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A ten-year bibliometric analysis of the journal *Review of Palaeobotany and Palynology* (2003 – 2012)

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ABSTRACT

The present work is a bibliometric analysis of a leading journal in Palaeobotany and Palynology, 'Review of Palaeobotany and Palynology'. The study, based on Web of Science™ as the tool reveals that 1821 authors have contributed 903 papers during the years 2003 to 2012. Our analysis includes the publications output, exponential growth rate, authorship patterns, collaborative co-efficient and prolific authors, country wise and organization-wise distribution of contributions.

The study reveals that multiple authorship with collaboration of three (25.47%) and two authors (25.36%) was dominant. The average degree of collaboration for study period was 0.87. The Collaborative Coefficient was 0.69. Country wise, USA stood first with 163 papers. Chinese Academy of Sciences, China and University Utrecht, The Netherlands were found to be the top ranked organizations contributing 73 and 31 papers respectively. This paper explores the mapping of the highly cited papers from Review of Palaeobotany and Palynology.

Keywords: Bibliometric analysis, Palaeobotany, Palynology, Exponential growth, Authorship patterns, Collaborative co-efficient, Collaborative research, VOSviewer, Highly cited papers

1. INTRODUCTION

Bibliometrics is the branch of information theory that attempts to analyse quantitatively and statistically the properties and behavior of recorded knowledge. Pritchard (1969)^[7] used the term bibliometrics to describe all studies which seek to quantify the process of written communication. He defined bibliometrics as the application of mathematics and statistical method to books and other media of communication. Bibliometric analysis helps in measuring the patterns of all forms of recorded information and their producers using statistics to describe the patterns of publication within a given field or body of literature. Researchers may use bibliometric methods of evaluation to determine the influence of a

single writer or to describe the relationship of two or more writers or works. Bibliometrics is the studies involve the application of quantitative analysis and statistics to publications such as journal articles and their accompanying citation counts (Thomson Reuters, 2008)^[13].

Paleobotany (also Palaeobotany, Gr. *Paleon* - old, Botany - study of plants) is the branch of paleontology or paleobiology that studies plants throughout geologic history (www.wikipedia.org)^[17]. Paleobotany includes the study of terrestrial plant fossils, as well as the study of prehistoric marine photoautotrophs, such as photosynthetic algae, seaweeds or kelp. A closely related field is palynology, which is the study of fossilized and extant spores and pollen (<https://sites.google.com>)^[18].

Paleobotany is important in the reconstruction of ancient ecological systems and climate, known as paleoecology and paleoclimatology respectively; and is fundamental to the study of green plant development and evolution. Paleobotany has also become important to the field of archaeology, primarily for the use of phytoliths in relative dating and in paleoethnobotany.

Palaeobotany has undergone a remarkable change in recent years by new collection of fossils from different geological horizons and research. The nature of Palaeobotany has undergone a sea change. It is no longer a descriptive subject. It has become more analytical especially with the availability of scanning electron media and high power optical microscopes for evaluation of micro-spores, spores and pollen, which throw sufficient light on the phyla, ecology and environment of the past ages. From an evolutionary point of view, it has a bearing on modern plants on structural organization and functioning of cells at the molecular level. The subject is comprehensive in scope adumbrating on the origin and evolution of life, reproductive behaviour and adaptations in the changing environment of the past geological periods (Prasad, 1999)^[6].

Researchers realize now that the field of Paleobotany, that attempts to reconstruct the flora of the past using proxy evidences, is widely used in understanding the evolution and dynamics of modern plant life. Realizing the importance of this field, in the present work, we have attempted to understand the publication patterns of an established journal, with Impact Factor (Impact factor is the average citation rate of a journal's articles) of 1.933 in 2012, in this domain. In this paper, an attempt has been made to analyze the contributions to *Review of Palaeobotany and Palynology* published during the year 2003-2012, in order to explore the year-wise growth, author pattern, collaborative research, keywords among the contributions.

2. SOURCE JOURNAL

Review of Palaeobotany and Palynology (ISSN: 0034-6667) is an international peer-reviewed journal (<http://www.journals.elsevier.com/review-of-palaeobotany-and-palynology/>) for articles in the fields of palaeobotany and palynology dealing with all groups, ranging from marine palynomorphs to higher land plants. The journal started in 1967 by Elsevier Science, Amsterdam, The Netherlands, publishes original works of authors in the form of regular articles, review papers, etc. The articles published in the journal are indexed in AESIS, AGI's Bibliography and Index of Geology, AGRICOLA, Agricultural Engineering Abstracts, BIOSIS, Bulletin Signalétique, Current Contents, ESRISAT, Elsevier BIOBASE, GEOBASE, GeoRef, PASCAL/CNRS, Petroleum Abstracts, Scopus.

3. LITERATURE REVIEW

A few studies have been carried out in the past related to some of the important journals in the field of Botany. Tissot (1991)^[14] studied the trends in pollen morphology. Saravanan & Panneerselvam (2012)^[9] conducted a bibliometric study on *Current Botany* with aim of summarizing the research activity in the field of botany and to reveal the most important aspects. Results showed that multi-authors contribution was high and Degree of collaboration was 0.95. Saravanan & Prasad (2012)^[10] conducted bibliometric analysis of a reputed scientist in Palynology, Thanikaimoni, by analyzing his publications over a 25-year period. Saravanan & Dominic (2013)^[8] analysed the attempts to highlight quantitatively and qualitatively the growth and development of international literature on Paleoecology in terms of publication output and citations as per Web of Science (1940-2013). The objective of the study was to perform a scientometric analysis of all paleoecology research publications in the world. Walton and Morris (2013)^[16] investigated the citation-patterns of monograph books in taxonomic botany.

4. OBJECTIVES

To our knowledge no bibliometric study has been conducted so far with a journal of *Review of Palaeobotany and Palynology*. Hence, the study has been undertaken to examine the following:

- Year wise distribution & Exponential Growth.

- To analyse the pattern of authorship, authors collaboration, top ten prolific authors contribution and applicability of Lotka's law.
- Top ten Organizations
- Geographical representation of publications.
- To analyse the characteristics of highly cited papers.
- To analyse the keywords appended by the authors.

5. HYPOTHESES

The following are the hypotheses formulated for this study:

1. Research productivity and contributions would be comparatively higher in developed countries.
2. Collaborative research will dominate in contributions in *Review of Palaeobotany and Palynology*.

6. MATERIALS AND METHODS

The selection of the journal *Review of Palaeobotany and Palynology* was based not only on the impact factor, but also on the collective opinion of the researchers with whom the authors personally interacted. The data presented in this paper have been accessed (on 25/04/2014) from Web of Science™ published by Thomson Reuters, U.S.A. Data were obtained from the Science Citation Index Expanded (SCI-EXPANDED), which is a very comprehensive database covering all aspects of science. The keyword "Review of Palaeobotany and Palynology" has been used as the search term in the field of "Publication Name" and the time period was limited to 2003 to 2012 (10 years). 903 papers from Palaeobotany and Palynology were retrieved. The documents were downloaded and bibliometrically analysed according to the objectives with the help of Microsoft Excel. Further, bibliometric indicators Exponential Growth, Degree of collaboration, Collaborative coefficient, and Bibliometric law especially Lotka's law have been employed to analyze the data. VOSviewer software was used to map the organization-wise contribution.

7. RESULTS AND DISCUSSION

The analysis of the data was done with a view to measure the growth of *Review of Palaeobotany and Palynology* papers over the years, as also authors' productivity, organizations, country wise distribution of papers and highly cited papers.

7.1. Year wise growth of *Review of Palaeobotany and Palynology*

Table 1: Year wise growth of *Review of Palaeobotany and Palynology*

YEAR	TP	%	CP	C%	EG	NCR	TC
2003	73	8.08	73	8.08	-	3684	995
2004	79	8.75	152	16.83	1.08	4292	1157
2005	64	7.09	216	23.92	0.81	3895	792
2006	85	9.41	301	33.33	1.33	4291	987
2007	72	7.97	373	41.30	0.85	3994	940
2008	72	7.97	445	49.28	1.00	4298	545
2009	133	14.73	578	64.00	1.85	8265	902
2010	112	12.40	690	76.41	0.84	7855	467
2011	90	9.97	780	86.37	0.80	6108	212
2012	123	13.62	903	100.00	1.37	8458	73
Total	903	100			9.93	55140	7070

TP = total papers, % = Percentage, CP = cumulative papers, C% = cumulative percentage, EG = exponential growth, NCR = Number of Cited References, TC = Total Citations

Table-1 reveals the growth of research literature appeared in *Review of Palaeobotany and Palynology* (Vol. 123, 2003 to Vol. 187, 2012). It is evident that the publications of 2003 were 73 and that increased to 123 in the year 2012. The fluctuations in publication pattern of Palaeobotany and Palynology literature were noticed throughout the period of study. However, the highest number of publications was recorded in 2009 (133 papers, 14.73%) due to publication of two special issues entitled ‘Late Palaeozoic palaeobotany and palynology in Central Europe: New contributions from the Czech Republic’ edited by Jiří Bek and Hans Kerp and ‘Spore/pollen fine structure in living and fossil plants’ edited by L. Grauvogel-Stamm, G. Guignard and C.H. Wellmann in 2009 June and July issues respectively. The lowest was in the year 2005 (64 papers, 7.09%). The reason could be the frequency of journal as there is an inconsistency in the number of issues published. Another possible reason could be the shift in research focus that could have happened due to editorial changes. An exponential growth (Tague et al., 1981)^[12] in number of publications was observed during 2003 to 2012. The total exponential growth rate value was 9.93 and the average exponential growth rate was 1.10 for the study period. The number of cited references, total citations, cumulative papers, and cumulative percentages are also presented in the table.

7.2. Source wise distribution of *Review of Palaeobotany and Palynology*

During 2003 to 2012 scientists contributed 903 publications under 6 different document categories. It is an accepted fact that most of the scholarly communication of scientific research is done by articles 766 (84.83 %), 58 (6.42 %) were reviews and 51 (5.65 %) were proceedings papers. Remaining 3 document categories were published as editorial materials (14), biographical item (9) and correction (5).

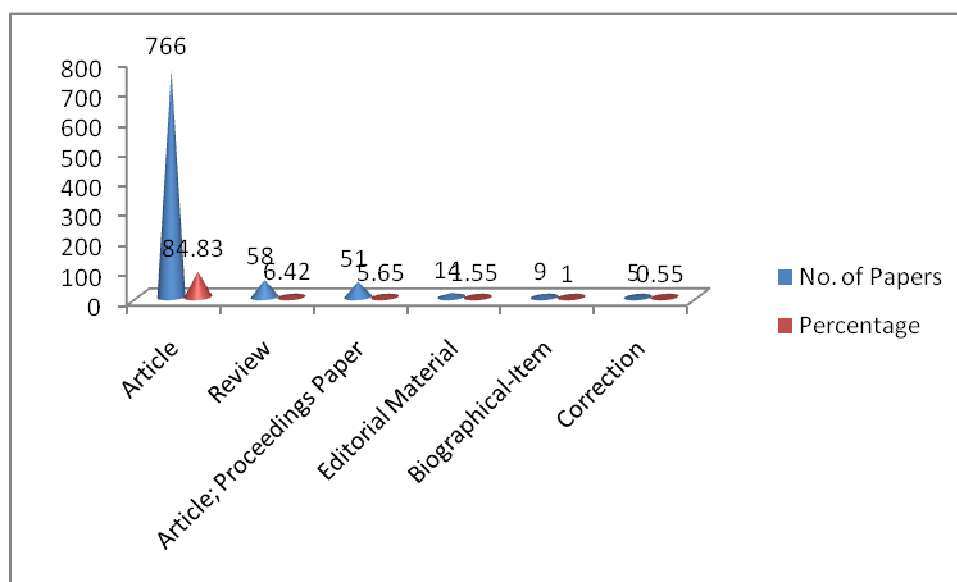


Figure 1: Source wise distribution of Review of Palaeobotany and Palynology

7.3. Authorship Pattern and Collaborative Measures in Review of Palaeobotany and Palynology

Table 2: Authorship Pattern year wise in Review of Palaeobotany and Palynology

Authorship pattern	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total	TA	%
Single	20	18	7	11	6	9	11	4	6	15	107	107	11.96
Two	18	24	30	27	19	13	23	34	20	21	229	458	25.36
Three	21	18	14	25	17	18	34	30	24	29	230	690	25.47
Four	7	12	8	12	17	15	31	16	22	22	162	648	17.94
Five	5	3	5	6	7	10	15	14	8	10	83	415	9.19
Six	2	2		1	1	3	11	3	3	16	42	252	4.65
Seven		1		2	2		3	4	5	5	22	154	2.44
Eight					1	2	1	4	2		10	80	1.11
Nine								2		4	6	54	0.66
Ten				1		1		1		1	4	40	0.44
Eleven					1		2				3	33	0.33
Twelve		1					1				2	24	0.22
Thirty seven							1				1	37	0.11
Eighty two					1		1				1	82	0.11
Total Multi authors	53	61	57	74	66	62	122	108	84	108	795	3074	100.00

Grand Total	73	79	64	85	72	72	133	112	90	123	903		
Degree of Collaboration	0.73	0.77	0.89	0.87	0.92	0.86	0.92	0.96	0.93	0.88	87	Average = 0.87	Av. Author/paper = 3.40
Collaborative Co-efficient	0.60	0.63	0.61	0.66	0.77	0.71	0.75	0.72	0.71	0.73	6.90	Average = 0.69	

TA – Total number of Authorship; % - Percentage

Collaborative research can be effectively measured from the number of authors in papers. It is observed from the Table-2; about 88.04% of papers were contributed by joint-authors. It is found that out of 903 papers, three authored papers were the highest with 230 (25.47%), followed by two authored papers with 229 (25.36%). The single author contribution was low (11.96%) when compared to multi authored papers. A significant note of the study is that the majority of the papers were contributed by joint authors. In essence, this shows a clear trend towards joint-authored papers. In order to measure the Collaborative Research Pattern, indicators like Degree of collaboration, and Collaborative coefficient were applied as per the methodology suggested by different authors as given below:

Degree of Collaboration (DC) is a measure of proportion of multiple authored papers derived by Subramanyam (1983)^[11] as,

$$DC = \frac{N_m}{N_m + N_s}$$

Where, DC = degree of collaboration

N_m = Number of multi authored publications

N_s = Number of single authored papers

The mathematical formula to calculate Collaborative Coefficient (Ajiferuke et al. 1988)^[1] is as,

$$CC = 1 - \frac{\sum_{j=1}^A (1/j) f_j}{N}$$

Where f_j is the number of j-authors papers published in a discipline during a certain period of time; N is the total number of papers published in a discipline during a certain period of time;

and J is the greatest number of authors per paper in a discipline. Using the above formulas Degree of Collaboration (DC) and Collaborative Co-efficient (CC) are calculated. The table shows DC and CC. The overall DC and CC is 0.87 and 0.69 respectively. The CC is increasing year to year which shows the increase in the productivity of joint authored papers which reflects that the nature of collaborations is also very high which proves that our hypothesis ‘Collaborative research dominates in contributions in *Review of Palaeobotany and Palynology*’. 1821 authors contributed to 903 papers on an average 3.40 authors per paper which is a clear indication of collaboration.

7.4. Most productive authors and Lotka’s Law in *Review of Palaeobotany and Palynology*

Author productivity is a measure for ranking the authors according to their publication output (Manoharan, 2014) ^[4]. Table-3 provides the rank list of the top ten authors in the field. The ranks are based on publication numbers (frequency) and h-index (The h-index - Hirsch index that provides an index based on a list of publications ranked in descending order by the times cited count by Hirsch, J.E., 2005) ^[2]. The top ten authors published between 13 and 24 papers during the study period. From 2003 to 2012, 903 papers were published by 1821 authors. Bek J. and Taylor TN were the most prolific authors, with 24 papers, and had the h-index of 8. Kerp H. ranked second in terms of paper numbers and had the highest h-index (h = 9). The Table shows first ten authors’ papers along with h-index. It is interesting to note from the table that authors from USA and Germany share two publications while Czech Republic, France, China, Sweden, England and The Netherlands have shared one paper.

Table 3: Prolific authors in *Review of Palaeobotany and Palynology* (first 10 authors)

Author (Country)	No. of Papers	Percentage	h-index
Bek J (Czech Republic)	24	2.7	8
Taylor TN (USA)	24	2.7	8
Kerp H (Germany)	21	2.3	9
Krings M (Germany)	20	2.2	8
Galtier J (France)	14	1.6	8
Li CS (China)	13	1.4	5
McLoughlin S (Sweden)	13	1.4	7
Riding JB (England)	13	1.4	4
Taylor EL (USA)	13	1.4	5
van Konijnenburg-van Cittert Jha (The Netherlands)	13	1.4	6

Lotka's Law (Lotka, 1926) ^[3] is one among the three classic laws of Bibliometrics, which deals with the frequency of publication by authors in any given field.

Lotka observed a quantitative relation among the authors and their scientific production. It states that, "... the number (of authors) making n contributions is about 1/n² of those making one; and the proportion of all contributors, that make a single contribution, is about 60 percent", which means that out of all the authors in a given field, 60% will have only one publication, 15% will have two publications and 7% of authors will have 3 publication and so on. In other words, in a particular topic, for every 100 authors whose contribution is single article, there will be 25 authors with two articles, 11 authors with three articles etc. The generalized form of Lotka's law can be expressed as $x^n y = k$. Where y is the number of authors with x articles, the exponent n and constant k are parameters to be estimated from a given set of author productivity data.

The productivity of *Review of Palaeobotany and Palynology* is test to find the conformity with the Lotka's inverse square law using Pao's (1985) ^[5] method and it is test by K-S goodness-of-fit test. The 'n' is determined using Linear Least Square (LLS) regression method. To determine the 'n' value, the LLS method is followed using the formula

$$n = \frac{[N \sum (\ln x \cdot \ln g(x)) - \sum \ln g(x) \sum \ln x]}{[N \sum (\ln x^2) - (\sum \ln x)^2]}$$

N = number of pairs of data

X = logarithm of x, i.e. number of articles

Y = logarithm of y, i.e. number of authors

The value of C, which is the theoretical number of authors with a single article, is determined from the following formula

$$C = \frac{1}{\sum_{x=1}^{p-1} \frac{1}{x^n} + \frac{1}{(n-1)(p^{n-1})} + \frac{1}{2} pn + \frac{n}{24 \times (p-1)^{n+1}}}$$

Table-4: Application of Lotka's Law in *Review of Palaeobotany and Palynology*

x	y	X	Y	xX	XY	yx/sigmayx	cum observ	Expect	Cum Exp	D
1	1299	0.000	3.114	0.000	0.000	0.713	0.713	0.680	0.680	0.033
2	276	0.301	2.441	0.091	0.735	0.152	0.865	0.145	0.825	0.040
3	104	0.477	2.017	0.228	0.962	0.057	0.922	0.059	0.884	0.038

4	46	0.602	1.663	0.362	1.001	0.025	0.947	0.031	0.915	0.033
5	32	0.699	1.505	0.489	1.052	0.018	0.965	0.019	0.933	0.032
6	19	0.778	1.279	0.606	0.995	0.010	0.975	0.013	0.946	0.029
7	15	0.845	1.176	0.714	0.994	0.008	0.984	0.009	0.955	0.029
8	10	0.903	1.000	0.816	0.903	0.005	0.989	0.007	0.961	0.028
9	4	0.954	0.602	0.911	0.575	0.002	0.991	0.005	0.966	0.025
10	2	1.000	0.301	1.000	0.301	0.001	0.992	0.004	0.970	0.022
11	3	1.041	0.477	1.084	0.497	0.002	0.994	0.003	0.974	0.020
12	1	1.079	0.000	1.165	0.000	0.001	0.995	0.003	0.976	0.018
13	5	1.114	0.699	1.241	0.779	0.003	0.997	0.002	0.978	0.019
14	1	1.146	0.000	1.314	0.000	0.001	0.998	0.002	0.980	0.017
20	1	1.301	0.000	1.693	0.000	0.001	0.998	0.001	0.981	0.017
21	1	1.322	0.000	1.748	0.000	0.001	0.999	0.001	0.982	0.017
24	2	1.380	0.301	1.905	0.415	0.001	1.000	0.001	0.983	
170	1821	14.94	16.57	15.36	9.21				Max D	0.040

Here ‘n’ is substituted with the value 2.23 and ‘c’ is calculated as 0.68 using the equation, while ‘p’ is assumed to be 20. By replacing the values of ‘n’ and ‘c’ in the above table difference is calculated. Here the D is minimum and hence the Lotka’s law is confirmed to the present data set. From Table-4 it is clear that the maximum absolute difference value D_{max} which represents the maximum deviation is identified as 0.040. The table value or critical value of D in K-S test at 0.05 and 0.01 levels are 0.0318 and 0.0381 respectively, while the calculated value of D is 0.040, which means the calculated value of D fall within the critical value of D. Therefore the author productivity of the present data set confirms Lotka’s law.

7.5. Organization wise distribution of *Review of Palaeobotany and Palynology*

There were around 819 organizations or institutions worldwide involved in *Review of Palaeobotany and Palynology* publications sharing 903 publications during 2003-2012. Of the total of 819 organizations, 493 (23.51%) were single organizational publications and the remaining 326 (76.49 %) were inter-organizational collaborated publications. The performance of the top ten most productive organizations was examined and is presented in Table-5 and in Figure-2. The Chinese Academy of Science, China was the top most in the list with 73 papers (8.08 %) followed by University Utrecht, The Netherlands with 31 papers (3.43%), third place occupied by University Kansas, USA with 28 papers (2.65%) and rest are shown in the table.

Table 5: Organization-wise contribution of *Review of Palaeobotany and Palynology*

Organizations (Country)	No. of Publications	Percentage
-------------------------	---------------------	------------

file is called from VOSviewer to map the bibliographic coupling of organizations (Figure-2). With the fractional counting method more than 5 authors documents selected. Of the 818 organizations, 101 items meet the threshold. For each of the 101 organizations, the number of bibliographic coupling links will be calculated. The organizations with the largest number of links i.e. 101 items are connected in 10 clusters with different colors. In the label view, 101 items are indicated both by their label and by a circle. For each item, the font size of the item's label and the size of the item's circle depend on the weight of the item. If items have been assigned to clusters, the color of the circle of an item can be determined by the cluster to which the item belongs. It clearly depicts the most prolific organizations Chinese Academy of Science, China, University Utrecht, The Netherlands, University Kansas and others respectively with different colors.

7.6. Country wise distribution of *Review of Palaeobotany and Palynology*

Table 6: Geographical distribution of contributions *Review of Palaeobotany and Palynology*

Country	Records	%
UK	174	12.03
USA	156	10.79
Germany	128	8.85
France	123	8.51
Peoples R China	112	7.75
Netherlands	71	4.91
Sweden	62	4.29
Argentina	52	3.60
Spain	48	3.32
Czech Republic	46	3.18
Canada	43	2.97
Australia	41	2.84
Belgium	29	2.01
Russia	29	2.01
Poland	25	1.73
Italy	23	1.59
Brazil	20	1.38
Austria	19	1.31
Switzerland	18	1.24
Unknown	18	1.24
South Africa	17	1.18
Denmark	16	1.11
Mexico	14	0.97
Norway	12	0.83
India	10	0.69
Portugal	10	0.69
Iran	9	0.62
New Zealand	9	0.62
Estonia	8	0.55
Japan	8	0.55
Finland	7	0.48
Romania	7	0.48
South Korea	7	0.48
Bulgaria	6	0.41
Hungary	6	0.41
Iceland	6	0.41
Ireland	6	0.41
Chile	4	0.28
Egypt	4	0.28
Morocco	4	0.28
Bolivia	3	0.21
Colombia	3	0.21
Pakistan	3	0.21
Turkey	3	0.21
Indonesia	2	0.14
Israel	2	0.14
Jordan	2	0.14
Malaysia	2	0.14
Rep of Georgia	2	0.14

Slovakia	2	0.14
Armenia	1	0.07
Croatia	1	0.07
Ecuador	1	0.07
Gabon	1	0.07
Greece	1	0.07
Kenya	1	0.07
Libya	1	0.07
Oman	1	0.07

Panama	1	0.07
Peru	1	0.07
Saudi Arabia	1	0.07
Tanzania	1	0.07
Tunisia	1	0.07
Uganda	1	0.07
Uruguay	1	0.07
Total	1446	100.00

Country-wise analysis reveals that among sixty five countries which contributed papers in *Review of Palaeobotany and Palynology* with 1821 authors for the study period in the Table-6 U.K. stands first with 174 (12.03%) papers, and the second position by USA with 156 (10.79%) papers, followed Germany with third position with 128 papers (8.85%) and fourth position by France 123 (8.51%) and the rest are depicted in the table.

The role of funding agencies was also assessed as this may significantly affect the course and discipline of research. 501 funding agencies played vital roll in the study period. 89% of funding agencies are from developed countries. The first ten places were occupied by China, USA, Germany, and Czech Republic respectively. It is clearly depicts that most developed countries are in major lead in contribution of Palaeobotany and Palynology literatures which is agreement with our hypothesis “Research productivity will be comparatively higher in developed countries”.

It is interesting note that India occupies 23rd place in Palaeobotany and Palynology literature. This difference may probably be due to lack of better infrastructure, laboratory and library facilities and less funding in our country for research activities in the discipline. The Department of Science and Technology, Government of India, New Delhi was the only funding agency for our country in the study period.

8. HIGHLY CITED PAPERS OF REVIEW OF PALAEOBOTANY AND PALYNOLOGY

The characteristics of highly cited papers are list in the Table-7 among the papers related to *Review of Palaeobotany and Palynology* research during 2003-2012. Citations received by the 10 top cited papers accumulated to 978 of all citations. Of the 10 papers, 1 have single author while the others have more than one author. The top cited paper was “Glossary of pollen and spore terminology” authored by Punt, W. et al., from The Netherlands and

published in 2007. In this paper, pollen and spore terminology was presented to the international palynological community and widely accepted as reference guide for palynologists to assist in the preparation of accurate and consistent descriptions of their material.

Table 7: Highly Cited Papers of *Review of Palaeobotany and Palynology*

S. No.	Title/Source	Times cited
1	Glossary of pollen and spore terminology. By: Punt, W.; Hoen, P. P.; Blackmore, S.; et al. Volume: 143 (1-2): 1-81, JAN 2007	343
2	Atlas of modern organic-walled dinoflagellate cyst distribution. By: Marret, F; Zonneveld, KAF. Volume: 125 (1-2): 1-200, JUN 2003	226
3	Holocene vegetation and climate history at Hurleg Lake in the Qaidam Basin, northwest China By: Zhao, Yan; Yu, Zicheng; Chen, Fahu; et al. Volume: 145 (3-4): 275-288, JUL 2007	61
4	Dinocyst distribution in surface sediments from the northeastern Pacific margin (40-60 degrees N) in relation to hydrographic conditions, productivity and upwelling. By: Radi, T; de Vernal, A. Conference: Workshop on Middle Latitude Dinoflagellates and Their Cysts Location: NOVA SCOTIA, CANADA Date: APR 29-MAY 02, 2002, Volume: 128 (1-2): 169-193, JAN 2004	54
5	Expected trends and surprises in the Lateglacial and Holocene vegetation history of the Iberian Peninsula and Balearic Islands. By: Carrion, Jose S.; Fernandez, Santiago; Gonzalez-Samperiz, Penelope; et al. Volume: 162 (3): 458-475, OCT 2010	53
6	Devonian-Early Carboniferous miospore biostratigraphy of the Amazon Basin, Northern Brazil. By: Melo, JHG; Loboziak, S. Volume: 124 (3-4): 131-202, MAY 2003	51
7	Pollen-vegetation relationships in non-arboreal moorland taxa. By: Bunting, MJ. Volume:125 (3-4): 285-298, JUL 2003	50
8	The influence of refugial population on Lateglacial and early Holocene vegetational changes in Romania. By: Feurdean, Angelica; Wohlfarth, Barbara; Bjorkman, Leif; et al. Volume: 145 (3-4): 305-320, JUL 2007	48
9	Quantitative relationships between modern pollen rain and climate in the Tibetan Plateau. By: Shen, Caiming; Liu, Kam-biu; Tang, Lingyu; et al. Volume: 140 (1-2): 61-77, JUN 2006	48
10	A key to morphogenera used for Mesozoic conifer-like woods. By: Philippe, Marc; Bamford, Marion K. Conference: 73rd Annual Meeting of the Palaontologische-Gesellschaft Location: Mainz, GERMANY Date: SEP 29-OCT 03, 2003. Sponsor(s): Palaontolog Gesell. Volume: 148 (2-4): 184-207, JAN 2008	44

9. KEYWORD TOMOGRAPHY

Table 8: Keyword analysis for *Review of Palaeobotany and Palynology*

Keyword	Total	%
Pollen	225	4.59
Fossil wood	143	2.91
In situ spores	104	2.12
Palynology	94	1.92
Vegetation	89	1.81

Cretaceous	72	1.47
Palaeoclimate	72	1.47
Holocene	68	1.39
China	58	1.18
Biostratigraphy	54	1.10
Miocene	53	1.08

Permian	53	1.08
Dinoflagellate cysts	52	1.06
Palaeoecology	47	0.96
Ultrastructure	42	0.86
Carboniferous	42	0.86
Triassic	33	0.67
Acritarchs	26	0.53

Pennsylvanian	26	0.53
Argentina	24	0.49
Taxonomy	23	0.47
Antarctica	20	0.41
Oligocene	20	0.41
Early Cretaceous	20	0.41
Taphonomy	20	0.41

The paleobotany and palynology research trends can be obtained by analyzing the author keywords appended to the research papers for the study periods. Keywords are one of the best bibliometric indicators to understand the content of the papers and to find out the growth of the subject field. In the journal *Review of Palaeobotany and Palynology* for the study period the authors have provided 4906 keywords. The high frequency keywords will enable us to understand the various aspects of the subjects. High frequency keywords were Pollen (225, 4.59%), Fossil wood (143, 2.91%), In situ spores (104, 2.12%), Palynology (94, 1.92%). Table-8 shows list of 25 keywords which have appeared more than 20 times.

10. FINDINGS AND CONCLUSION

The total numbers of papers published in *Review of Palaeobotany and Palynology* was 903 for the study period 2003-2012. During the study period highest numbers of papers published have appeared in 2009 (133 papers). A total of 903 publication including 6 document types were published for the study period. Articles were the dominant document type (84.83%) and among them joint-authored publications were the more dominant. The present work had taken up a detailed analysis of *Review of Palaeobotany and Palynology* literature over a ten year period (2003-2012). A word of caution here is that the present work is only on the numbers, and do not in any way reflect the growth or decline in the standard of publications. The authors accept the limitation of the work: The first fact is that our work need not necessarily be reflective of the current trend in the robust field of Palaeobotany and Palynology as the entire scope is restricted to only one journal. Yet the work provides a reasonable glimpse of the works in the field of Palaeobotany and Palynology, using a reputed journal indicating the direction in which the field is trending. An evident comparison with other journals with higher impact factors may be unavoidable, but the clear fact is that most of those would be focusing on broader themes, but the protagonist in this case is a journal with a specific theme. It will be interesting to replicate this work in a few years from now to observe the changes in the publication patterns of this journal.

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