

# Bibliometric Analysis of the *Polish Journal of Environmental Studies* (2000-11)

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## Abstract

A bibliometric approach was employed to identify the characteristics of *Polish Journal of Environmental Studies* during 2000-11. It is a young journal, and bibliometric analyses can provide insights into its citation and performance pattern. Findings can be used to devise approaches to improve performance for young journals in general. Our analysis included the publication's output, distribution of authors' keywords, and performances of countries, institutions, and authors. Bibliometric indicators such as total, single, collaborative, first author, and corresponding author publications were applied. The top-cited publications each year and publications of the highest impact also are reported. Results show that "heavy metals" were the most frequently used author keywords, followed by "soil" and "cadmium." Authors from 54 different countries published in the journal, with the most publications submitted by authors from Poland. Two Polish institutions, Technical University of Gdańsk and Adam Mickiewicz University in Poznań, were the main contributing institutions.

**Keywords:** bibliometric, citation, impact factor, SCI-expanded, citations per publications, journal

## Introduction

The *Polish Journal of Environmental Studies* (*Pol. J. Environ. Stud.*) has been indexed in the Science Citation Index Expanded (SCI-Expanded) and listed in Web of Science subject categories of Environmental Sciences since 2000. Bibliometric analysis is a quantitative analysis done to aid the evaluation of research performance [1]. Bibliometric analysis, based on statistical data about publications, citations, and other related indicators, has been widely used to reveal objective performance and development of scientific journals. Numerous bibliometric analyses of journals have been reported, including medical related journals, for example the *American Journal of Roentgenology* [2], the *American Journal of Veterinary*

*Research* [3], *Pain* [4], and the *Journal of Cardiothoracic and Vascular Anesthesia* [5], as well as other scientific journals, including *Physics* [6], *Zoo Biology* [7], *Uspekhi Khimii* [8], *Intelligence* [9], *Water Research* [10], *Physical Therapy* [11], and *Bulletin of Marine Science* [12]. The number of publications by document type [8, 10, 11] publication years [10, 11], country, institution, and author [10] were often revealed to provide basic information about a journal. Impact factor, which was created in the early 1960s [13], has become a staple in many types of analyses of a journal's scientific impact [14].

Another commonly used term to feature a journal is citation classics [9, 15]. Meanwhile, citations per publication providing average citations [16], has been applied in various studies [17, 18]. Furthermore, internationalization of journals is also an important concern to identify centers of intellectual activity [2, 19]. Bibliometric indicators relat-

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ed to the total number of publications, independent, and collaborative publications usually have been applied to evaluate country and institution publication's performance [10, 20, 21]. Recently, indicators relating to corresponding author and first author also were employed to enhance performance of countries and institutions [10, 22, 23].

The bibliometric method was employed to obtain an overview of *Pol. J. Environ. Stud.* from 2000 to 2011. In addition to analyzing the characteristics of document types, impact factor, number of publications, and highly cited publications, the study also identified the most cited publications by year and their citation lives, as well as the performance of contributing countries, institutes, and authors. Furthermore, this study provides a citation profile of a young journal. Findings from this study can be used to devise approaches for improving a young journal's performance.

## Methods

Documents used in this study were derived from the Science Citation Index Expanded (SCI-Expanded) database of the Web of Science from Thomson Reuters. Keywords "*Polish Journal of Environmental Studies*" were searched in terms of a publication's name. A total of 1,451 documents from 2000 to 2011 were downloaded by this filter. The analysis measured indicators such as impact factor (IF), citations per publication (CPP), TC2011, C2011, and countries' related indicators: TP, SP, CP, FP, and RP. The introduction and calculation of these indicators were interpreted thus – TC2011 and C2011 were used to assess the citations of the publications. A publication's TC2011 was defined as the number of times it was cited from its publication year to the end of 2011. The index of citation from Web of Science was updated over time. By comparison, TC2011 was an invariable parameter to measure repeatability in providing more scientific and accurate information. A publication's C2011 was defined as the number of times it was cited in 2011, thereby determining the latest and the most influential research in the journal.

Publications originating from England, Scotland, Northern Ireland, and Wales were reclassified as being from the United Kingdom (UK). Collaborative type of countries and institutions was determined by the author addresses. The publications were classified by four types for country and institution.

- (1) The term "single country publication" was assigned if the researchers' addresses were from the same country. The term "single institute publication" was assigned if the researchers' addresses were from the same institution.
- (2) The term "internationally collaborative publication" was assigned to those publications that were co-authored by researchers from more than one country. The term "inter-institutionally collaborative publication" was assigned if authors were from different institutions.

Table 1. Document types of the *Polish Journal of Environmental Studies* (2000-11).

Document type	TP	%	TC2011	CPP
Article	1,249	86	2,741	2.19
Letter	84	0.90	235	2.80
Review	76	0.41	541	7.12
Proceedings Paper Article	23	5.8	62	2.70
Editorial Material	13	1.6	1	0.0769
Correction	6	5.2	2	0.333

TP – total number of publications, % – percentage, TC2011 – total citations from its publication to 2011, CPP – citations per publication

- (3) The term "first author publication" was assigned if the first author was from the country or institution of analysis.
- (4) The term "corresponding author publication" was assigned if the corresponding author was from the country or institution of analysis.

TP, SP, CP, FP, and RP were the total number of publications, "single country publications" or "single institute publications," "internationally collaborative publications" or "inter-institutionally collaborative publications," "first author publications" and "corresponding author publications," respectively.

Impact factor (IF) was introduced by Garfield and Sher [24] to help select additional source journals using recent citations received from other journals. The IF of a given journal is defined by Journal Citation Reports (JCR) as the number of citations of all papers published in the previous two years, divided by the total number of papers published in those years. It is a measure of the frequency with which the average paper in a journal has been cited in a particular year.

## Results and Discussion

### Characteristics of Document Type

*Pol. J. Environ. Stud.* published 1,463 papers from 2000 to 2011 (Table 1). Articles made up 86% of the total papers, followed by letters (5.7%), reviews (5.2%), proceedings paper articles (1.6%), editorial materials (1.0%), and corrections (0.41%). Among the 6 document types, reviews had the highest CPP of 7.12, followed by letters (2.80), proceedings paper articles (2.70), and articles (2.18). While it was not surprising for reviews to have had higher CPP than articles, it is unusual to have found higher CPP in letters and proceedings than articles [25]. Table 2 shows the annual number of publications, authors, references, and pages per publication from 2000 to 2011. The annual total number of publications increased by 155% from 78 to 199 over the 11-year period. Also, the numbers of authors per publication, references per paper, and pages per paper showed an increasing trend from 2.4, 28, and 6.3 in 2000 to 3.3, 33, and 7.5 in 2011, respectively.

Table 2. Characteristics of *Polish Journal of Environmental Studies*, 2000 to 2011.

Year	TP	AU	AU/TP	NR	NR/TP	PG	PG/TP
2000	78	187	2.4	2158	28	494	6.3
2001	70	201	2.9	2092	30	455	6.5
2002	103	306	3.0	2600	25	664	6.4
2003	104	312	3.0	2742	26	710	6.8
2004	101	300	3.0	2784	28	669	6.6
2005	118	352	3.0	3382	29	812	6.9
2006	115	335	2.9	3778	33	878	7.6
2007	121	383	3.2	3707	31	876	7.2
2008	126	434	3.4	3759	30	913	7.2
2009	152	473	3.1	4456	29	1119	7.4
2010	175	601	3.4	5255	30	1261	7.2
2011	188	617	3.3	6167	33	1420	7.6
Total	1451	4501		42880		10271	
Average			3.1		30		7.1

TP – total number of publications, AU – number of authors, NR – cited reference counts, PG – page counts, AU/TP – number of authors per publication, NR/TP – cited reference counts per publication, PG/TP – page counts per paper

### Trends of Impact Factor

*Pol. J. Environ. Stud.* was listed in the Web of Science subject category of Environmental Sciences. Fig. 1 shows its IF and ranking within the subject category from 2002 to 2010. Both IF and ranking fluctuated over this period, not showing a definite trend. Its IF was highest in 2008 with 0.963, and lowest in 2005 with 0.352. In terms of ranking of IF, 2002 was the best year, ranking 83 out of a total of 132 journals, followed by 2008 (124 out of 163) and 2009 (138 out of 181). On average, it has ranked among the top 85<sup>th</sup> percentile among all journals.

How quickly recent publications are cited is an important factor that can affect IF [13]. In general, citation per publication for a research field would have a sharp increase after publication, and would reach a peak in a specific year. The peak year varies among disciplines. The peak year could be, for example, the 2<sup>nd</sup> year [20], the 3<sup>rd</sup> year [26], the 4<sup>th</sup> year [27], or the 6<sup>th</sup> year [28]. Fig. 2 shows citation per publication for each year of article life up to the 9<sup>th</sup> year, which was the last year with at least 200 papers. The purpose was to identify the peak year citations per publication (PCPP). Interestingly, it does not show a peak, unlike previous findings, but shows an increasing trend with a slight aberration in year 5.

Since IF only considers citations within 2 years after publication, the IF of *Pol. J. Environ. Stud.* would be higher if it was calculated after a few more years. Thus, the common indicator IF is not an unbiased criteria for all journals, since PCPP by year of each journal is different from each other. Different fields show different citation frequencies for IF [25, 29]. The 2-year IF penalizes studies that take

longer for citations [30], and it was reported that there are potential misuses and limitation of this index [31]. The citation pattern of the publications in *Pol. J. Environ. Stud.* may suggest that the IF be accounted for a longer period after publication to maintain a better citation performance. This study may have provided some initial evidence that citation life for papers published by young journals may significantly differ from those published by well-established journals.

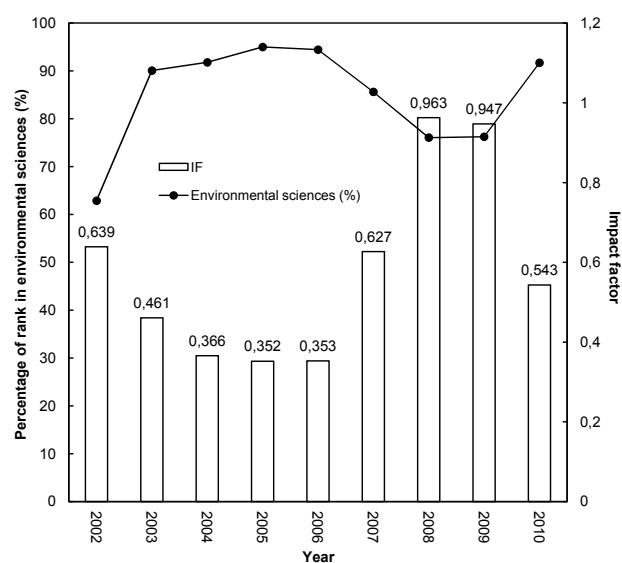


Fig. 1. Rankings of *Polish Journal of Environmental Studies* by impact factor in environmental sciences category from 2002 to 2010.

### Trends of Number of Publications and Highly Cited Papers

Highly cited publications (TC2011  $\geq 10$ ) were identified. Fig. 3 shows the distribution of highly cited publications by year. There were 75 publications cited at least 10 times before the end of 2011, accounting for 5.1% of the total publications in *Pol. J. Environ. Stud.* Among these 75 publications, 53 (71%) were issued during 2000-03. The year 2002 was the most productive, with 20 publications, which made up 19% of all publications that year (20/103). Year 2001 with 18% (13/71), and year 2000 with 14% (11/78) also topped the list. The percentage fell from 19% in 2002 to 1.3% in 2009, and none in 2008, 2010, and 2011. As indicated in previous research, papers published earlier were more likely to be a highly cited since they have had more time to be cited [32].

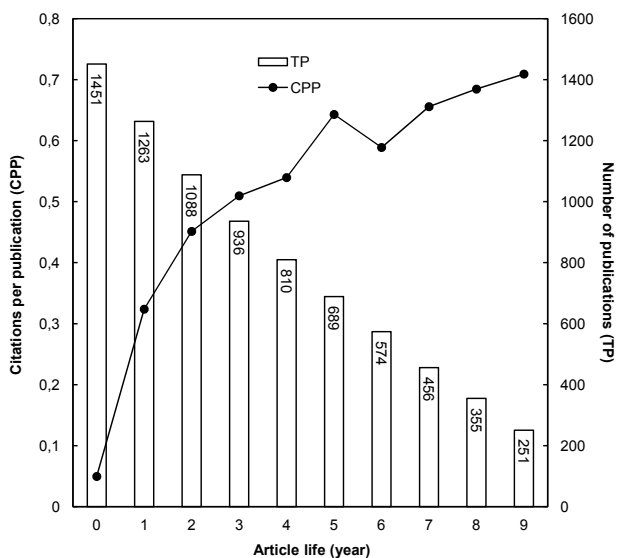


Fig. 2. Trend of number of citations per publication.

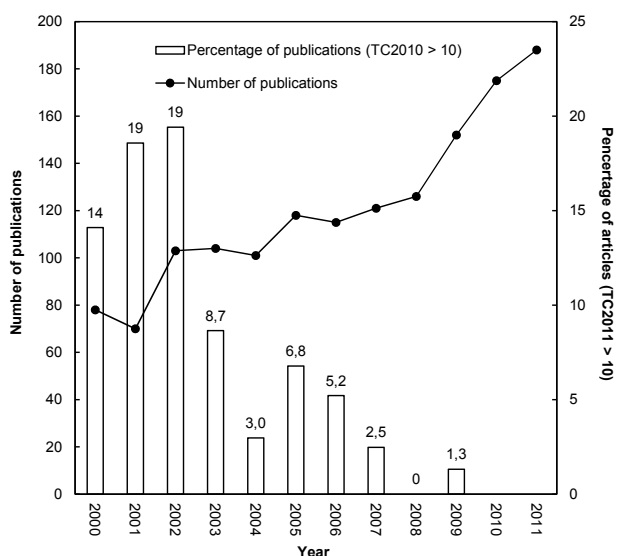


Fig. 3. Trend of number of publications and percentage of highly cited publications (TC2011  $\geq 10$ ).

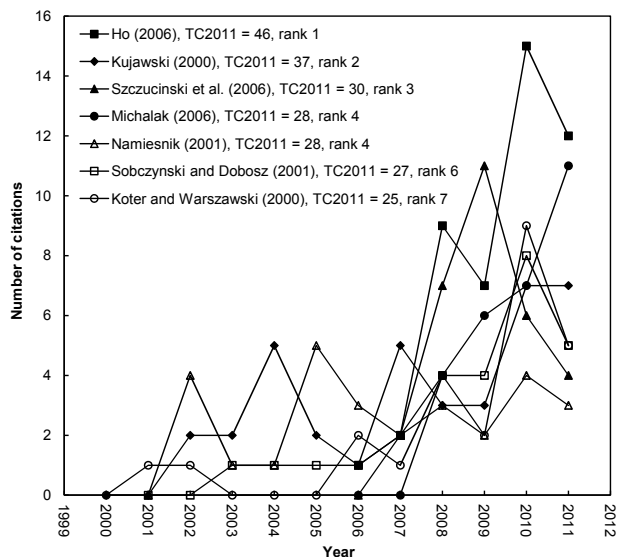


Fig. 4. Citation lives of the top 7 publications with the TC2011  $\geq 25$ .

### Most Frequently Cited Publications and Their Citation Lives

Oftentimes, the true intellectual milestones may be found in the reference list of the most cited papers, and they influence a great many people and help a great many subsequent advances [32, 33]. Table 3 lists the 16 most cited papers published each year from 2000 to 2011. Eight of them were articles, 6 were reviews, and 2 were proceedings paper articles. Only one paper was international collaboration. Eleven papers were published by Poles. These publications were considered citation leaders emerging from *Pol. J. Environ. Stud.* Among these 16 publications, 11 papers' TC2011 were greater than 10, except the top publications of 2008, 2010, and 2011. The fact that top publications in recent years had lower citations may partly be due to the short citation window [32]. Four of the 16 yearly top publications were singly authored, including Ho Y.S. in 2006 [42], Kujawski W. in 2000 [34], Namiesnik J. in 2001 [35], and Gosar M. in 2008 [45].

Fig. 4 shows the citation lives of the top 7 publications (TC2011  $\geq 25$ ). Among these 7 publications, the article "isotherms for the sorption of lead onto peat: comparison of linear and non-linear methods" by Ho Y.S. in 2006 [42] ranked No. one in TC2011, and also ranked No. one in C2011. In addition, Michalowicz and Duda in 2007 [43], Kujawski in 2000 [34], and Szyzewski et al. in 2009 [46] also ranked in the top ten in C2011, with 5<sup>th</sup>, 6<sup>th</sup>, and 6<sup>th</sup>, respectively. These papers indicated a strong and sustainable potential to receive high numbers of citations.

### Characteristics of Countries, Institutions, and Authors

Excluding 14 publications without any information on the author's address, the remaining 1,449 publications originated from 54 countries. Table 4 shows characteristics of





Table 5. Characteristics of the top 12 productive institutions (TP  $\geq$  30).

Institution	TP	TP R (%)	SP R (%)	CP R (%)	FP R (%)	RP R (%)	C%
Adam Mickiewicz Univ Poznan, Poland	85	1 (5.9)	1 (4.9)	2 (8.2)	1 (5.1)	1 (5.1)	42
Polish Acad Sci, Poland	74	2 (5.1)	6 (2.8)	1 (10)	2 (3.7)	2 (3.7)	62
Univ Warmia & Mazury Olsztyn, Poland	56	3 (3.9)	2 (4.3)	8 (3)	3 (3.6)	3 (3.6)	23
Nicholas Copernicus Univ, Poland	53	4 (3.7)	3 (3.7)	6 (3.6)	5 (3.2)	4 (3.3)	30
Univ Agr, Poland	52	5 (3.6)	3 (3.7)	7 (3.4)	4 (3.3)	4 (3.3)	29
Gdansk Univ Technol, Poland	51	6 (3.5)	5 (3.2)	3 (4.3)	6 (3.1)	6 (3.1)	37
Gdansk Tech Univ, Poland	35	7 (2.4)	9 (2.5)	11 (2.3)	7 (2.2)	7 (2.2)	29
Silesian Tech Univ, Poland	34	8 (2.4)	11 (1.5)	3 (4.3)	10 (1.9)	10 (1.9)	56
Univ Warmia & Mazury, Poland	34	8 (2.4)	7 (2.7)	19 (1.6)	7 (2.2)	7 (2.2)	21
Med Univ Silesia, Poland	31	10 (2.2)	15 (1.3)	5 (4.1)	10 (1.9)	10 (1.9)	58
Univ Gdansk, Poland	30	11 (2.1)	10 (1.7)	8 (3)	12 (1.6)	12 (1.6)	43
Med Univ Bialystok, Poland	30	11 (2.1)	8 (2.6)	37 (0.91)	9 (2)	9 (2)	13

TP – total number of publications, SP – single institution publications, CP – inter-institutionally collaborative publications, FP – first author publications, RP – corresponding author publications, C% – percentage of inter-institutionally collaborative publications in a country, R (%) – rank in percentage (share in publications)

the top 10 most productive countries. Among those publications, 1,334 (92%) were single country publications, while 115 (7.9%) were internationally collaborative publications. The top 5 countries such as Poland, Turkey, Lithuania, China, and Slovakia accounted for 92% of total publications. While it has been reported that the USA was the leader in publication quantity [10, 19, 23], in this journal Poland was ranked No. 1 in the five bibliometric indicators used in this study. Poland had the lowest percentage of internationally collaborative publications (C% = 6.7%) and Japan had the highest CPP with 4.27. As the number of publication increased, so did the number of contributing countries, as indicated in Fig. 5. The number of countries contributing to this journal has increased from 7 countries in 2000 and 5 countries in 2001 to 26 in 2009, 28 in 2010, and 27 in 2011. Of the 1,449 publications from 670 institutions in 54 countries, 1,007 (69%) were single country publications, and 442 (31%) were inter-institutionally collaborative publications. The top 19 productive institutions were from Poland. Lithuanian University of Agriculture at Lithuania ranked 20<sup>th</sup> in total publications (TP = 16). It was the only institution not from Poland that ranked in the top 42 institutions. Table 5 shows 12 institutions with at least 20 total publications (TP  $\geq$  20). Technical University of Gdańsk published the most total, single institution, first author, and corresponding author publications while the Polish Academy of Sciences published the most inter-institutionally collaborative publications and Medical University of Białystok had lower collaborative publications. It has been accepted that the first author is the person who contributed most to the work and writing of the article [50]. The corresponding author is perceived as the author contributing significantly to the article independently of the author position [51]. An analysis of authors' publications in

a journal with three bibliometric indicators such as total publications, first author, and corresponding author publications was recently reported [10]. Table 6 lists the 17 authors with at least 10 publications. Of the 1,459 publications with author's information, there were 3,029 authors. Namiesnik J. contributed the most with 46 publications, followed by Donderski W. (28), Siepak J. (22), and Moniuszko-Jakoniuk J. (20).

In general, first author and corresponding author made the most contributions to a paper. There were 1,459 publications from 1,057 first authors from 46 countries. Both Czczuga B. and Wyszowska J. published the most first author publications (FP = 13), followed by Donderski W. (FP = 11). There were 1,445 publications from 1,015 corre-

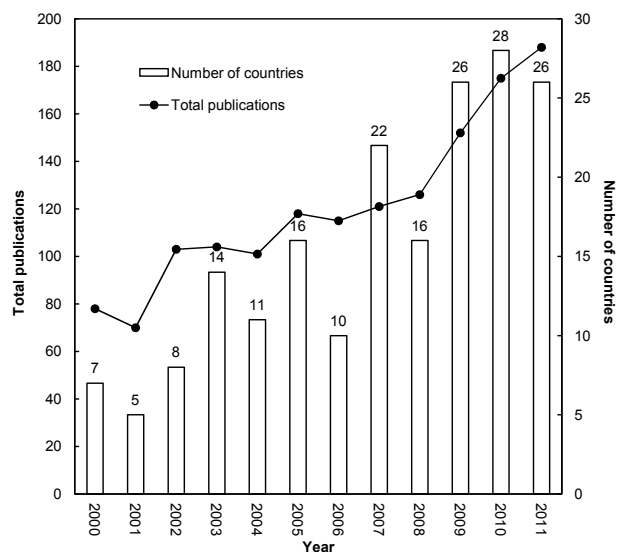
Fig. 5. Development of *Polish Journal of Environmental Studies*.

Table 6. Top 17 most productive authors (TP ≥ 10) in *Polish Journal of Environmental Studies*.

Authors	Rank (TP)	Rank (FP)	Rank (RP)
Namiesnik J.	1 (46)	12 (5)	1 (21)
Donderski W.	2 (28)	3 (11)	2 (12)
Siepak J.	3 (22)	N/A	11 (6)
Moniuszko-Jakoniuk J.	4 (20)	39 (3)	43 (3)
Polkowska Z.	5 (17)	20 (4)	43 (3)
Domka F.	6 (16)	N/A	2 (12)
Buszewski B.	7 (15)	83 (2)	5 (9)
Kiziewicz B.	7 (15)	20 (4)	6 (8)
Niedzielski P.	9 (14)	6 (7)	11 (6)
Czczuga B.	9 (14)	1 (13)	4 (10)
Wyszkowska J.	9 (14)	1 (13)	10 (7)
Siepak M.	12 (11)	224 (1)	N/A
Kucharski J.	12 (11)	83 (2)	6 (8)
Olanczuk-Neyman K.	12 (11)	20 (4)	11 (6)
Falandysz J.	15 (10)	4 (8)	6 (8)
Klimiuk E.	15 (10)	7 (6)	19 (5)
Ulfig K.	15 (10)	7 (6)	11 (6)

TP – total number of publications, SP – single author publications, RP – corresponding author publications, N/A – not available

sponding authors from 44 countries. Namiesnik J. published the most corresponding author papers (RP = 21), followed by Donderski W. and Domka F. with 12 papers, respectively. A bias could appear in authorship analysis because two or more authors may have the same name, or authors used different names in their publications (e.g. name changes due to marriage). Therefore, it is strongly recommended to establish an “international identity number” that would be assigned to an individual when he/she publishes the first paper in the Web of Science listed journals [10].

### Distribution of Author Keywords

Research trends can be obtained by analyzing the author keywords [52]. However, bibliometric methods using author keyword analysis were not possible until recent years [21], hence a few studies have used the information for trend analysis [53, 54]. There were 4,354 keywords in 1,436 publications in *Pol. J. Environ. Stud.* The top three most frequently used keywords were “heavy metals” (TP = 96; 6.7%), “soil” (TP = 51; 3.6%), and “cadmium” (TP = 49; 3.4%), which were associated with hot topics in *Pol. J. Environ. Stud.* In addition, a higher ranking of keywords included “lead” (TP = 38; 2.6%), “zinc” (TP = 24; 1.7%), “mercury” (TP = 18; 1.3%), “arsenic” (TP = 17; 1.2%),

“heavy metal” (TP = 18; 1.3%), and “copper” (TP = 14; 1.0%). Keywords such as “sewage sludge,” “pollution,” “water,” “toxicity,” “adsorption,” “bacteria,” “heavy metal,” “sediments,” “arsenic,” “fish,” “liver,” “Poland,” “speciation,” “air pollution,” “heterotrophic bacteria,” “biodegradation,” “polycyclic aromatic hydrocarbons,” “rats,” and “nitrogen” were used by authors in 1% of publications. These keywords were highly related to the scope of the journal.

### Conclusion

A total of 1,463 publication including 6 document types were published in *Pol. J. Environ. Stud.* from 2000 to 2011. Articles were the dominant document type, and had a CPP of 1.9. Review had the highest CPP of 7.1. The peak year of citations per publication was not found, suggesting a better citation performance of impact factor calculated by longer years. Furthermore, this could be specific to young journals. More research is needed to assess if peak year differs between young and well-established journals within the same subject category. The annual production experienced notable growth as the journal was becoming more international. Publications were contributed to by 670 institutions from 54 countries. Nevertheless, 83% of the publications were published by Poland. Moreover, 11 of the 16 top cited publications in each year were published by authors from Poland. In particular, the top 5 publications with the greatest TC2011 and C2011 were the same publications that were published by Ho (article) and Michalak (review) in 2006, respectively. *Pol. J. Environ. Stud.* is a young journal and has shown significant growth in quantity over the past 11 years. It would be beneficial to attract authors from other countries to publish in the journal. As more authors from other countries publish in *Pol. J. Environ. Stud.*, its ranking and citations would likely improve as well.

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