# 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? *Fisheries* 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: *Phragmites* vs. *Spartina*. *Wetlands* 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 *Pfiesteria piscicida* and related dinoflagellates from complex algal culture and environmental sample DNA pools. *Proceedings of the National Academy of Sciences of the United States of America* 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 Sher[2] found that authors working in research-based disciplines tend to cite themselves on the average of 20% of the time. MacRoberts and MacRoberts[3] 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.