Bibliometric Analysis

for the U.S. Environmental Protection Agency/Office of Research and Development's Endocrine Disrupting Chemicals (EDCs) Research Program

This is a bibliometric analysis of the papers prepared by intramural and extramural researchers of the U.S. Environmental Protection Agency's (EPA) Endocrine Disrupting Chemicals (EDCs) Research Program. For this analysis, 698 (652 journal articles and 46 non-journal publications) were reviewed, and they were published from 1998 to 2008. The journal articles were cited 12,895 times and the non-journal publications were cited 180 times in the journals covered by Thomson's *Web of Science*[1] and Scopus[2]. Of the 652 journal articles, 598 (91.7%) have been cited at least once in a journal. Of the 46 non-journal publications, 20 (43.5%) have been cited at least once in a journal.

Searches of Thomson Scientific's *Web of Science* and Elsevier's Scopus were conducted to obtain times cited data for the EDCs journal publications. 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. For this analysis, the *ESI* highly cited papers thresholds as well as the hot papers thresholds were used to assess the influence and impact of the EDCs papers. *JCR* is a recognized authority for evaluating journals. It 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. The two key measures used in this analysis to assess the journals in which the EPA EDCs papers are published are the Impact Factor and Immediacy Index. The Impact Factor 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 other journals in the same field. The Immediacy Index is a measure of how quickly the "average article" in a journal is cited. This index indicates how often articles published in a journal are cited within the same year and it is useful in comparing how quickly journals are cited.

The report includes a summary of the results of the bibliometric analysis, an analysis of the 652 EDCs journal papers analyzed by *ESI* field (e.g., Environment/Ecology, Pharmacology & Toxicology, Plant & Animal Science), an analysis of the journals in which the EDCs papers were published, a table of the highly cited researchers in the EDCs Research Program, an analysis of the non-journal publications, and any patents that have resulted from the program.

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[1] Thomson Scientific's *Web of Science* provides access to current and retrospective multidisciplinary information from approximately 8,830 of the most prestigious, high impact research journals in the world. *Web of Science* also provides cited reference searching.

[2] Scopus is a large abstract and citation database of research literature and quality Web sources designed to support the literature research process. Scopus offers access to 15,000 titles from 4,000 different publishers, more than 12,850 academic journals (including coverage of 535 Open Access journals, 750 conference proceedings, and 600 trade publications), 27 million abstracts, 245 million references, 200 million scientific Web pages, and 13 million patent records.

SUMMARY OF RESULTS

1. **More than one-quarter of the EDCs publications are highly cited papers.** 181 (27.8%) of the EDCs papers qualify as highly cited when using the *ESI* criteria for the top 10% of highly cited publications. This is 2.8 times the 10% of papers expected to be highly cited. 27 (4.1%) of the EDCs papers qualify as highly cited when using the *ESI* criteria for the top 1%, which is 4.1 times the number expected. 3 (0.5%) of these papers qualify as very highly cited when using the criteria for the top 0.1%, which is 5 times the number anticipated. 2 (0.3%) papers actually meet the 0.01% threshold for the most highly cited papers, which is 30 times the expected number for this program.

2. **The EDCs papers are more highly cited than the average paper.** Using the *ESI* average citation rates for papers published by field as the benchmark, in 12 of the 16 fields in which the 562 EDCs journal papers were published, the ratio of actual to expected cites is greater than 1, indicating that the EDCs papers are more highly cited than the average papers in those fields. For all 16 fields combined, the ratio of total number of cites to the total number of expected cites (12,895 to 6,667) is 1.9, indicating that the EDCs papers are more highly cited than the average paper.

3. **Nearly one-half of the EDCs papers are published in high impact journals ranked by Impact Factor.** 272 of the 652 papers were published in the top 10% of journals ranked by *JCR* Impact Factor, representing 41.7% of the EDCs journal papers. This number is 4.2 times higher than the expected 65 papers. 184 of the 652 papers appear in the top 10% of journals ranked by *JCR* Immediacy Index, representing 28.2% of the EDCs journal papers. This number is 2.8 times higher than the expected 65 papers.

4. **Six of the EDCs journal papers qualify as hot papers.** Using the hot paper thresholds established by *ESI* as a benchmark, 6 hot papers, representing 0.9% of the EDCs papers, were identified in the analysis. Hot papers are papers that were highly cited shortly after they were published. The number of EDCs hot papers identified is 9 times higher than the expected 0.6 hot papers.

5. **The authors of the EDCs papers cite themselves much less than the average author.** 544 of the 12,895 cites are author self-cites. This 4.2% author self-citation rate is well below the accepted range of 10-30% author self-citation rate.

6. **Twenty-one of the authors of the EDCs papers are included in *ISIHighlyCited.com***, which is a database of the world's most influential researchers who have made key contributions to science and technology during the period from 1981 to 1999.

7. **No patents were issued and no patent applications were filed** by investigators from 1997 to 2007 for research that was conducted under EPA's EDCs research program.

8. **The 46 nonjournal publications were cited 180 times in journals.** 20 (43.5%) were cited at least once in a journal and the authors cited themselves 9 times (5.0% self-citation rate), which is much less than the literature-reported 10-30% range for author self-citation. 2(4.4%) of the nonjournal publications were highly cited when using the *ESI* criteria for the top 10% of highly cited publications.

Highly Cited EDCs Publications

All of the journals covered by *ESI* are assigned a field, and to compensate for varying citation rates across scientific fields, different thresholds are applied to each field. Thresholds are set to select highly cited papers to be listed in *ESI*. Different thresholds are set for both field and year of publication. Setting different thresholds for each year allows comparable representation for older and younger papers for each field.

The 652 EDCs research papers reviewed for this analysis were published in journals that were assigned to 16 of the 22 *ESI* fields. The distribution of the papers among these 16 fields and the number of citations by field are presented in Table 1.

Table 1. EDCs Papers by *ESI* Fields

***ESI* Field**	**No. of Citations**	**No. of EPA Papers**	**Average Cites/Paper**
Agricultural Sciences	26	3	8.7
Biology & Biochemistry	1,390	79	17.6
Chemistry	398	36	11.0
Clinical Medicine	1,626	74	22.0
Computer Science	3	2	1.5
Engineering	29	5	5.8
Environment/Ecology	3,362	195	17.2
Geosciences	7	1	7.0
Mathematics	0	1	0
Microbiology	1	1	1.0
Molecular Biology & Genetics	64	7	9.1
Multidisciplinary	1,100	10	110.0
Neuroscience & Behavior	274	26	10.5
Pharmacology & Toxicology	3,582	138	26.0
Plant & Animal Science	1,007	72	14.0
Social Sciences, general	26	2	13.0
	Total = 12,895	**Total = 652**	**19.8**

There are 181 (27.8% of the papers analyzed) highly cited EPA EDCs papers in 12 of the 16 fields—Agricultural Sciences, Biology & Biochemistry, Chemistry, Clinical Medicine, Computer Science, Engineering, Environment/Ecology, Multidisciplinary, Neuroscience & Behavior, Pharmacology & Toxicology, Plant & Animal Science, and Social Sciences—when using the *ESI* criteria for the **top 10% of papers**. Table 2 shows the number of EPA papers in those 12 fields that meet the **top 10%**

threshold in *ESI*. Twenty-seven (4.1%) of the papers analyzed qualify as highly cited when using the *ESI* criteria for the **top 1% of papers**. These papers cover 6 fields—Biology & Biochemistry, Clinical Medicine, Engineering, Environment/Ecology, Multidisciplinary, and Pharmacology & Toxicology. Table 3 shows the 27 papers by field that meet the **top 1% threshold in *ESI***. The citations for these 27 papers are provided in Tables 4 through 9. There were 3 (0.5%) very highly cited EDCs papers in the fields of Environment/Ecology and Multidisciplinary (see Table 10). These papers, which met the **top 0.1% threshold in *ESI*,** are listed in Table 11. Two (0.3%) of the EDCs papers met the **top 0.01% threshold in *ESI*** (see Table 12), which is 30 times the expected number of papers that should meet this threshold for this size program. These papers are listed in Table 13.

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

***ESI* Field**	**No. of Citations**	**No. of Papers**	**Average Cites/Paper**	**% of Papers in Field**
Agricultural Sciences	21	1	21.0	33.3%
Biology & Biochemistry	506	16	31.6	20.2%
Chemistry	183	5	36.6	13.9%
Clinical Medicine	940	21	44.8	28.4%
Computer Science	3	1	3.0	50.0%
Engineering	24	2	12.0	40.0%
Environment/Ecology	2,077	56	37.1	28.7%
Multidisciplinary	1,080	7	154.3	70.0%
Neuroscience & Behavior	11	1	11.0	3.8%
Pharmacology & Toxicology	2,539	44	57.7	31.9%
Plant & Animal Science	779	26	30.0	36.1%
Social Sciences, general	17	1	17.0	50.0%
	Total = 8,180	**Total = 181**	**45.2**	**27.8%**

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

***ESI* Field**	**No. of Citations**	**No. of Papers**	**Average Cites/Paper**	**% of EPA Papers in Field**
Biology & Biochemistry	47	1	47.0	1.3%
Clinical Medicine	213	4	53.2	5.4%
Engineering	22	1	22.0	20.0%
Environment/Ecology	632	9	70.2	4.6%
Multidisciplinary	1,027	6	171.2	60.0%

***ESI* Field**	**No. of Citations**	**No. of Papers**	**Average Cites/Paper**	**% of EPA Papers in Field**
Pharmacology & Toxicology	841	6	140.2	4.4%
	Total = 2,782	**Total = 27**	**103.0**	**4.1%**

Table 4. Highly Cited EDCs Papers in the Field of Biology & Biochemistry (top 1%)

No. of Cites	**First Author**	**Paper**
47	Anway MD	Epigenetic transgenerational actions of endocrine disruptors. *Endocrinology* 2006;147(6):S43-S49.

Table 5. Highly Cited EDCs Papers in the Field of Clinical Medicine (top 1%)

No. of Cites	**First Author**	**Paper**
151	Gray LE	Effects of environmental antiandrogens on reproductive development in experimental animals. *Human Reproduction Update* 2001;7(3):248-264.
48	Gray LE	Adverse effects of environmental antiandrogens and androgens on reproductive development in mammals. *International Journal of Andrology* 2006;29(1):96-104.
6	Euling SY	Examination of US puberty-timing data from 1940 to 1994 for secular trends: Panel findings. *Pediatrics* 2008;121:S172-S191.
8	Rider CV	A mixture of seven antiandrogens induces reproductive malformations in rats. *International Journal of Andrology* 2008;31(2):249-262.

Table 6. Highly Cited EDCs Papers in the Field of Engineering (top 1%)

No. of Cites	**First Author**	**Paper**
22	De Jesus MA	Nanofabrication of densely packed metal-polymer arrays for surface-enhanced Raman spectrometry. *Applied Spectroscopy* 2005;59(12):1501-1508.

Table 7. Highly Cited EDCs Papers in the Field of Environment/Ecology (top 1%)

No. of Cites	First Author	Paper
187	Crisp TM	Environmental endocrine disruption: an effects assessment and analysis. *Environmental Health Perspectives* 1998;106(Suppl 1):11-56.
130	Ankley GT	Description and evaluation of a short-term reproduction test with the fathead minnow (Pimephales promelas). *Environmental Toxicology and Chemistry* 2001;20(6):1276-1290.
48	Mills LJ	Review of evidence: are endocrine-disrupting chemicals in the aquatic environment impacting fish populations? *Science of the Total Environment* 2005;343(1-3):1-34.
186	Swan SH	Decrease in anogenital distance among male infants with prenatal phthalate exposure. *Environmental Health Perspectives* 2005;113(8):1056-1061.
18	LeBlanc GA	Crustacean endocrine toxicology: a review. *Ecotoxicology* 2007;16(1):61-81.
18	Villeneuve DL	A graphical systems model to facilitate hypothesis-driven ecotoxicogenomics research on the teleost brain-pituitary-gonadal axis. *Environmental Science & Technology* 2007;41(1):321-330.
26	Mergler D	Methylmercury exposure and health effects in humans: a worldwide concern. *Ambio* 2007;36(1):3-11.
5	Kostich MS	Risks to aquatic organisms posed by human pharmaceutical use. *Science of the Total Environment* 2008;389(2-3):329-339.
14	Lorber M	Exposure of Americans to polybrominated diphenyl ethers. *Journal of Exposure Science and Environmental Epidemiology* 2008;18(1):2-19.

Table 8. Highly Cited EDCs Papers in the Field of Multidisciplinary (top 1%)

No. of Cites	First Author	Paper
160	Hawkins MB	Identification of a third distinct estrogen receptor and reclassification of estrogen receptors in teleosts. *Proceedings of the National Academy of Sciences of the United States of America* 2000;97(20): 10751-10756.
248	Zhu Y	Cloning, expression, and characterization of a membrane progestin receptor and evidence it is an intermediary in meiotic maturation of fish oocytes. *Proceedings of the National Academy of Sciences of the United States of America* 2003;100(5):2231-2236.

No. of Cites	First Author	Paper
252	Zhu Y	Identification, classification, and partial characterization of genes in humans and other vertebrates homologous to a fish membrane progestin receptor. *Proceedings of the National Academy of Sciences of the United States of America* 2003;100(5):2237-2242.
69	Timms BG	Estrogenic chemicals in plastic and oral contraceptives disrupt development of the fetal mouse prostate and urethra. *Proceedings of the National Academy of Sciences of the United States of America* 2005;102(19):7014-7019.
259	Anway MD	Epigenetic transgenerational actions of endocrine disruptors and mate fertility. *Science* 2005;308(5727):1466-1469.
39	Kidd KA	Collapse of a fish population after exposure to a synthetic estrogen. *Proceedings of the National Academy of Sciences of the United States of America* 2007;104(21):8897-8901.

Table 9. Highly Cited EDCs Papers in the Field of Pharmacology & Toxicology (top 1%)

No. of Cites	First Author	Paper
195	Parks LG	The plasticizer diethylhexyl phthalate induces malformations by decreasing fetal testosterone synthesis during sexual differentiation in the male rat. *Toxicological Sciences* 2000;58(2):339-349.
209	Laws SC	Estrogenic activity of octylphenol, nonylphenol, bisphenol A and methoxychlor in rats. *Toxicological Sciences* 2000;54(1):154-167.
217	Gray LE	Perinatal exposure to the phthalates DEHP, BBP, and DINP, but not DEP, DMP, or DOTP, alters sexual differentiation of the male rat. *Toxicological Sciences* 2000;58(2):350-365.
126	Zhou T	Developmental exposure to brominated diphenyl ethers results in thyroid hormone disruption. *Toxicological Sciences* 2002;66(1):105-116.
89	Wilson VS	Phthalate ester-induced gubernacular lesions are associated with reduced insl3 gene expression in the fetal rat testis. *Toxicology Letters* 2004;146(3):207-215.
5	Richardson VM	Possible mechanisms of thyroid hormone disruption in mice by BDE 47, a major polybrominated diphenyl ether congener. *Toxicology and Applied Pharmacology* 2008;226(3):244-250.

Table 10. Number of Very Highly Cited EDCs Papers by Field (top 0.1%)

ESI Field	No. of Citations	No. of Papers	Average Cites/Paper	% of EPA Papers in Field
Environment/Ecology	200	2	100.0	1.0%
Multidisciplinary	259	1	259.0	10.0%
	Total = 459	**Total = 3**	**153.0**	**0.5%**

Table 11. Very Highly Cited EDCs Papers (top 0.1%)

ESI Field	No. of Cites	First Author	Paper
Environment/ Ecology	186	Swan SH	Decrease in anogenital distance among male infants with prenatal phthalate exposure. *Environmental Health Perspectives* 2005;113(8):1056-1061.
	14	Lorber M	Exposure of Americans to polybrominated diphenyl ethers. *Journal of Exposure Science and Environmental Epidemiology* 2008;18(1):2-19.
Multidisciplinary	259	Anway MD	Epigenetic transgenerational actions of endocrine disruptors and mate fertility. *Science* 2005;308(5727):1466-1469.

Table 12. Number of Extremely Highly Cited EDCs Papers by Field (top 0.01%)

ESI Field	No. of Citations	No. of Papers	Average Cites/Paper	% of EPA Papers in Field
Environment/Ecology	14	1	14.0	0.5%
Multidisciplinary	259	1	259.0	10.0%
	Total = 273	**Total = 2**	**136.5**	**0.3%**

Table 13. Extremely Highly Cited EDCs Papers (top 0.01%)

ESI Field	No. of Cites	First Author	Paper
Environment/ Ecology	14	Lorber M	Exposure of Americans to polybrominated diphenyl ethers. *Journal of Exposure Science and Environmental Epidemiology* 2008;18(1):2-19.

ESI Field	No. of Cites	First Author	Paper
Multidisciplinary	259	Anway MD	Epigenetic transgenerational actions of endocrine disruptors and mate fertility. *Science* 2005;308(5727):1466-1469.

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 12 of the 16 fields in which the EPA EDCs papers were published, the ratio of actual to expected cites is greater than 1, indicating that the EDCs papers are more highly cited than the average papers in those fields (see Table 14). For all 16 fields combined, the ratio of total number of cites to the total number of expected cites (12,895 to 6,667) is 1.9, indicating that the EDCs papers are more highly cited than the average paper.

Table 14. Ratio of Actual Cites to Expected Cites for EDCs Papers by Field

ESI Field	Total Cites	Expected Cite Rate	Ratio
Agricultural Sciences	26	15	1.7
Biology & Biochemistry	1,390	1,164	1.2
Chemistry	398	292	1.4
Clinical Medicine	1,626	922	1.8
Computer Science	3	1	3.0
Engineering	29	13	2.2
Environment/Ecology	3,362	1,622	2.1
Geosciences	7	6	1.2
Mathematics	0	0.1	0
Microbiology	1	3	0.3
Molecular Biology & Genetics	64	130	0.5
Multidisciplinary	1,100	48	22.9
Neuroscience & Behavior	274	456	0.6
Pharmacology & Toxicology	3,582	1,507	2.4
Plant & Animal Science	1,007	480	2.1
Social Sciences, general	26	8	3.2
TOTAL	**12,895**	**6,667**	**1.9**

***JCR* Benchmarks**

Impact Factor. The *JCR* 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 15 indicates the number of EDCs papers published in the top 10% of journals, based on the *JCR* Impact Factor. Two hundred seventy-two (272) of 652 papers were published in the top 10% of journals, representing 41.7% of EPA's EDCs papers. This indicates that nearly one-half of the EDCs papers are published in the highest quality journals as determined by the *JCR* Impact Factor, which is 4.2 times higher than the expected percentage.

Table 15. EDCs Papers in Top 10% of Journals by *JCR* Impact Factor

EPA EDCs Papers in that Journal	Journal	Impact Factor (IF)	*JCR* IF Rank
1	New England Journal of Medicine	52.589	2
1	Science	26.372	14
1	British Medical Journal	9.723	109
6	Proceedings of the National Academy of Sciences of the United States of America	9.598	114
1	Cancer Research	7.672	164
1	Development	7.293	182
1	Human Reproduction Update	7.257	185
1	Nucleic Acids Research	6.954	194
1	Hippocampus	5.745	272
41	Environmental Health Perspectives	5.636	279
1	Journal of Clinical Endocrinology and Metabolism	5.493	290
7	Analytical Chemistry	5.287	309
1	American Journal of Epidemiology	5.285	310
3	Epidemiology	5.283	311
1	Molecular Ecology	5.169	326
15	Critical Reviews in Toxicology	5.145	330
1	Lab on a Chip	5.068	335
13	Endocrinology	5.045	339

EPA EDCs Papers in that Journal	Journal	Impact Factor (IF)	*JCR* IF Rank
2	Bioinformatics	5.039	340
1	Journal of Medicinal Chemistry	4.895	359
1	Cancer Epidemiology Biomarkers & Prevention	4.642	405
1	Cancer	4.632	408
4	Pediatrics	4.473	435
1	Tissue Engineering	4.409	456
22	Environmental Science & Technology	4.363	465
1	BMC Genomics	4.180	514
1	Applied and Environmental Microbiology	4.004	571
2	Environmental Science and Pollution Research	3.894	598
9	Toxicology and Applied Pharmacology	3.846	614
87	Toxicological Sciences	3.814	622
1	Evolution & Development	3.733	659
1	European Journal of Neuroscience	3.673	680
19	Biology of Reproduction	3.670	682
1	Journal of Chromatography A	3.641	695
1	American Journal of Public Health	3.612	709
1	Electrophoresis	3.609	710
1	Journal of Raman Spectroscopy	3.514	744
4	Chemical Research in Toxicology	3.508	745
2	BMC Bioinformatics	3.493	756
1	Physiological Genomics	3.493	756
3	Hormones and Behavior	3.401	782
1	Neuroscience	3.352	815
1	ATLA-Alternatives to Laboratory Animals	3.203	871
3	Analytica Chimica Acta	3.186	877
3	Fertility and Sterility	3.168	883
Total = 272			

Immediacy Index. The *JCR* 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 16 indicates the number of EDCs papers published in the top 10% of journals, based on the *JCR* Immediacy Index. One hundred eighty-four (184) of the 652 journal articles appear in the top 10% of journals, representing 28.2% of the EDCs papers. This indicates that more than one-quarter of the EDCs papers are published in the highest quality journals as determined by the *JCR* Immediacy Index, which is 2.8 times higher than the expected percentage.

Table 16. EDCs Papers in Top 10% of Journals by *JCR* Immediacy Index

EPA EDCs Papers in that Journal	Journal	Immediacy Index (II)	*JCR* II Rank
1	New England Journal of Medicine	11.962	2
1	Science	6.387	15
1	British Medical Journal	6.210	18
6	Proceedings of the National Academy of Sciences of the United States of America	1.724	136
3	Epidemiology	1.623	152
2	ILAR Journal	1.594	159
1	Nucleic Acids Research	1.589	160
1	Development	1.462	194
1	American Journal of Public Health	1.337	226
1	Human Reproduction Update	1.319	231
1	Lab on a Chip	1.241	265
1	Journal of Clinical Endocrinology and Metabolism	1.221	271
13	Endocrinology	1.137	299
1	Cancer Research	1.131	304
2	Environmental Science and Pollution	1.120	311
1	American Journal of Epidemiology	1.087	329
41	Environmental Health Perspectives	0.958	425
7	Analytical Chemistry	0.911	471
2	Reviews of Environmental Contamination and Toxicology	0.857	527
1	Cancer	0.824	554

EPA EDCs Papers in that Journal	Journal	Immediacy Index (II)	*JCR* II Rank
4	Pediatrics	0.820	557
1	Journal of Medicinal Chemistry	0.789	594
1	Ambio	0.777	610
1	Journal of Environmental Monitoring	0.763	625
1	Experimental Gerontology	0.761	626
1	Molecular Ecology	0.732	663
1	Evolution & Development	0.731	665
19	Biology of Reproduction	0.723	675
1	Journal of Experimental Biology	0.722	678
1	Cancer Epidemiology Biomarkers & Prevention	0.705	702
1	Physiological Genomics	0.705	702
4	Environmental Pollution	0.699	716
3	Fertility and Sterility	0.694	726
1	Reproduction Fertility and Development	0.686	739
2	Molecular and Cellular Endocrinology	0.682	746
3	SAR and QSAR in Environmental Research	0.674	765
1	Molecular Reproduction and Development	0.670	771
1	Hippocampus	0.655	800
9	Reproductive Toxicology	0.655	800
1	Environment International	0.639	834
16	Environmental Research	0.632	845
1	Neuroscience	0.627	856
22	Environmental Science & Technology	0.615	876
Total = 184			

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.

Using the hot paper thresholds established by *ESI* as a benchmark, 6 hot papers, representing 0.9% of the EDCs papers, were identified in three fields—Environment/Ecology, Multidisciplinary, and Pharmacology & Toxicology. The number of EDCs hot papers is 9 times higher than expected. The hot papers are listed in Table 17.

Table 17. Hot Papers Identified Using *ESI* Thresholds

Field	*ESI* Hot Papers Threshold	No. of Cites in 2-Month Period	Paper
Environment/ Ecology	3	6 cites in February-March 2007	LeBlanc GA. Crustacean endocrine toxicology: a review. *Ecotoxicology* 2007;16(1):61-81.
	6	6 cites in September-October 2008	Lorber M. Exposure of Americans to polybrominated diphenyl ethers. *Journal of Exposure Science and Environmental Epidemiology* 2008;18(1):2-19.
	6	12 cites in February-March 2006	Swan SH, et al. Decrease in anogenital distance among male infants with prenatal phthalate exposure. *Environmental Health Perspectives* 2005;113(8):1056-1061.
Multidisciplinary	10	19 cites in May-June 2006	Anway MD, et al. Epigenetic transgenerational actions of endocrine disruptors and male fertility. *Science* 2005;308(5727):1466-1469.
	10	10 cites in February-March 2004	Zhu Y, et al. Cloning, expression, and characterization of a membrane progestin receptor and evidence it is an intermediary in meiotic maturation of fish oocytes. *Proceedings of the National Academy of Sciences of the United States of America* 2003;100(5):2231-2236.
Pharmacology & Toxicology	3	3 cites in January 2006	Carmichael NG, et al. Agricultural chemical safety assessment: a multisector approach to the modernization of human safety requirements. *Critical Reviews in Toxicology* 2006;36(1):1-7.

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 EDCs papers. Of the 12,895 total cites, 544 are author self-cites—a 4.2% author self-citation rate. Garfield and Sher[3] found that authors working in research-based disciplines tend to cite themselves on the average of 20% of the time. MacRoberts and MacRoberts[4] claim that approximately 10% to 30% of all the citations listed fall into the category of author self-citation.

[3] Garfield E, Sher IH. New factors in the evaluation of scientific literature through citation indexing. *American Documentation* 1963;18(July):195-210.

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

Kovacic and Misak[5] recently reported a 20% author self-citation rate for medical literature. Therefore, the 4.2% self-cite rate for the EDCs papers is well below the range for author self-citation.

Highly Cited Researchers

A search of Thomson's *ISIHighlyCited.com* revealed that 21 (1.5%) of the 1,379 authors of the EDCs papers are highly cited researchers. *ISIHighlyCited.com* is a database of the world's most influential researchers who have made key contributions to science and technology during the period from 1981 to 1999. The highly cited researchers identified during this analysis of the EDCs publications are presented in Table 18.

Table 18. Highly Cited Researchers Authoring EDCs Publications

Highly Cited Researcher	Affiliation	*ESI* Field
Andersen, Melvin E.	CIIT Centers for Health Research	Pharmacology
Ankley, Gerald	U.S. Environmental Protection Agency	Environment/Ecology
Birnbaum, Linda S.	U.S. Environmental Protection Agency	Pharmacology
Boobis, Alan R.	Imperial College London	Pharmacology
Brown, Sandra	Winrock International	Environment/Ecology
Burger, Joanna	Rutgers University	Environment/Ecology
German, J. Bruce	University of California-Davis	Agricultural Sciences
Giesy, John P.	University of Saskatchewan	Environment/Ecology
Guillette, Louis J.	University of Florida	Environment/Ecology
Jobling, Susan	University of Brunel	Environment/Ecology
Klaassen, Curtis D.	University of Kansas Medical Center	Pharmacology
McLachlan, John A.	Tulane University	Environment/Ecology
Needham, Larry L.	National Center for Environmental Health	Environment/Ecology
Rao, P. Suresh Chandra	Purdue University	Environment/Ecology
Sih, Andrew	University of California–Davis	Environment/Ecology
Soto, Ana M.	Tufts University	Environment/Ecology Pharmacology
Starfield, Barbara	The Johns Hopkins University	Social Sciences, general
Stegeman, John J.	Woods Hole Oceanographic Institution	Pharmacology

[5] Kavaci N, Misak A. Author self-citation in medical literature. *Canadian Medical Association Journal* 2004;170(13):1929-1930.

Highly Cited Researcher	Affiliation	*ESI* Field
Suidan, Makram T.	University of Cincinnati	Environment/Ecology
Sumpter, John P.	Brunel University	Environment/Ecology
Wright, S. Joseph	Smithsonian Tropical Research Institute	Environment/Ecology
Total = 21		

Patents

No patents have been issued or patent applications filed by investigators from 1998 to 2008 for research that was conducted under EPA's EDCs Research Program.

Nonjournal Publications (Books, Book Chapters, Reports, and Proceedings)

Forty-six nonjournal publications (books, book chapters, reports, and proceedings) produced by the program from 1998 to 2008 were included in the analysis. Of these 46 nonjournal publications, 20 (43.5%) have been cited at least once in a journal. The 46 publications were cited 180 times in the journals covered by Thomson Reuter's *ISI Web of Science*. The authors of the nonjournal publications cited themselves 9 times, a 5.0% self citation rate, which is well below the 10-30% range report in the literature for author self-citation. Application of the ESI fields and highly cited benchmarks used for journal papers to the nonjournal publications, indicated that 2 (4.4%) of the nonjournal publications were highly cited when using the ESI criteria for the top 10% of highly cited publications. None of the nonjournal publications met the ESI criteria for the top 1%, 0.1%, or 0.01% highly cited publications.

This bibliometric analysis was prepared by
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