common collection evaluation techniques are analyses of ILL request records, reshelving and usage statistics, and local citation data.

Interlibrary Loan (ILL)

ILL is an obvious candidate for collection development information, as requests must be tracked for copyright purposes and these requests represent material needed by patrons that the collection is lacking. According to M. Murphy and K. Rupp-Serrano keeping constant tallies on ILL requests can be a money-saving practice, “as often it is less expensive to maintain a subscription and/or purchase older volumes than to make continual requests for such materials which may result in the added cost of copyright fees.”¹³ In Suzanne Ward, Tanner Wray, and Karl Debus-Lopez’s estimation, each ILL transaction costs \$27.83 for the lending and borrowing member libraries, with the borrowing library assuming two-thirds of the costs.¹⁴ While this of course varies from library to library, it does show that there is a significant cost for each ILL request, “Even if the two libraries enjoy reciprocal lending privileges at no direct cost, each library incurs costs associated with staff time, supplies, shipping, equipment, network fees, and more.”¹⁵ In addition to the purely practical aspect, Camille Livingston and Antje Mays point out that, “these data can point to gaps in the library collection and/or specialized research in areas beyond the library’s scope.”¹⁶ Therefore, by analyzing the data topically, it is possible to assess whether there is a particular area in which the library’s collection is weak.

Assessment of ILL data can be taken a step further by comparing owned items by topic or class to borrowed items in that same topic or class. Connie Van Fleet explains the use of the “collection balance indicator,” which essentially allows a librarian to quantitatively assess the strength of a particular collection. The indicator is discovered through the following formula:

$$\frac{\text{New Acquisitions in Class}}{\text{Total Acquisitions}} - \frac{\text{Titles Borrowed in Class}}{\text{Total Titles Borrowed}}$$

According to Van Fleet, the result of the formula indicates whether “the library might be relying too heavily on ILL materials to satisfy local patron need in a particular area.”¹⁷ Thus, ILL data can be used on many different levels to better understand patron needs and collection weaknesses.

While ILL data offers a wealth of information, there are several cautions which must be observed. First, Nancy Butkovich mentions the danger of skewed data arising when one researcher requests a single title multiple times in the course of a short period of time. She explains that this can be avoided by looking at a multi-year period, which typically neutralizes this skewing.¹⁸ Anthony Ferguson and Kathleen Kehoe recommend the review of proposed titles by a subject specialist to ensure that they are appropriate to the scope of the library, despite their popularity among patrons.¹⁹ A further complication for the use of ILL data, particularly in relation to serials, is that it is often more cost effective to pay the copyright and ILL fees than to maintain a subscription to a particular journal; “if the copyright fees and delivery costs associated with accommodating article requests for a particular journal exceed that journal’s subscription price (over a sustained period of time), the decision of whether to buy is heavily influenced by these financial factors.”²⁰ Anthony Ferguson and Kathleen Kehoe found that a minimum of ten requests

had to be made from a specific title for the costs of acquiring a copy to near the costs of owning a periodical title.²¹ However, they argue that it is also important to calculate patron attitudes and opinions, as well as speed of access, to determine whether owning or subscribing to a particular title versus borrowing or requesting copies makes sense.²² Therefore, there are many steps in the collection assessment and development process and while this paper focuses on the identification of titles for potential purchase or subscription, these other steps must be taken to make the final selection decisions.

In-House Usage Statistics

Reshelving using the “sweep method” is a common means for assessing in-house use. Hill, Madarash-Hill, and Hayes offer an explanation of their use of the sweep method at the University of Akron over a ten-year period, “Employing the ‘sweep method,’ we monitor in-house use of periodicals by marking each use prior to reshelving any bound or unbound periodical.”²³ Thus, each time a journal is removed from the shelf, it is counted and then replaced. Ideally this would capture actual use of a journal, but defining use is difficult. Because it is impossible to know why exactly a journal was taken from a shelf and how it was “used,” Hill, Madarash-Hill, and Hayes simplify this process, “we have decided to count use as anytime that a periodical has been moved from its designated place in the shelf.”²⁴ Therefore, the sweep method, while perhaps reliable in its statistics, requires a very broad definition of use.

Keith Swigger and Adeline Wilkes summarize their criticism of the reshelving statistics with the following statement, “All that is really counted is the number of times a journal was left unshelved.”²⁵ C. Lafferty claims that despite signs telling patrons not to

reshelve materials, there are a certain number of “helpful patrons” who continue to reshelve books.²⁶ Among the problems Hill, Madarash-Hill, and Hayes mention are:

Uncounted is the use of periodicals by patrons who reshelve their materials. Undercounted is the use of multiple articles from a single volume or reuse of periodicals from tables or copiers before they are marked and reshelled. Overcounted use includes instances when multiple issues have been pulled from the shelf for browsing, and unread issues/volumes are counted.²⁷

However, these authors find that because they use their numbers comparatively, the actual totals are less important than their value relevant to other journals. Therefore, they feel that these numbers are safe to use for collection assessment and development purposes.²⁸ By only using the data within the context of its collection, and in a relative fashion, it is possible to disregard some of the more worrisome validity issues.

Electronic Journal Usage Statistics

There is currently a shortage of case studies on the effectiveness of electronic journal usage statistics for collection development decisions. The majority of articles available at present focus on the need for standards among vendors to make these statistics more meaningful, as well as on the shortcomings of the current metrics. Among the “e-metric obstacles” cited are the lack of reliability, the frequent unavailability of reports due to technical problems, and the lack of standard definitions, methods, and practices between vendors.²⁹ Elise Anderson also notes that whether a library creates its own metrics or uses vendor-supplied statistics, “developing useful statistics requires a significant investment in time, personnel and money.”³⁰ In fact, this area is such a prominent, complex topic in the current literature that entire books have been written about electronic metrics and how to develop them successfully.³¹

However, Anderson points to the vast potential of this data far beyond standard collection development assessments. She suggests that in addition to making deselection choices using these metrics, such as cost per use, librarians could use the objective data to argue for increased library funding for particular electronic resources, pinpoint low-use resources and offer workshops to increase familiarity and usage, and identify journals in need of greater simultaneous user accounts.³² And, finally, David Nicholas and friends reflect on the uses for the electronic usage statistics they collected for the OhioLink e-resource system, and find that the data helps publishers as well as librarians in understanding user needs.³³ Therefore, while the territory of electronic usage statistics still leaves much to be desired and explored, there are numerous possibilities for this data in the future. At present, it seems safest to look at this data with the same relative scope we use to evaluate reshelving statistics.

Citation Analysis

Citation analysis appears to be the tool of choice currently, as a simple descriptor search on this subject restricted to 2005-2006 within the Library and Information Science Abstracts (LISA) bibliographic database returns 196 articles versus the same search with “use statistics” at 92, “interloans” at 72, and “circulation statistics” at six.³⁴ The vast majority of these articles focus on academic institutions, perhaps because they have faculty, graduate student, and undergraduate student papers and publications which they can analyze for citation analysis purposes. Among the frequently cited advantages of this method are that lists of sources and cited materials can be drawn to meet the needs of specific subject areas; that this type of evaluation is responsive to the latest developments

in a specialization; and, that citation analysis focuses on the actual use by local patrons.³⁵ However, Joseph Wible points out that the citation does not actually indicate that the patron used the library's copy of a particular item. But, he explains, "if the title is being cited heavily by the library's primary clientele, it should be held in the library's collection even if it is not specifically the library's copy which is being used."³⁶ In essence, the key advantages of citation analysis center on the actual claim of use for research purposes by patrons. Citations change according to research focus and topics, thus by analyzing references, librarians can better understand the research interests of patrons unobtrusively.

Although popular, citation analysis is not without its critics. While the advantages focus on theoretical applications, the disadvantages focus on the actual practice. First, it can be difficult to include source items which are representative of user needs and the subject area in question.³⁷ William Loughner adds that, "Only the citations of those local researchers who published during the given time period are counted. The uncited work that they also used and all the material used by those who did not publish are not counted."³⁸ Thomas Nisonger questions what a citation really means, "it is unclear what a citation actually indicates, most citation studies count all citations (positive, negative, and neutral) equally; a resource might have been cited simply because it was readily available to the researcher; and an item could be cited without actually having been used."³⁹ The *Pacific Northwest Collection Assessment Manual* contains a similar warning, "unknown variables govern original citations such as: credentials of [the] author, availability of information resources to the author and selection of source materials, and bias of the author. A citation is not an inherent guarantee of quality."⁴⁰ In

a similar vein, Loughner points out that a citation analysis typically focuses on source title, not specific year or volume, so that one article from decades ago could be cited repeatedly and, thus, falsely inflate the importance of a particular journal.⁴¹ And, he adds that “Journals with a small number of papers will generally rank lower. This problem would include new journals and journals that have undergone name changes.”⁴² Therefore, although citation analysis looks at actual claimed use by specific patrons on particular topics to determine user needs, it ignores the context of the citation. It also disregards the details related to citations, such as the number of different articles and years cited in a specific journal and the number of articles per journal.

Comparative Studies

In 1988, Adeline Tallau compared nine different evaluation measurements: probability of owning journal articles from abstracts and indexes, monographs in LC classes, items cited in annual review volumes, faculty publications, cited materials in faculty publications, materials citing faculty publications, as well as, the analysis of the circulation of recently added monographs and questionnaires completed by faculty and librarians.⁴³ She found that each measure answers a different question and “addresses a different aspect of collection evaluation.” In support of this, she states, “The fact that each answer reveals something different about the collection is supported by the general lack of overall relationships between the results when the collection is held constant.”⁴⁴ Diane Schmidt and Elisabeth B. Davis agree with Tallau, but frame their argument in terms of types of use, “Some of the differences between the relative rankings of journals in the circulation and citation studies can be attributed to the way certain journals are

used.”⁴⁵ Therefore, these authors find that there are significant variances in the data, due to the measures themselves.

Deborah Blecic, however, found that with a large enough sample size “circulation and citation data correlate well with in-house use,” although there are certain publications which are frequently used but not cited, in her case clinical review journals.⁴⁶ Howard Dess compared a survey of faculty, reshelving counts, and citation analysis in 1997 and found that there was a strong correlation with high use journals in each method, but “the low use end presented a much more discordant picture.” For example, he finds 60 zero-use titles in SciSearch and 42 zero-use titles in reshelving statistics, however only five of these titles overlap.⁴⁷ Sherri Edwards had similar findings at the Science and Technology Library at the University of Akron, “While many of our titles with high citation counts also had high shelving counts, and conversely, titles with low citation counts had low shelving counts, surprisingly, several titles with low citation counts (less than five) had high shelving counts.”⁴⁸ And, finally, Diane Schmidt and Elisabeth Davis had similar findings, “We also found that while our citation study and our circulation study did not produce identical results, either a citation study or a brief circulation study is sufficient to identify high use titles.”⁴⁹ Therefore, each collection evaluation measure has its strengths and weaknesses, but is most reliable and valid in its relation to high-use titles. For selection purposes then it seems that one method would provide insight into collection needs and usage while at the same time not requiring an untenable amount of resources. However, a one or two method approach may be less effective for deselection and the comparison of low-use titles.

METHODOLOGY

The EPA-RTP Library houses several different types of materials, including a documents collection, serials, microfiche, audio-visual materials, and monographs. The majority of the library collection is comprised of journal titles (approximately 400).⁵⁰ The predominance of periodicals in science libraries is quite common and well documented. As Charles Harvey Brown notes in 1956, “Scientists and librarians at all familiar with the use of scientific publications recognize that generally research scientists refer to serials much more frequently than they do to books...”⁵¹ For this reason, I chose to limit my research to this subset of the collection.

The technique I employed to analyze the journal collection involved, first, analyses and reviews of ILL request records, in-house and electronic usage statistics, and citation analysis data, and, second, a comparison of the data findings. I gathered each set of data and sorted, stored and analyzed the data using Microsoft Excel. Each of the data sets can be found in the appendices.

ILL Request Data

“Interlibrary Loan” is somewhat of a misnomer for the department at the EPA, as staff members not only assist with access to publications not owned by the library, but also photocopy or scan articles which are in the collection for patrons, as a type of document delivery service. Therefore, there is some degree of crossover between the ILL data and the usage statistics in terms of traditional definitions. To make this study more applicable to other library situations, I focused the study on the traditional definition of

ILL by collecting data solely from OCLC requests made by the library. Using the library's CLIO database, I ran the Copyright Status Report for two time periods: 1/1/2005 to 12/31/2005 and 1/1/2006 to 12/31/2006. This report only includes journal titles which were requested over five times within the specified time period, meaning that zero-values represent zero to four requests for a particular title. I then compared the two time periods in an attempt to uncover any trends in requests and possible use.

Usage Statistics

The print and electronic usage statistics were gathered from existing spreadsheets created and maintained by the Serials Librarian and Serials Assistant. The print usage statistics are comprised of a list of the titles owned by the library during 2005-2006 with the total number of times each journal title was reshelved during each time period. Because journal circulation is not captured in the circulation database at the EPA-RTP library, this is the only means of capturing physical use within the library. Use in this case is defined as any time a journal is pulled from the shelf and placed on one of the carts available in the library for reshelving. Patrons as well as library staff, in the case of document delivery requests, place journals used by internal (EPA) researchers on these carts.

Electronic usage statistics are provided through the library's subscription databases and are stored and tracked in a spreadsheet by the Serials Librarian and Serials Assistant. Use in this case is defined as any time an article is actually opened in the subscription database, not simply a hit on a journal's site. These statistics are subdivided according to year as well, with one spreadsheet for 2005 and another for 2006. I

compiled the data into a single spreadsheet to compare the data for 2005 and 2006. I excluded electronic journals where the usage statistics included the entire EPA library network's use (51 total), as this is a site specific study. And, I excluded all titles with a zero-value for either year. Through consultation with the Serials Librarian, I learned that the zero-values frequently indicate access issues or issues in collecting statistics from vendors. In total, this included 37 journals with 36 zero-values in 2005 and 1 zero-value in 2006. And, finally, because the print usage date range overlapped with the dates of electronic journal usage, I made this a third category in the spreadsheet rather than incorporating it into the two existing columns.

Citation Analysis Data

The final area of data collection was an analysis of citations found in patron publications during the 2005 and 2006 calendar years. I located these publications using the following search in the ISI Citation Databases:

OG=EPA AND ZP=27711

While my original ambition was to analyze all articles published by EPA- RTP researchers within each year, I quickly discovered that this would be unmanageable as there were 300 articles published in 2005 and 264 published in 2006. As an alternative approach, I searched for the top 50 researchers in terms of number of publications for each year. I then compared these lists, confirmed EPA employee status, and identified researchers who had a similar number of articles published in both years, essentially those with a difference of fewer than two articles between the two years. My final step was to identify the six researchers of this final group who had the greatest number of total

articles in the two year period. I then searched the databases for articles published by these researchers in 2005 (34 articles) and 2006 (37 articles.) To prepare the data for analysis, I exported the full records to Microsoft Excel and separated the citations into separate columns. I excluded all obvious non-journal titles from each group, which equaled 26 in 2005 and 63 in 2006. Five articles in 2005 and four articles in 2006 had no citations; and, in 2006, one article had a single citation. In the end, I had 1,129 citations in the 2005 calendar year and 1,197 in 2006 to analyze with an average of 38 citations per article.

RESULTS

The main goal for each of the comparisons was to determine the differences and similarities between the data sets and whether they are predicting the same future use or pinpointing very different types of use. Second, I noted the total number of journals which were either used or cited without significant change over the two year period for each method to determine which was the most successful.

In the ILL data, there were few crossovers from one year to the next. In 2005, there were a total of 590 requests and 936 in 2006 from a total of 119 journals. Of the 119 journals requested, there were only 27 (22.7%) which were in common between the two years. Of these, 16 of the 27 (59.3%) experienced an increase of 12.5% to 166.7%, while four (14.8%) had exactly the same request rate, and seven (25.9%) had a decrease of 10% to 58.8%. There were only ten journals (8.4%) with a 25% or less change between 2005 and 2006.

In terms of the journal usage studies, the results were troubled. As I alluded to in the literature review, electronic statistics are problematic. I had to exclude 88 titles of the initial 142 journals (62%) due to either inconstant user group basis or unreliable data and totals. The print journals only represented 10% or greater of the total use for six journals. For this reason and because these statistics overlapped with the 2005 and 2006 electronic usage statistics, I chose to disregard these metrics in the study.

Overall, there was a 2.46% increase in the total use of the electronic journals included in this study. There were 27 journals (30.7%) which experienced a decrease in use with the percent of decrease ranging from 2.9% to 62.86%. Twenty-six journals (29.5%) had an increase in use, with the percent change ranging from 0.39% to 268.42%. For 36 journals (41%), there was less than a 25% change in usage. And, one journal had exactly the same usage from year to year.

In the citation analysis study, the six patrons cited a total of 574 different journals, with 1,129 total citations in 355 different journals in 2005 and 1,195 total citations in 369 different journals in 2006. In 2005, 51 of the journals (14.4%) were cited five or more times totaling 686 or 60.8% of the total citations. The remaining portion of the journals, 304 total or 85.6%, received 443 of the total citations or 39.2%. In 2006, 57 of the journals (15.5%) were cited five or more times and received 747 of the total citations or 62.5%, while 312 of the journals (84.6%) were cited four or fewer times and received 448 of the citations or 37.5%. Thirty of the 51 journals (58.8%) cited five or more times in 2005 were also cited five or more times in 2006.

Finally, I defined the top titles as those with less than 25% change between 2005 and 2006 in the ILL and usage statistics; or, in the case of the citation analysis, those cited five or more times both years. There was no overlap between the journals identified by ILL data analysis and citation analysis. However, there are eight crossovers in the 58 journals (13.8%) listed in the citation and usage statistics.

DISCUSSION & CONCLUSION

In order to determine which method was the best predictor of future use, I compared the total number of identified journal titles by each method with continuous use of significant citations both years. Based on these lists, I ranked the methods from most to least journals: first, usage studies (36 titles); second, citation analysis (30); and, third, ILL request analysis (10). However, this ranking does not capture the outstanding issues of the reliability or validity of the numbers. When looking at the broader picture, the usage statistics are the least reliable and inspire the least confidence due to the number which had to be excluded from the study. The ILL statistics, on the other hand, are extremely reliable, but offer little insight in this situation since there is few journals which are requested consistently between the two years.⁵² The citation analysis data, at present, then seems the most promising, as even with this study which includes less than 1% of the total number of publishing authors at the EPA, there seems to be a relationship between the high use titles from year to year.⁵³ Until the e-metrics system is rid of its many inconsistencies, it seems that citation analysis really is worth it. It would, however,

be interesting to repeat this study in a couple years' time to note possible changes to the conclusion.

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 31. *E-Metrics for Library and Information Professionals* (New York: Neal-Schuman Publishers, Inc., 2006) is an excellent example.

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32. Anderson, 20-22.
33. David Nicholas et al, "The Big Deal: Ten Years On," *Learned Publishing* 18, no. 4 (October 2005): 256-7.
34. The choice of terms is based on the available 'descriptors' within the LISA bibliographic database. The same type of finding is mentioned by Kristin LaBonte in the Summer 2005, no 43 issue of *Issues in Science and Technology Librarianship*, "Citation analysis is now commonly used to determine what titles to purchase, to discontinue, or to weed."
35. *Pacific Northwest Collection Assessment Manual*, 1986: 38.
36. Joseph G. Wible, "Comparative Analysis of Citation Studies, Swept Use, and ISI's Impact Factors as Tools for Journal Deselection," *IAMSLIC at Crossroads: Proceedings of the 15th Annual Conference* (St. Petersburg, FL: IAMSLIC, 1990), 116.
37. Daniel T. Richards and Dottie Eaken, 192.
38. William Loughner, "Scientific journal usage in a large university library: a local citation analysis," *Serials Librarian* 29.3/4 (1996): 86.
39. Thomas E. Nisonger, *Evaluation of Library Collections, Access, and Electronic Resources: a literature guide and annotated bibliography* (Westport, CT: Libraries Unlimited, 2003), 168.
40. *Pacific Northwest Collection Assessment Manual*, 38.
41. Loughner, 86.
42. Ibid.
43. Adeline Tallau, "An Exploratory Comparison of Eight Collection Assessment Measures in a University Research Library" (Ph.D. diss., Rutgers University, 1988), ii-iii.
44. Ibid., 272.
45. Schmidt and Davis, [n]
46. DD Blecic, "Measurements of Journal Use: An Analysis of the Correlations Between Three Methods," *Bulletin of the Medical Library Association* 87, no. 1 (1999): 24.
47. Howard M. Dess, "Gauging Faculty Utilization of Science Journals: A Defensive Strategy for a Lean Budget Era," *Science and Technology Libraries* 16, no. 3/4 (1997): 187.

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48. Sherri Edwards, "Citation Analysis as a Collection Development Tool: A Bibliometric Study of Polymer Science Theses and Dissertations," *Serials Review* 25, no. 1 (1999): 17-19.
49. Schmidt and Davis, [n].
50. Library – RTP, available online: <http://www.epa.gov/rtp/library/index.htm>, accessed March 4, 2007.
51. Charles Harvey Brown, *Scientific Serials: Characteristics and lists of most cited publications in mathematics, physics, chemistry, geology, physiology, botany, zoology, and entomology* (Chicago: Association of College and Reference Libraries, 1956), 21; Rolland E. Stevens agrees, "The literatures of science and technology consist almost wholly of serial references..." in his work, *Characteristics of Subject Literatures* (Chicago: Association of College and Reference Libraries, 1953), 19.
52. Perhaps this low rate of crossover means the library is highly successful in identifying and purchasing the titles important to patrons.
53. Using the ISI Citation Database, there appears to be 2089 total EPA authors who published articles between 2005 and 2006. This study represents 0.29% of those authors.

APPENDIX A – ILL Statistics

Title	2005 Total	2006 Total
Ageing research reviews	8	7
Alcoholism: clinical and experimental research	8	11
Allergy	6	0
Analytica chimica acta	6	0
Annals of allergy, asthma, & immunology	14	0
Annals of the New York Academy of Sciences	23	23
Antioxidants & redox signaling	0	12
Archives of internal medicine	0	13
Arteriosclerosis, thrombosis, and vascular biology	0	9
Assay and drug development technologies	0	7
Atherosclerosis	17	7
Basic research in cardiology	6	0
Behavioral brain research	22	38
Biochimica et biophysica acta	17	11
Biomarkers	8	0
Biomaterials	12	0
Bioorganic & medicinal chemistry	6	0
Biotechniques	0	6
Brain, behavior, and immunity	0	11
Cellular and molecular life sciences: CMLS	8	9
Clinica chimica acta	6	11
Clinical immunology	0	12
Clinical pharmacokinetics	0	6
Computational statistics & data analysis	6	12
Current medicinal chemistry	11	0
Current opinion in microbiology	12	0
Developmental and comparative immunology	7	8
Developmental dynamics	6	0
Ecology letters	0	11
Energy & fuels	6	0
Energy economics	6	0
Environmental geochemistry & health	7	0
Epidemiology	0	15
European journal of pharmacology	6	16
Evolution & development	0	6
Experimental and toxicologic pathology	0	17
Experimental gerontology	7	11
Food additives and contaminants	0	6
Food chemistry	0	6
Free radical biology & medicine	12	20
Fuel processing technology	8	0
Fungal genetics and biology	7	0
Health physics	0	26

Human & experimental toxicology	0	7
Human reproduction	0	6
Industrial & engineering chemistry research	7	0
Insect biochemistry and molecular biology	9	0
International archives of allergy and immunology	6	8
International journal of cancer	0	6
International journal of environmental health research	7	0
International journal of food microbiology	7	13
International journal of hygiene and environmental health	20	17
International journal of obesity and related metabolic disorders	0	6
Journal of the American Statistical Association	9	0
Journal of aerosol medicine	9	9
Journal of aging and physical activity	0	15
Journal of analytical and applied pyrolysis	0	8
Journal of applied microbiology	0	17
Journal of biological rhythms	6	0
Journal of biomolecular screening	0	8
Journal of chemical information and modeling	7	15
Journal of comparative neurology	0	6
Journal of environmental biology	9	0
Journal of environmental health	0	10
Journal of environmental monitoring: JEM	0	7
Journal of environmental radioactivity	0	13
Journal of environmental radioactivity	0	80
Journal of feline medicine and surgery	8	0
Journal of food protection	9	12
Journal of materials science	6	0
Journal of medicinal chemistry	0	29
Journal of microscopy	6	0
Journal of multivariate analysis	7	0
Journal of nanoscience and nanotechnology	6	10
Journal of neurobiology	9	0
Journal of neuroscience methods	9	7
Journal of the American College of Cardiology	9	6
Journal of the American Geriatrics Society	0	7
Journal of the American Veterinary Medical Association	10	0
Journal of the American Water Resources Association	0	6
Journal of theoretical biology	7	0
Journal of thermal envelope and building science	6	0
Journal of toxicology and environmental health. Part B, Critical reviews	0	10
Langmuir	7	0
Mechanisms of ageing and development	34	34
Medical hypotheses	0	7
Methods in molecular biology	0	8
Microbes and infection	0	7
Military medicine	0	8
Molecular and cellular biochemistry	0	8
Molecular and cellular endocrinology	0	13

Molecular endocrinology	0	8
Molecular microbiology	7	0
Nature cell biology	0	7
Neurobiology of aging	7	10
Neurobiology of learning and memory	0	11
Neurochemistry international	7	0
Neuropsychopharmacology	0	6
Pest management science	9	0
Pharmaceutical research	10	9
Progress in brain research	7	0
Progress in neurobiology	7	0
Radiation protection dosimetry	0	7
Radiation research	0	6
Rapid communications in mass spectrometry: RCM	0	6
Respiratory medicine	0	7
Seminars in cell & developmental biology	0	6
Statistics & probability letters	6	6
Statistics in medicine	0	10
The American Journal of cardiology	11	0
The Journal of endocrinology	0	7
The Journal of steroid biochemistry and molecular biology	0	10
The Journal of the American Oil Chemists' Society	0	9
The journals of gerontology. Series A, Biological sciences and medical sciences	0	20
The Lancet infectious diseases	0	6
The Laryngoscope	7	0
Theriogenology	6	8
Trends in microbiology	0	7
Water, air, and soil pollution	9	0

APPENDIX B – Usage Statistics

Journal Title	Online Usage 2005	Online Usage 2006	Print Usage 2005-2006
Aerosol Science and Technology	216	300	58
American Association for Cancer Research (AACR). 5-journal suite incl.: Cancer Epidemiology, Biomarkers and Prevention, Cancer Research, Clinical Cancer Research, Molecular Cancer Research, Molecular Cancer Therapeutics	3043	3187	75
American Journal of Physiology (consolidated)	2410	2340	25
American Journal of Respiratory and Critical Care Medicine	1810	1425	12
American Journal of Respiratory Cell and Molecular Biology	651	799	4
Analytical and Bioanalytical Chemistry	105	117	3
Annals of Internal Medicine	673	450	3
Annals of Occupational Hygiene	529	544	10
Archives of Environmental Contamination and Toxicology	98	148	26
Basic and Clinical Pharmacology and Toxicology	66	57	1
Biochemical Journal	521	496	3
Bioinformatics	349	484	7
Biology of Reproduction	1176	777	1
Biometrics	43	74	7
Chest	752	607	5
Circulation Research	257	308	0
Circulation	1317	1236	3
Clinical and Experimental Allergy (Clin & Exp Allergy Reviews)	120	161	5
Critical Reviews in Toxicology	371	314	26
Drug Metabolism and Disposition	1555	1454	5
EMBO Journal (incl. EMBO reports)	827	1729	2
Endocrinology	1604	1534	9
European Respiratory Journal	776	779	6
Experimental Lung Research	35	30	9
FASEB Journal	614	499	7
Free Radical Research	63	53	5
Immunology	38	27	2
Indoor Air	124	94	11
Indoor and Built Environment	102	125	3
Inhalation Toxicology	452	638	18
International Archives of Occupational and Environmental Health	131	87	49
International Journal of Toxicology	65	82	4
Journal of Applied Physiology	672	680	12
Journal of Atmospheric Chemistry	50	50	33

Journal of Immunology	1350	1221	2
Journal of Neurochemistry	137	112	13
Journal of Neurophysiology	188	146	0
Journal of Neuroscience	991	1000	8
Journal of Nutrition	1023	875	8
Journal of Occupational and Environmental Hygiene	41	93	38
Journal of Pharmacokinetics and Pharmacodynamics	28	34	6
Journal of Pharmacology and Experimental Therapeutics	991	929	25
Journal of Physiology	18	22	2
Laboratory Investigation	115	123	7
Molecular Pharmacology	611	694	11
Neuropathology and Applied Neurobiology	35	13	1
Oncogene	973	3332	18
Pediatrics	1595	1402	14
Pharmacological Reviews	188	224	3
Psychopharmacology	89	40	12
Science	436	377	112
Toxicologic Pathology	132	193	5
Toxicological Sciences (incl. Toxicologist)	8768	7729	30
Visual Neuroscience	19	70	1

APPENDIX C – Citation Analysis Data

Publication	2005	2006	Total
ACTA ENDOCR-COP S	1	1	2
ACTA MED SCAND	1	0	1
ACTA OTOLARYNGOL STO	1	0	1
ACTA PHARMACOL TOX	0	1	1
ACTA PHYSIOL HUNG	0	1	1
ACTA PHYSIOL SCAND S	1	0	1
ADV EXP MED BIOL	2	2	4
ADV INORG CHEM	1	1	2
ADV MODERN ENV TOXIC	1	0	1
ADV PHARMACOL	1	0	1
ADVERSE DRUG REACT T	0	1	1
AEROSOL SCI TECH	0	2	2
AGENTS ACTIONS	1	0	1
ALCOHOL ALCOHOLISM	1	0	1
ALCOHOL CLIN EXP RES	0	1	1
AM HEART J	1	1	2
AM IND HYG ASSOC J	0	1	1
AM J CLIN NUTR	1	0	1
AM J CRIT CARE MED	0	1	1
AM J DIS CHILD	0	1	1
AM J EPIDEMIOL	2	6	8
AM J HUM GENET	1	0	1
AM J IND MED	0	2	2
AM J PATHOL	4	3	7
AM J PHYS ANTHROPOL	0	1	1
AM J PHYSIOL	7	4	11
AM J PHYSIOL-CELL PH	0	1	1
AM J PHYSIOL-ENDOC M	0	1	1
AM J PHYSIOL-GASTR L	2	0	2
AM J PHYSIOL-LUNG C	22	8	30
AM J PUBLIC HEALTH	1	1	2
AM J RESP CELL MOL	7	11	18
AM J RESP CELL MOL B	1	0	1
AM J RESP CRIT CARE	15	16	31
AM J VET RES	0	6	6
AM REV RESPIR DIS	21	12	33
ANAEROBE	0	1	1
ANAEROBIC LAB MANUAL	0	1	1
ANAL BIOCHEM	5	3	8
ANAL CHEM	2	2	4
ANALYST	0	6	6
ANAT REV	0	1	1
ANGEW CHEM INT EDIT	0	1	1

ANN MED	1	1	2
ANN NY ACAD SCI	1	1	2
ANN OCCUP HYG	3	3	6
ANNU REV BIOCHEM	0	1	1
ANNU REV NUTR	3	0	3
ANNU REV PHARMACOL	2	0	2
ANTICANCER RES	0	1	1
ANTIMICROB AGENTS CH	0	1	1
ANTIOXID REDOX SIGN	0	1	1
APPL ENVIRON MICROB	0	1	1
APPL OCCUP ENV HYG	0	1	1
APPL ORGANOMET CHEM	2	3	5
AQUAT TOXICOL	2	0	2
AQUATIC SURFACE CHEM	1	0	1
ARCH ANAT MICR MORPH	0	1	1
ARCH BIOCHEM BIOPHYS	4	5	9
ARCH DIS CHILD	1	0	1
ARCH ENVIRON CON TOX	1	1	2
ARCH ENVIRON HEALTH	0	2	2
ARCH EXP PATHOL PH	0	1	1
ARCH IND HYG OCC MED	1	0	1
ARCH INTERN MED	0	1	1
ARCH MICROBIOL	0	1	1
ARCH TOXICOL	11	14	25
ARCH TOXICOL S	2	0	2
ARSENIC ENV 2	0	1	1
ARTERIOSCL THROM VAS	1	1	2
ASS PARTICULATE MATT	0	1	1
ATLAS METAL LIGAND E	1	0	1
ATMOS ENG	0	1	1
ATMOS ENVIRON	1	0	1
ATMOS ENVIRON A-GEN	0	1	1
AUST J SOIL RES	1	0	1
AUTODECAY	1	0	1
B ENVIRON CONTAM TOX	2	2	4
B WORLD HEALTH ORGAN	0	1	1
BBA-MOL CELL RES	1	0	1
BEHAV BRAIN RES	1	0	1
BERL MUNCH TIERARZTL	0	1	1
BFR 2004 TOR CAN JUN	2	0	2
BIOCELL	1	0	1
BIOCHEM BIOPH RES CO	10	4	14
BIOCHEM CELL BIOL	0	1	1
BIOCHEM J	3	8	11
BIOCHEM PHARMACOL	13	12	25
BIOCHEM SOC T 2	0	1	1
BIOCHEMISTRY ANIMAL	1	0	1
BIOCHEMISTRY-US	1	1	2

BIOCHIM BIOPHYS ACTA	0	3	3
BIOFACTORS	1	0	1
BIOL LAB MOUSE	1	0	1
BIOL NEONATE	1	1	2
BIOL PHARM BULL	0	5	5
BIOL REPROD	2	6	8
BIOL TRACE ELEM RES	0	1	1
BIOMETALS	2	0	2
BIOMETRICS	0	1	1
BIOREMED J	0	1	1
BIOSTATISTICS	0	1	1
BIOTECHNIQUES	1	1	2
BIRTH DEFECTS RES B	0	2	2
BLOOD	8	1	9
BLOOD CELL MOL DIS	3	1	4
BLOOD PRESSURE	1	0	1
BMC BIOCH	1	0	1
BMC NEUROSCI	1	0	1
BRAIN RES	1	0	1
BRAIN RES B	0	1	1
BRAIN RES MOL BRAIN	1	0	1
BRIT J CANCER	1	0	1
BRIT J HAEMATOL	3	0	3
BRIT J IND MED	0	1	1
BRIT J NUTR	1	0	1
BRIT J PHARMACOL	1	0	1
BRIT J RHEUMATOL	1	0	1
BRIT MED J	1	1	2
BRIT VET J	0	1	1
CAN MED ASSOC J	0	1	1
CAN RESP J	1	0	1
CANC LETT	1	0	1
CANCER CAUSE CONTROL	0	1	1
CANCER EPIDEM BIOMAR	4	2	6
CANCER LETT	3	0	3
CANCER RES	13	9	22
CARCINOGENESIS	16	8	24
CASARETT DOULLS TOXI	1	0	1
CELL	2	3	5
CELL COMMUN SIGNAL	0	1	1
CELL MOL LIFE SCI	0	1	1
CHEM COMMUN	0	2	2
CHEM ENG NEWS	1	0	1
CHEM INDUCED ALTERAT	0	1	1
CHEM INT HDB	0	1	1
CHEM PHARM BULL	0	1	1
CHEM RES TOXICOL	41	17	58
CHEM REV	2	1	3

CHEM SILICA	1	0	1
CHEM-BIOL INTERACT	6	2	8
CHEMOSPHERE	13	9	22
CHEST	3	4	7
CHEST S	1	1	2
CIRC RES	0	1	1
CIRCULATION	0	4	4
CLAY MINERALOGY	1	0	1
CLIN APPL BLOOD GASE	1	0	1
CLIN BIOCHEM	0	1	1
CLIN CHEM	1	8	9
CLIN CHEST MED	0	1	1
CLIN CHIM ACTA	1	0	1
CLIN ENDOCRINOL	0	2	2
CLIN EXP ALLERGY	3	1	4
CLIN IMMUNOL	0	1	1
CLIN INFECT DIS S1	0	1	1
CLIN MICROBIOL REV	0	4	4
CLIN PHARMACOKINET	0	1	1
CLIN PHARMACOL THER	2	1	3
CLIN PHYSIOL	1	0	1
CLUSTALX	1	0	1
COMBUST TOXICOL	0	1	1
COMMENTS INORG CHEM	1	0	1
COMMUNICATION	0	1	1
COMP BIOCHEM PHYS A	0	1	1
COMP BIOCHEM PHYS C	2	2	4
COMP BIOL NORMAL LUN	0	1	1
CONCENTRATION DOSE F	0	1	1
CONTEMP TOP LAB ANIM	0	1	1
COPEIA	1	1	2
CR ACAD SCI D NAT	1	0	1
CRIT CARE MED	1	1	2
CRIT REV BIOCHEM MOL	1	0	1
CRIT REV TOXICOL	2	3	5
CRITICAL STABILITY C	1	0	1
CURR DEV PSYCHOPHARM	1	0	1
CURR DRUG METAB	0	1	1
CURR HYPERTENS REP	0	1	1
CURR OPIN PULM MED	0	1	1
DERMATOL CLIN	0	1	1
DESIGN EXPT	0	1	1
DEV BIOL	2	0	2
DEV BRAIN RES	1	0	1
DEV COMP IMMUNOL	1	0	1
DEV MODEL HUMAN RAT	0	1	1
DEV NEUROSCI-BASEL	0	1	1
DHHS PUBLICATION NIH	0	1	1

DIFFERENTIATION	1	0	1
DIOXINS HLTH	1	0	1
DNA CELL BIOL	2	0	2
DRUG CHEM TOXICOL	0	4	4
DRUG DISCOV TODAY	0	1	1
DRUG METAB DISPOS	3	10	13
DRUG METAB REV	0	1	1
DRUGS	0	1	1
ECOTOXICOLOGY	3	1	4
EFFECT DI 2 ETHYLHEX	0	1	1
EFFECTS AIR CONTAMIN	0	1	1
EM 0630	0	2	2
ENC HLTH PERSPECT	0	1	1
ENDOCR RES	0	2	2
ENDOCR REV	3	3	6
ENDOCRINE BIOASSAY D	0	1	1
ENDOCRINE DISRUPTERS	2	0	2
ENDOCRINE DISRUPTION	1	0	1
ENDOCRINOL JAPON	1	1	2
ENDOCRINOLOGY	7	13	20
ENV HLTH PERSPECT	2	7	9
ENV HLTH PERSPECT S9	1	0	1
ENV SCI TECHNOL	1	0	1
ENV TOXICOL	1	0	1
ENVIRON FORENSICS	1	0	1
ENVIRON HEALTH PE S1	10	9	19
ENVIRON HEALTH PERSP	28	76	104
ENVIRON INT	3	5	8
ENVIRON MOL MUTAGEN	3	0	3
ENVIRON RES	8	8	16
ENVIRON SCI POLLUT R	1	1	2
ENVIRON SCI TECHNOL	15	28	43
ENVIRON TOXICOL	2	0	2
ENVIRON TOXICOL CH 1	2	0	2
ENVIRON TOXICOL CHEM	13	8	21
ENVIRON TOXICOL PHAR	4	0	4
ENVIRONMENT 2	1	0	1
EPIDEMIOLOGY	0	5	5
EQUINE VET EDUC	0	2	2
EQUINE VET J	0	18	18
EQUINE VET J S	0	1	1
EUR J BIOCHEM	2	0	2
EUR J CELL BIOL	1	0	1
EUR J CLIN INVEST	1	0	1
EUR J CLIN INVEST S1	1	0	1
EUR J DRUG METAB PH	0	1	1
EUR J ENDOCRINOL	1	0	1
EUR J NEUROSCI	1	0	1

EUR RESP S13	1	0	1
EUR RESPIR J	5	7	12
EXP BIOL ME	0	1	1
EXP BIOL MED	0	2	2
EXP LUNG RES	1	2	3
EXP NEUROL	1	0	1
EXP PHYSIOL	1	0	1
EXP TOXICOL PATHOL	1	0	1
EXPER LUNG RES	0	1	1
EXPERIENTIA	0	1	1
FASEB J	5	1	6
FD COSMET TOXICOL	0	1	1
FEBS LETT	1	4	5
FED PROC	1	1	2
FEMALE REPROD TOXICO	0	1	1
FEMS MICROBIOL LETT	0	1	1
FERTIL STERIL	0	1	1
FOLIA GEOBOT	0	1	1
FOOD ADDIT CONTAM	1	0	1
FOOD CHEM TOXICOL	5	3	8
FREE RADICAL BIO MED	6	3	9
FREE RADICAL RES	0	1	1
FRESEN J ANAL CHEM	1	1	2
FUND APPL TOXICOL	12	14	26
FUNDAM APPL TOXICOL	0	3	3
GASTROENTEROLOGY	1	0	1
GEN COMP ENDOCR	1	0	1
GEN MOT COMMENTS 4 E	0	1	1
GENE	1	0	1
GENES CELLS	1	0	1
GENESIS	1	0	1
GENOME BIOL	0	1	1
GENOMICS	1	1	2
GUT	0	2	2
HAUTARZT	0	1	1
HDB PHYSL RESP SYS 1	1	0	1
HDB TOXICOLOGIC PATH	1	1	2
HEALTH AFFAIR	0	1	1
HEPATOLOGY	3	1	4
HIERARCHICAL BIVARIA	0	1	1
HLTH PERSPECT	0	1	1
HUM EXP TOXICOL	0	3	3
HUM GENE THER	0	1	1
HUM MUTAT	1	0	1
HUM PATHOL	1	0	1
HUM REPROD UPDATE	2	2	4
HYPERTENSION	0	2	2
IARC SCI PUBL	5	0	5

ILAR J	2	0	2
IND MED SURG	1	0	1
INDOOR AIR	0	1	1
INFECT IMMUN	1	0	1
INFLAMMATORY AIRWAY	0	1	1
INHAL TOXICOL	14	15	29
INHAL TOXICOL S1	1	1	2
INHALED PARTICLES	0	1	1
INT ARCH ALLERGY IMM	1	0	1
INT ARCH OCC ENV H S	0	1	1
INT ARCH OCC ENV HEA	1	2	3
INT J ANDROL	0	1	1
INT J CANCER	2	0	2
INT J EPIDEMIOL	0	1	1
INT J HEMATOL	1	0	1
INT J HYG ENVIR HEAL	1	1	2
INT J OCCUP MED ENV	0	1	1
INT J ONCOL	1	0	1
INT J RADIAT BIOL	0	1	1
INT J TOXICOL	2	3	5
IRON	1	0	1
ISSUES RISK ASSESSME	0	1	1
J AGR FOOD CHEM	2	1	3
J AIR WASTE MANAGE	1	12	13
J ALLERGY	0	1	1
J ALLERGY CLIN IMMUN	4	0	4
J AM ACAD DERMATOL	0	1	1
J AM CHEM SOC	2	0	2
J AM COLL NUTR	1	0	1
J AM COLL TOXICOL	3	1	4
J AM STAT ASSOC	0	1	1
J AM VET MED ASSOC	0	1	1
J AM WATER WORKS ASS	0	1	1
J ANAL ATOM SPECTROM	4	4	8
J ANAL TOXICOL	1	1	2
J ANDROL	0	1	1
J APPL PHYSIOL	11	9	20
J APPL PHYSL RESPIR	1	1	2
J APPL TOXICOL	2	5	7
J ASTHMA	2	0	2
J ATHEROSCLER THROMB	0	1	1
J BACTERIOL	1	0	1
J BIOCHEM TOXICOL	1	1	2
J BIOCHEM-TOKYO	0	1	1
J BIOL CHEM	46	21	67
J BRONCHOL	0	1	1
J CANCER EDUC	0	1	1
J CARDIOVASC PHAR S5	2	0	2

J CELL PHYSIOL	1	0	1
J CHROMATOGR	0	1	1
J CHROMATOGR B	3	4	7
J CLIN ENDOCR METAB	0	1	1
J CLIN INVEST	7	4	11
J ENDOCRINOL	1	0	1
J ENHANC HEAT TRANSF	2	0	2
J ENVIRON ECON MANAG	0	1	1
J ENVIRON MONITOR	0	2	2
J ENVIRON PATHOL TOX	2	0	2
J ENVIRON SCI HEAL B	0	1	1
J EXP BOT	0	1	1
J EXPO ANAL ENV EP 1	0	1	1
J EXPO ANAL ENV EPID	2	3	5
J FREE RAD BIOL MED	1	0	1
J HISTOCHEM CYTOCHEM	1	0	1
J IMMUNOL	5	5	10
J INORG BIOCHEM	5	3	8
J INORG NUCL CHEM	1	0	1
J LAB CLIN MED	1	0	1
J LEUKOCYTE BIOL	1	0	1
J LIQ CHROMATOGR	0	1	1
J MOL BIOL	1	0	1
J NATL CANCER I	1	1	2
J NEUROCHEM	2	0	2
J NEURO-ONCOL	1	0	1
J NEUROSCI	4	1	5
J NUTR	5	2	7
J NUTR S1	2	0	2
J OCCUP ENVIRON MED	0	4	4
J OCCUP MED	0	1	1
J PATHOL	1	0	1
J PATHOL BACTERIOL	0	1	1
J PHARM PHARMACOL	0	2	2
J PHARMACOKINET PHAR	0	1	1
J PHARMACOL EXP THER	6	3	9
J PHYS CHEM-US	1	0	1
J RADIOANAL NUCL CH	0	1	1
J ROY STAT SOC B MET	1	0	1
J STEROID BIOCHEM	8	0	8
J TOXICOL ENV HEAL A	8	8	16
J TOXICOL ENV HEALTH	10	4	14
J TOXICOL ENV HLTH	0	1	1
J TOXICOL SCI	4	2	6
J TRACE ELEM ELECT H	0	1	1
J VET INTERN MED	0	2	2
J VIRAL HEPATITIS	0	1	1
JAMA-J AM MED ASSOC	0	5	5

JAPCA-INT J AIR POLL	0	2	2
JPN J CANCER RES	2	0	2
KEY REV SCI ISSUES 2	0	1	1
LAB ANIM	1	0	1
LAB ANIM SCI	1	3	4
LAB ANIM-UK	1	0	1
LAB INVEST	3	1	4
LAB PROCEDURES USED	1	0	1
LANCET	2	5	7
LEUKEMIA LYMPHOMA	1	0	1
LIFE SCI	1	0	1
LIV ENV 4 INT S U WA	0	1	1
LUNG	0	1	1
MAMM GENOME	2	1	3
MED HYPOTHESES	2	0	2
MERCK MANUAL GERIATR	0	1	1
MESTER	1	0	1
MET IONS BIOL SYST	1	0	1
METABOLIC PATHWAYS A	0	1	1
METABOLISM	2	1	3
METAL MICROSTRUCTURE	1	0	1
METAMORPHOSIS POSTEM	1	0	1
METHOD CELL BIOL	1	0	1
METHOD ENZYMOL	1	1	2
METHOD HORMONE RES	0	1	1
METHOD VIROL	0	1	1
METHODS	0	2	2
METHODS HORMONE RE A	0	1	1
MICROBIOL MOL BIOL R	1	0	1
MICROSC RES TECHNIQ	1	0	1
MIKROSKOPIE	1	0	1
MODERN PATHOL	0	1	1
MOL BIOL CELL	0	1	1
MOL CARCINOGEN	1	0	1
MOL CELL	1	1	2
MOL CELL BIOCHEM	2	0	2
MOL CELL BIOL	2	3	5
MOL CELL ENDOCRINOL	1	0	1
MOL CLONING LAB MANU	1	0	1
MOL ENDOCRINOL	4	4	8
MOL NEUROTOXICOLOGY	1	0	1
MOL PHARMACOL	5	4	9
MONALDI ARCH CHEST D	1	0	1
MORTALITY RESIDENTS	0	1	1
MRBAYES BAYESIAN ANA	1	0	1
MULTIPLE COMP THEORY	0	1	1
MUTAGENESIS	2	0	2
MUTAT RES	3	1	4

MUTAT RES-DNA REPAIR	1	0	1
MUTAT RES-ENVIR MUTA	1	0	1
MUTAT RES-GEN TOX EN	1	0	1
MUTAT RES-REV MUTAT	1	0	1
NAT GENET	5	2	7
NAT GENET S	0	1	1
NAT REV DRUG DISCOV	1	0	1
NATURE	8	3	11
NEURO TOXICOL	0	1	1
NEUROCHEM INT	0	1	1
NEUROENDOCRINOLOGY	0	1	1
NEUROREPORT	1	0	1
NEUROSCI LETT	1	0	1
NEUROSCIENCE	1	0	1
NEUROTOX RES	1	0	1
NEUROTOXICOL TERATOL	1	0	1
NEUROTOXICOLOGY	5	4	9
NEUTRON ACTIVATION A	0	1	1
NEW ENGL J MED	4	6	10
NIPPON YAKAKURIGAKU	0	1	1
NORMAL TABLE XENOPUS	1	0	1
NOVART FDN SYMP	0	1	1
NUCLEIC ACIDS RES	3	1	4
NUTR REP INT	1	0	1
NUTR TOXICOLOGY	0	1	1
OCCUP ENVIRON MED	3	3	6
ONCOGENE	3	0	3
OPHTHALMIC PLAST REC	1	0	1
ORGANOHALOG COMPD	0	3	3
ORGANOHALOGEN COMPOU	4	7	11
P 3 INT C HARM YOK 1	0	1	1
P 3 INT WORKSH BROM	0	1	1
P AM THORAC SOC	0	4	4
P NATL ACAD SCI USA	22	7	29
P NATL ACAD SCI-BIOL	1	0	1
P ROY SOC MED	1	0	1
P SOC EXP BIOL MED	2	2	4
P WORKSH INFL AIRW D	0	1	1
PART FIBRE TOXICOL	0	2	2
PARTICLE FIBRE TOXIC	0	1	1
PATHOBIOLOGY AGING R	0	1	1
PATHOL RES PRACT	1	0	1
PATHOLOGY	1	0	1
PATHOLOGY FISCHER RA	3	0	3
PATHOLOGY MOUSE	1	0	1
PATHOLOGY TUMORS LAB	1	0	1
PATTYS TOXICOLOGY	0	1	1
PAUP PHYLOGENETIC AN	1	0	1

PEDIATR PHARMACOL	0	1	1
PEDIATRICS	1	0	1
PESTICIDE BOOK	0	1	1
PESTICIDE RESIDUES F	1	0	1
PFLUG ARCH EUR J PHY	1	0	1
PFLUGERS ARCH	1	0	1
PHARM TOXICOL S1	1	0	1
PHARMACOGENETICS	1	2	3
PHARMACOL BASIS THER	1	0	1
PHARMACOL RES COMMUN	1	0	1
PHARMACOL REV	1	1	2
PHARMACOL TOXICOL	1	1	2
PHARMACOLOGY	1	0	1
PHILOS T ROY SOC B	1	0	1
PHYSIOL BEHAV	1	1	2
PHYSIOL RES	0	1	1
PHYSIOL RES S1	0	1	1
PHYSIOL REV	1	1	2
PHYSL AMPHIBIA	1	0	1
PLANT PHYSIOL	0	3	3
PNEUMONOL ALERGO S1	0	1	1
POLYBROMINATED DIPHE	1	0	1
POLYCYCL AROMAT COMP	0	1	1
PRINCIPLES PROCESSES	0	1	1
PROG CLIN BIOL RES	3	0	3
PROSTAGLANDINS	0	1	1
PROSTATE	5	0	5
PROTEINS	1	0	1
PSYCHOPHYSIOLOGY	1	0	1
PUBLIC HEALTH NUTR	1	0	1
PULM PHARMACOL THER	0	1	1
REANALYSIS HARVARD 6	0	1	1
RECENT PROGR HORMONE	0	2	2
RECEPT RES	1	0	1
REFERENCE GUIDE SIMU	0	1	1
REGUL TOXICOL PHARM	1	9	10
REPROD TOXICOL	2	14	16
REPRODUCTION	1	1	2
RES COMMUN CHEM PATH	1	0	1
RES REP HLTH EFF I	1	0	1
RESP MED	1	2	3
RESP PHYSIOL	1	2	3
RESPIRATION	0	1	1
RESPIROLOGY	0	1	1
REVISED ANAL TIME SE	0	6	6
RISK ANAL	1	1	2
S AFR MED J	0	1	1

SCAND J HAEMATOL	1	0	1
SCAND J WORK ENV HEA	1	0	1
SCAND J WORK ENV S1	1	0	1
SCI TOTAL ENVIRON	1	5	6
SCIENCE	4	5	9
SEM RESP CRIT CARE M	0	1	1
SEMIN NEPHROL	0	1	1
SEMIN PERINATOL	1	0	1
SIMILIARITIES DIFFER	1	0	1
SIMPLE INHIBITION SY	1	0	1
SOIL SCI SOC AM J	1	0	1
SOURCES OCCURRENCE C	0	1	1
STEROIDS	3	0	3
SUDAAN USERS MANUAL	1	0	1
SUSSWASSERFAUNA MITT	0	1	1
SYST BIOL	1	0	1
TALANTA	0	1	1
TERATOGEN CARCIN MUT	0	1	1
TERATOLOGY	1	2	3
TEX REP BIOL MED	1	0	1
THER DRUG MONIT	0	1	1
THORAX	1	5	6
THYROID	2	1	3
TOXICOL APPL PHARM	72	67	139
TOXICOL ENVIRON CHEM	1	0	1
TOXICOL IN VITRO	4	4	8
TOXICOL IND HEALTH	8	6	14
TOXICOL LETT	12	15	27
TOXICOL PATHOL	16	3	19
TOXICOL PATHOL S1	0	6	6
TOXICOL SCI	56	89	145
TOXICOL SCI S	3	1	4
TOXICOLOGICAL EVALUA	1	0	1
TOXICOLOGIST	1	8	9
TOXICOLOGY	15	17	32
TOXICOLOGY METALS	0	1	1
TREATISE PULMONARY T	0	1	1
TRENDS BIOCHEM SCI	2	2	4
TRENDS GENET	1	0	1
TRENDS NEUROSCI	1	0	1
ULTRASTRUCT PATHOL	0	1	1
UNPUB TOXICOL APPL P	1	0	1
UROLOGY	0	1	1
VENOMOUS EARTH	0	1	1
VET IMMUNOL IMMUNOP	0	2	2
VET J	0	1	1
VET REC	0	1	1
VITAM HORM	0	1	1

WADSWORTH ANAEROBIC	0	1	1
WATER RES	0	2	2
XENOBIOTICA	5	16	21

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