

Bibliometric Analysis for Papers on Topics Related to Water Quality Research (Papers Published 2000 to 2005)

This is a bibliometric analysis of the papers prepared by intramural and extramural researchers of the U.S. Environmental Protection Agency (EPA) on topics related to water quality research that were published from 2000 to 2005. For this analysis, 506 papers were reviewed. These 506 papers were cited 2,547 times in the journals covered by Thomson's Web of Science.¹ Of these 506 papers, 379 (75%) have been cited at least once in a journal.

The analysis was completed using Thomson's Essential Science Indicators (ESI) and Journal Citation Reports (JCR) as benchmarks. ESI provides access to a unique and comprehensive compilation of essential science performance statistics and science trends data derived from Thomson's databases. The chief indicators of output, or productivity, are journal article publication counts. For influence and impact measures, ESI employs both total citation counts and cites per paper scores. The former reveals gross influence while the latter shows weighted influence, also called impact. JCR presents quantifiable statistical data that provide a systematic, objective way to evaluate the world's leading journals and their impact and influence in the global research community.

Summary of Analysis

Nearly one-twelfth of the water quality publications are highly cited papers. A review of the citations indicates that 41 (8.1%) of the water quality papers qualify as highly cited when using the ESI criteria for the top 10% of highly cited publications. One (0.2%) of the water quality papers qualify as highly cited when using the criteria for the top 1%. None of the papers meet the 0.1% and 0.01% thresholds for very highly cited papers.

The water quality papers are more highly cited than the average paper. Using the ESI average citation rates for papers published by field as the benchmark, in 10 of the 12 fields in which the EPA water quality papers were published, the ratio of actual to expected cites is greater than 1, indicating that the water quality papers are more highly cited than the average papers in those fields.

More than one-eighth of the water quality papers are published in very high impact journals. Sixty-seven (67) of 506 papers were published in the top 10% of journals ranked by JCR Impact Factor, representing 13.2% of EPA's water quality papers. Approximately one-eighth of the water quality papers are published in the top 10% of journals ranked by JCR Immediacy Factor. Sixty-two (62) of the 506 papers appear in the top 10% of journals, representing 12.2% of EPA's water quality papers.

¹ Thomson's *Web of Science* provides access to current and retrospective multidisciplinary information from approximately 8,500 of the most prestigious, high impact research journals in the world. *Web of Science* also provides cited reference searching.

Two of the water quality publications qualified as hot papers. ESI establishes citation thresholds for hot papers, which are selected from the highly cited papers in different fields, but the time frame for citing and cited papers is much shorter—papers must be cited within 2 years of publication and the citations must occur in a 2-month time period. Using the current hot paper thresholds established by ESI as a benchmark, two of the water quality papers, representing 0.4% of the water quality publications, were identified as hot papers in the analysis.

The authors of the water quality papers cite themselves less than the average self-citation rate. One hundred ninety-eight (198) of the 2,547 cites are author self-cites. This 7.8% author self-citation rate is below the accepted range of 10-30% author self-citation rate.

Highly Cited Water Quality Publications

The 506 water quality papers reviewed for this analysis covered 12 of the 22 ESI fields of research. The distribution of the papers among these 12 fields and the number of citations by field are presented in Table 1.

Table 1. Water Quality Papers by ESI Fields

No. of Citations	ESI Field	No. of EPA Water Quality Papers	Average Cites/Paper
1,580	Environment/Ecology	343	4.61
202	Pharmacology & Toxicology	26	7.77
151	Chemistry	28	5.39
127	Microbiology	15	8.47
108	Engineering	30	3.60
99	Multidisciplinary	4	24.75
98	Plant & Animal Science	24	4.08
86	Biology & Biochemistry	25	3.44
47	Geosciences	5	9.40
36	Agricultural Sciences	3	12.00
8	Clinical Medicine	2	4.00
5	Physics	1	5.00
Total = 2,547		Total = 506	5.03

There were 41 (8.1% of the papers analyzed) highly cited EPA water quality papers in 9 of the 12 fields—Microbiology, Multidisciplinary, Engineering, Pharmacology & Toxicology, Environment/Ecology, Chemistry, Plant & Animal Science, Geosciences, and Agricultural Sciences—when using the ESI criteria for the **top 10% of papers**. Table 2 shows the number of EPA papers in those nine fields that met the **top 10% threshold in ESI**.

One (0.2%) of the papers analyzed qualified as highly cited when using the ESI criteria for the **top 1% of papers** (see Table 3). This paper was categorized in the field of Environment/Ecology. The citation for this paper is presented in Table 4. There were no papers that met the 0.1% and 0.01% thresholds for very highly cited papers.

Table 2. Number of Highly Cited Water Quality Papers by Field (top 10%)

No. of Citations	ESI Field	No. of Papers	Average Cites/Paper	% of EPA Papers in Field
95	Microbiology	2	47.50	13.33%
85	Multidisciplinary	3	28.33	75.00%
79	Engineering	9	8.78	30.00%
71	Pharmacology & Toxicology	2	35.50	7.69%
67	Environment/Ecology	14	4.78	4.08%
51	Chemistry	5	10.20	17.86%
31	Plant & Animal Science	4	7.75	16.67%
30	Geosciences	1	30.00	20.00%
10	Agricultural Sciences	1	10.00	33.33%
Total = 519		Total = 41	12.66	

Table 3. Number of Highly Cited Water Quality Papers by Field (top 1%)

No. of Citations	ESI Field	No. of Papers	Average Cites/Paper	% of EPA Papers in Field
3	Environment/Ecology	1	3.00	0.29%
Total = 3		Total = 1	3.00	

Table 4. Highly Cited Water Quality Paper in the Field of Environment/Ecology (top 1%)

No. of Cites	First Author	Paper
3	Lackey RT	Economic growth and salmon recovery: an irreconcilable conflict? <i>Fisheries</i> 2005;30(3):30-32.

Ratio of Actual Cites to Expected Citation Rates

The expected citation rate is the average number of cites that a paper published in the same journal in the same year and of the same document type (article, review, editorial, etc.) has received from the year of publication to the present. Using the ESI average citation rates for papers published by field as the benchmark, in 10 of the 12 fields in which the EPA water quality papers were published, the ratio of actual to expected cites is greater than 1, indicating that the EPA papers are more highly cited than the average papers in those fields (see Table 5).

Table 5. Ratio of Average Cites to Expected Cites for Water Quality Papers by Field

ESI Field	Total Cites	Expected Cite Rate	Ratio
Environment/Ecology	1,580	1,521.89	1.04
Pharmacology & Toxicology	202	170.6	1.18
Chemistry	151	127.81	1.18
Microbiology	127	117.73	1.08
Engineering	108	38.47	2.81
Multidisciplinary	99	16.67	5.94
Plant & Animal Science	98	74.84	1.31
Biology & Biochemistry	86	232.19	0.37
Geosciences	47	26.78	1.76
Agricultural Sciences	36	12.51	2.88
Clinical Medicine	8	8.86	0.90
Physics	5	3.32	1.51

JCR Benchmarks

The Impact Factor is a well known metric in citation analysis. It is a measure of the frequency with which the *average article* in a journal has been cited in a particular year. The Impact Factor helps evaluate a journal's relative importance, especially when compared to others in the same

field. The Impact Factor is calculated by dividing the number of citations in the current year to articles published in the 2 previous years by the total number of articles published in the 2 previous years.

Table 6 indicates the number of water quality papers published in the top 10% of journals, based on the JCR Impact Factor. Sixty-seven (67) of 506 papers were published in the top 10% of journals, representing 13.2% of EPA's water quality papers. This exceeds the expected number of 51 papers (10%) published in the top 10% of high impact journals.

Table 6. Water Quality Papers in Top 10% of Journals by JCR Impact Factor

EPA Water Quality Papers in that Journal	Journal	Impact Factor (IF)	JCR IF Rank
9	Environmental Science & Technology	3.557	540
7	Environmental Health Perspectives	3.929	439
5	Journal of Chromatography A	3.359	602
4	Analytical Chemistry	5.450	243
4	Ecology	4.104	394
4	Applied and Environmental Microbiology	3.810	470
4	Toxicological Sciences	3.391	591
4	Ecological Applications	3.287	623
4	Limnology and Oceanography	3.024	737
3	TRAC-Trends in Analytical Chemistry	3.888	452
2	Nature	32.182	9
2	Proceedings of the National Academy of Sciences of the United States of America	10.452	88
2	Electrophoresis	3.743	482
2	Ecosystems	3.283	624
2	Remote Sensing of Environment	3.185	666
2	Bioscience	3.041	730
1	Lancet	21.713	20
1	Progress in Nuclear Magnetic Resonance Spectroscopy	6.885	175
1	Molecular Ecology	4.375	351
1	Drug Metabolism and Disposition	3.836	461

EPA Water Quality Papers in that Journal	Journal	Impact Factor (IF)	JCR IF Rank
1	Journal of the American Society for Mass Spectrometry	3.760	479
1	Proceedings of the Royal Society of London Series B-Biological Sciences	3.653	509
1	Frontiers in Ecology and the Environment	3.362	600
Total = 67			

Immediacy Index

The journal Immediacy Index is a measure of how quickly the *average article* in a journal is cited. It indicates how often articles published in a journal are cited within the year they are published. The Immediacy Index is calculated by dividing the number of citations to articles published in a given year by the number of articles published in that year.

Table 7 indicates the number of EPA water quality papers published in the top 10% of journals, based on the JCR Immediacy Index. Sixty-two (62) of the 506 papers appear in the top 10% of journals, representing 12.2% of EPA's water quality papers. This exceeds the expected number of 51 papers (10%) published in the top 10% of high impact journals.

Table 7. Water Quality Papers in Top 10% of Journals by JCR Immediacy Index

EPA Water Quality Papers in that Journal	Journal	Immediacy Index (II)	JCR II Rank
9	Environmental Science & Technology	0.623	617
7	Environmental Health Perspectives	1.202	202
5	Freshwater Biology	0.664	558
4	Analytical Chemistry	0.885	346
4	Ecological Applications	0.747	466
4	Ecology	0.590	676
3	Ecotoxicology	1.450	151
3	Hydrobiologia	0.681	532
3	Journal of Geophysical Research	0.617	630
3	TRAC-Trends in Analytical Chemistry	0.583	681
2	Nature	6.089	5

EPA Water Quality Papers in that Journal	Journal	Immediacy Index (II)	JCR II Rank
2	Ecosystems	2.048	76
2	Proceedings of the National Academy of Sciences of the United States of America	1.923	89
2	Bioscience	0.863	356
2	Electrophoresis	0.575	697
1	Lancet	5.017	12
1	Journal of Paleolimnology	1.581	132
1	Journal of Oceanography	0.692	519
1	Molecular Ecology	0.674	545
1	Progress in Nuclear Magnetic Resonance Spectroscopy	0.667	551
1	Drug Metabolism and Disposition	0.590	676
1	Journal of the American Society for Mass Spectrometry	0.575	697
Total = 62			

Hot Papers

ESI establishes citation thresholds for hot papers, which are selected from the highly cited papers in different fields, but the time frame for citing and cited papers is much shorter—papers must be cited within 2 years of publication and the citations must occur in a 2-month time period. Papers are assigned to 2-month periods and thresholds are set for each period and field to select 0.1% of papers. There were no hot papers identified for the most recently completed 2-month period (i.e., September-October 2005), but there were two hot papers identified from previous periods.

Using the current hot paper thresholds established by ESI as a benchmark, two of the water quality papers, representing 0.4% of the water quality publications, were identified in the fields of Environment/Ecology and Multidisciplinary. The hot papers are listed in Table 8.

Table 8. Hot Papers Identified Using Current ESI Thresholds

Field	ESI Hot Papers Threshold	No. of Cites in 2-Month Period	Paper
Environment/ Ecology	7	9 cites in March- April 2003	Angradi TR, et al. Vegetation type and the intertidal macroinvertebrate fauna of a brackish marsh: <i>Phragmites</i> vs. <i>Spartina</i> . <i>Wetlands</i> 2001;21(1):75-92.
Multidisciplinary	6	7 cites in October- November 2001	Steidinger KA, Rublee PA. Heteroduplex mobility assay-guided sequence discovery: elucidation of the small subunit (18S) rDNA sequences of <i>Pfiesteria piscicida</i> and related dinoflagellates from complex algal culture and environmental sample DNA pools. <i>Proceedings of the National Academy of Sciences of the United States of America</i> 2000; 97(8):4303-4308.

Author Self-Citation

Self-citations are journal article references to articles from that same author (i.e., the first author). Because higher author self-citation rates can inflate the number of citations, the author self-citation rate was calculated for the water quality papers. Of the 2,547 total cites, 198 are author self-cites—a 7.8% author self-citation rate. Garfield and Sher² found that authors working in research-based disciplines tend to cite themselves on the average of 20% of the time. MacRoberts and MacRoberts³ claim that approximately 10% to 30% of all the citations listed fall into the category of author self-citation. Therefore, the 7.8% self-cite rate for the water quality papers is below the expected range for author self-citation.

² Garfield E, Sher IH. New factors in the evaluation of scientific literature through citation indexing. *American Documentation* 1963;18(July):195-201.

³ MacRoberts MH, MacRoberts BR. Problems of citation analysis: a critical review. *Journal of the American Society of Information Science* 1989;40(5):342-349.