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Quantitative Analysis Of The Research Publications On Palaeontology Literature: A Scientometric Study

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Abstract

The study analyses the Scientometric analysis of the Quantitation techniques on the Publications trend has been measured in the field of Palaeontology based on the Scopus data for the period of study between 2005 and 2019. The topmost productive year was 2019 with 998 records (8.28%). Similarly the least productive year was 2005 with 371 records (3.08%). The publications, from 2005 to 2012 (8 years) 45.82% publications were found; whereas from 1913 to 2019 (7 years) 54.18% publications were found. The maximum number of citations in the year 2011 comprises 24683 citations and the minimum number of citations is 3115 in 2019. The maximum number of citations per paper is 39.28 in 2006. The highest exponential growth rate was found to be 1.23 in the year 2010 with 909 publications. The highest AGR was found in the year 2010 (23) followed by the year 2007 (21.83). The maximum RGR value is found to be 0.79 in the year 2006 and the minimum value is found to be 0.08 in the year 2018. Here the correlation coefficient of these two variables is 0.96. The highest CC 0.61 is reported in the year 2019. The overall CC =0.53 which is far from 0. The highest MCC 0.61 has been reported in the year 2019. The lowest MCC 0.40 has been reported in the year in 2006. The overall MCC is 0.53. The journal titled “Journal of Vertebrate Palaeontology" occupied the first position with 1494 publications. The second most productive journal was " PLoS ONE " with 471 publications.

Keywords : Scientometrics, Palaeontology, SCOPUS, Exponential Growth Rate, Time Series Analysis, Collaborative Co-efficient, Authorship Index

Introduction

The term' Scientometrics' ('naukometriya') was coined by Vassily V. Nalimov and Z. M. Mulchenko in the year 1971 in Russia. This word is mostly used to describe the study of all areas of science and technology literature. The term received widespread notoriety after Braun, Bujdoso & Schubert founded the magazine "Scientometrics" in Hungary in 1978. Scientometrics encompasses all quantitative aspects of science, science communication, and science policy, according to its subtitle. Scientometrics is a term that is commonly interchanged with bibliometrics to describe quantitative approaches for quantifying science. The

measurement entails counting artefacts in order to produce and use data, as well as drawing conclusions from the counts. Scientometrics has a long history dating back to the early twentieth century. The quantity of literature written was a major focus of early investigations in Scientometrics. Cole and Eales[5] in 1917 added a new dimension to Scientometrics by attempting to establish the dynamics of literature contributions and country-level scientific productivity. Hulme (1923), on the other hand, looked at the author and journal entries in the Royal Society's catalogue and ranked the countries based on their journal literary output. To explain the quantitative analysis, he used the term 'statistical bibliography.' However, the preceding pioneering investigations received little attention and remained unnoticed at first. Other pioneering publications by Lotka, Gross & Gross, De Solla Price, and Eugene Garfield gradually emerged, all of which contributed significantly to the development of the area of Scientometrics. With the publication of T. Braun's[8] journal "Scientometrics" in 1977, the term "Scientometrics" acquired popularity.

Palaeontology: An overview

Palaeontology (Greek: palaios, old; onta, creatures; logos, speech) is the study of living organisms, both animal and vegetable, that have inhabited this planet at different times throughout its history. It is the earth's ancient life history, and if it could ever be completed, it would provide us with a detailed description of the structure, habits, and distribution of all creatures and plants that have ever thrived on the planet's land surfaces or inhabited its waterways. However, for reasons that will be explored later, the paleontological record is highly imperfect, and our knowledge is disrupted by gaps that not only account for a significant amount of our solid data, but in many cases are of such a character that they can never be filled. Palaeontology can be thought of as the Zoology and Botany of the past, as Zoology deals with the creatures that currently occupy the world and Botany with the plants that already exist. From this, the only genuine point of view, some understanding of Zoology and Botany is required for the study of Palaeontology, and any aspects of these sciences that are thought necessary will be introduced at the appropriate time.

Literature Review

Philip M Frazer et al (2021) analysed the Bibliometric Analysis of 4 Major Foot and Ankle Surgery Journal. Alexander W. Peters et al (2020) studied the Comparative analysis of authorship trends in the Journal of Hand Surgery European and American volumes. Maria E. Squire et al. (2020) investigated the Trends in Gender Authorship and Collaborations: A 30-Year Comparative Bibliometric Analysis of Manuscripts from The Journal of Bone and Joint Surgery and The Bone and Joint Journal. Ellen Lutnick et al.(2021) analysed the authorship Proliferation of Research Articles in Top 10 Orthopaedic Journals: A 70-Year Analysis. Saleh S. Baeesaet al.(2017) studied the Quality of Spine Surgery Research from the Arab Countries: A Systematic Review and Bibliometric Analysis. On review of the literature, it was found that there were no studies like, yearly output of articles, authorship patterns, Degree of Collaboration, Pattern of Co-Authorship Index (CAI) and Collaborative Coefficient (CC) of annual research output in the field of spine surgery literature during the period of 1991-2019. Hence it is proposed to study quantitatively the literature published on spine surgery by using

the bibliographic database, namely MEDLINE which covered in the Pubmed. Baskaran (2019) analysed 11,941 total records on social networks and media retrieved from Web of Science database during the period of study. The study found that predominantly records 2,576 (21.57%) of the publications brought out in 2018, followed by 2,281 (19.10%) records published in 2017. The United States announced the National Nanotechnology Initiative (NNI) in 2000 based on a long-term vision (Roco & AL., 2000). Since 2000, nanotechnology has been recognized as a national priority in all industrialized countries, as well as many developing, and at least thirty countries have initiated, or are beginning, national activities in this field (Roco, 2001). Nano technology has been assiduously investigated by bibliometric methods, used to obtain a clear perspective on it under the rapid pace of the publications. While expert-based road mapping is one option to assess emerging technologies (Fleischer & AL., 2005) . A computer-assisted approach is more helpful to facilitate awareness of global research trends. Braun & AL. (1997) focus on the scientific aspects of nanotechnology and describe the rapid development of the field since the early 1990s. They could establish an exponential growth pattern of publications in Nano science and nanotechnology starting in the early 1990s. Baskaran (2018) analyzed that more numbers of Male respondents 62.83 % of them M.Phil and 62.06 % of them Ph.D .the study analyzed the Social Networks found the SD and CV are 39.04212 and 1519.502 reflected by Nature Network. Meyer & Persson (1998) characterized the field as more interdisciplinary than other areas of science and explored the contributions made by various fields of science and technology to Nano science. Meyer (2000, 2001) studied the interrelationships between science and technology. In addition, Meyer (2006) investigated co-author maps of Nano science, while Calero & AL. (2006) proposed an author/organization combination and investigated clusters of authors to detect potential partners with similar activities. Chau & AL. (2006) constructed a web portal about nanotechnology. Baskaran (2021) analysed the mapping of research trends and author productivity of global literature on coronavirus output of research publications as indexed in the Web of Science from 1996 to 2020. A total of 12,706 publications were published on Coronavirus during 1996–2020. The highest number of publications, 783 or 6.162% was published in 2004. A total of 33,814 authors contributed to the 12,706 publications (i.e. the total publications shared by 37.57% of the authors).

Objectives of the Study

1. To Year wise distribution and Citations of Publications in Palaeontology Literature during study period 2005 to 2019.
2. To study the Exponential Growth and Annual Growth Rate in Palaeontology Literature
3. To find out the Relative Growth Rate (RGR) and Doubling Time (DT) of Palaeontology
4. To analyse the Time Series Analysis of Palaeontology literature output
5. To find the Degree of Collaboration, Collaborative Index, Collaborative Coefficient,
6. Modified Collaborative Coefficient and Co-authorship Index
7. To examine the Keyword Analysis Zipfs' Law and Prolific Journal in Palaeontology Literature

Methodology

This study is based on Scientometric analysis conducted to assess the growth rate of Palaeontology Literature with the help of Scopus source database during 2005-2019. The source database, bibliometric and Scientometric indicators used, statistical tool, techniques and formulas applied have been described in this chapter. The source database used in this study is Scopus. Scopus launched in November 2004 by Elsevier, which is the largest abstract and citation database of peer-reviewed literature, that includes scientific journals, books and conference proceedings. It is equipped with high class data and comprehensive contents to track analyse and imagine the research to give a complete overview of the world's research output in the fields of science, technology, medicine, social sciences, and arts and humanities. As research turns into progressively more global, interdisciplinary and collaborative, researchers from around the world prefer Scopus database for their scientific research activities. Scopus covers 22,800 titles from 100 more than 5000 international publishers, over 8 million conference papers from worldwide events.

Discussion

Year -wise distribution of Publications in Palaeontology

The study evaluates research productivity in the field of Palaeontology Literature; the frequency distribution of publications was analyzed and interpreted. A total number of 12052 records were published between 2005 and 2019 on Palaeontology Literature and those records retrieved from the Scopus database which is a multidisciplinary abstract and citation database. As per the analysis of data, it was observed from Table 1 that the topmost productive year was 2019 with 998 records (8.28%). Similarly the least productive year was 2005 with 371 records (3.08%). It was also observed that out of all publications, from 2005 to 2012 (8 years) 45.82% publications were found; whereas from 1913 to 2019 (7 years) 54.18% publications were found. According to Table 1 and Figure 1 the frequency distribution of Publications, it was also observed that the growth of productivity in Palaeontology Literature was a gradual increase from the year 2015 to 2019. Figure 1 described that there was gradual increase in every five block years as follows: from the year 2005 to 2009 with 2720 (22.57%) records followed by 2010-2014 with 4604 (38.2%) records; 2015-2019 with 4728 (39.23%) records respectively. It was found that the Average Number of Publications per year was 803.46 between the study period 2005 and 2019.

Table 1 : Year wise distribution of Publications on Palaeontology

S. No	Year	Publications	% of 12052	Cumulative Growth	Cumulative Percentage
1	2005	371	3.08	371	3.08
2	2006	449	3.73	820	6.80
3	2007	547	4.54	1367	11.34
4	2008	614	5.09	1981	16.44
5	2009	739	6.13	2720	22.57
6	2010	909	7.54	3629	30.11
7	2011	974	8.08	4603	38.19

8	2012	919	7.63	5522	45.82
9	2013	858	7.12	6380	52.94
10	2014	944	7.83	7324	60.77
11	2015	985	8.17	8309	68.94
12	2016	873	7.24	9182	76.19
13	2017	985	8.17	10167	84.36
14	2018	887	7.36	11054	91.72
15	2019	998	8.28	12052	100
Total		**12052**	**100**		

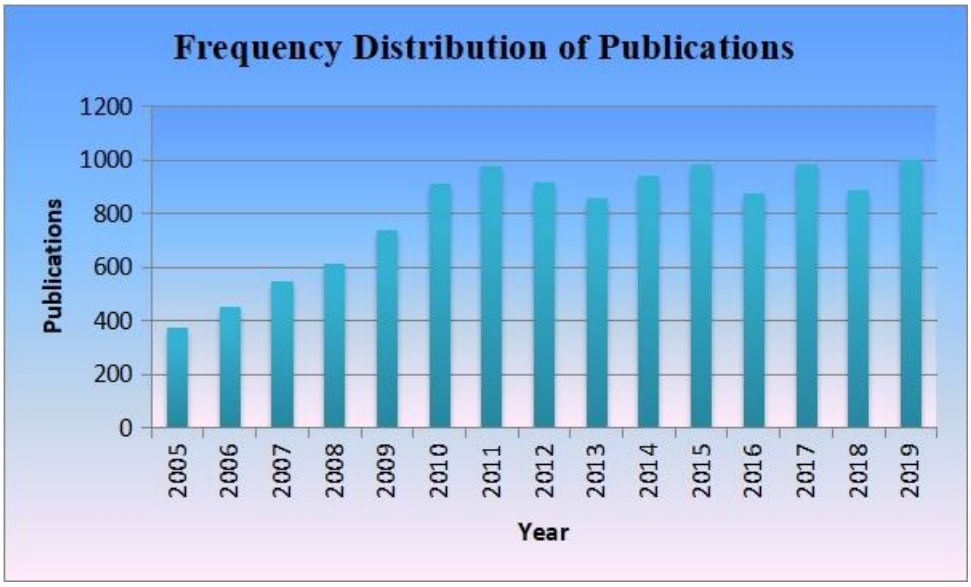

Figure 1: Year wise distribution of Publications on Palaeontology

Distribution of Citations in Palaeontology

Frequency Distribution of Citations and Citation per paper (CPP) in the field of Palaeontology Literature research output is observed from Table 2. The maximum number of citations in the year 2011 comprises 24683 citations and the minimum number of citations is 3115 in 2019. The maximum number of citations per paper is 39.28 in 2006. The minimum number of citations per publication is 3.12 in 2019. A total of 232618 citations were observed during the study period. The overall citation per paper is 19.3. Average Number of Citations per year is 15507.86.

Table 2: Distribution of Citations in Palaeontology Literature

S. No	Year	Publications	Citations	CPP
1	2005	371	14295	38.53
2	2006	449	17635	39.28
3	2007	547	20895	38.2
4	2008	614	18242	29.71
5	2009	739	21689	29.35
6	2010	909	24219	26.64

7	2011	974	24683	25.34
8	2012	919	19192	20.88
9	2013	858	14667	17.09
10	2014	944	15218	16.12
11	2015	985	16862	17.12
12	2016	873	9177	10.51
13	2017	985	7373	7.49
14	2018	887	5356	6.04
15	2019	998	3115	3.12
Total		**12052**	**232618**	**19.3**
Average Number of Citations per year			**15507.86**	

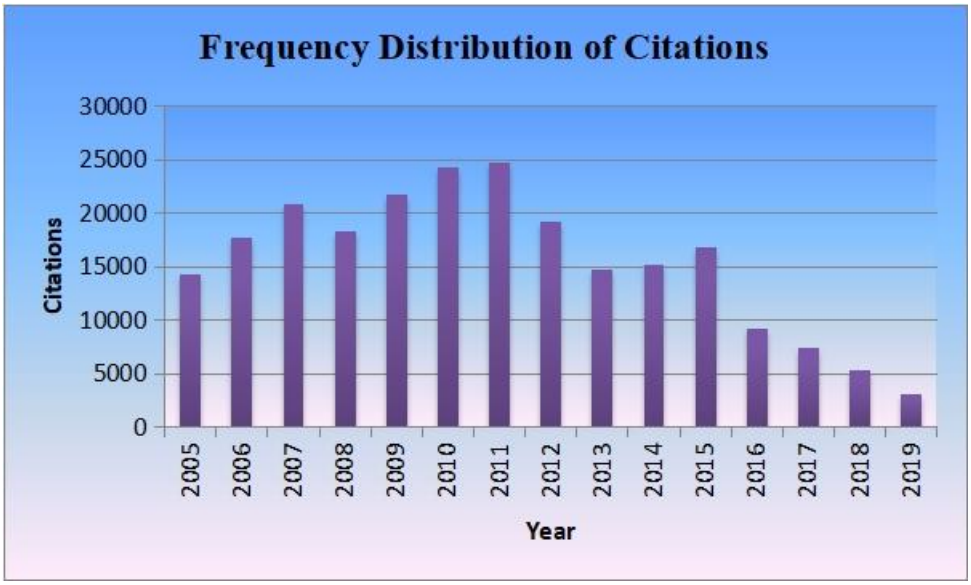

Figure 2: Distributions of Citations in Palaeontology

Exponential Growth Rate in Palaeontology

Table 3 shows the exponential growth of publications output in Palaeontology Literature observed during the period 2005-2019. The highest exponential growth rate was found to be 1.23 in the year 2010 with 909 publications. The lowest exponential growth rate was found to be 0.89 in the year 2016 with 873 publications. The analysis shows from figure 3, overall average exponential growth rate was 1.07. On the whole, it was clearly known that there was a fluctuation in Exponential Growth Rate during the study period.

Table 3: Exponential Growth Rate in Palaeontology

Year	Publications	Exponential Growth Rate
2005	371	
2006	449	1.21
2007	547	1.22
2008	614	1.12
2009	739	1.20
2010	909	1.23
2011	974	1.07
2012	919	0.94
2013	858	0.93
2014	944	1.10
2015	985	1.04
2016	873	0.89
2017	985	1.13
2018	887	0.90
2019	998	1.13
Total	**12052**	**1.07**

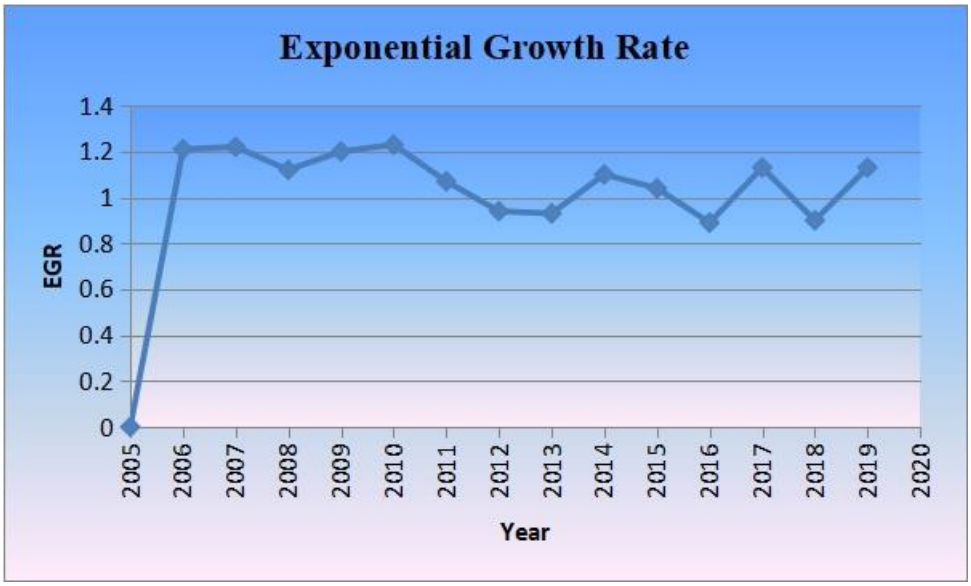

Figure 3: Exponential Growth Rate in Palaeontology Literature

Annual Growth Rate of Palaeontology Literature

Table 4 depicts the annual growth rate output of Palaeontology Literature. It indicates that the annual growth rate fluctuated throughout the study period 2005-2019. The highest AGR was found in the year 2010 (23) followed by the year 2007 (21.83). It was also found that the years 2012, 2013, 2016, and 2018 had a negative growth rate. However, there is positive growth during the recent years in the field of Palaeontology Literature research in India (Figure 4).

Table 4 : Annual Growth Rate of Palaeontology

Year	Publications	Annual Growth Rate
2005	371	
2006	449	21.02
2007	547	21.83
2008	614	12.25
2009	739	20.36
2010	909	23.00
2011	974	7.15
2012	919	-5.65
2013	858	-6.64
2014	944	10.02
2015	985	4.34
2016	873	-11.37
2017	985	12.83
2018	887	-9.95
2019	998	12.51
Total	**12052**	

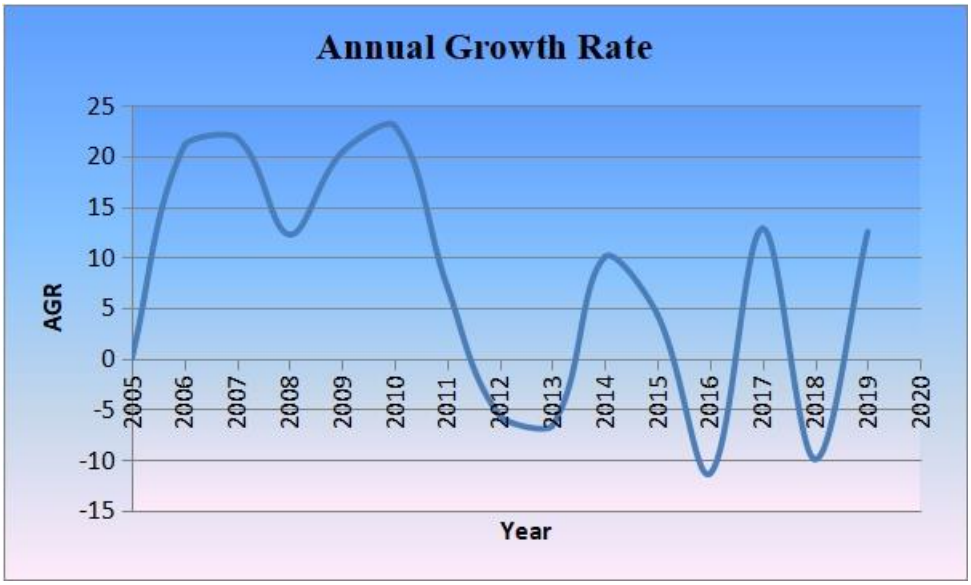

Figure 4: Annual Growth Rate of Palaeontology

Relative Growth Rate (RGR) and Doubling Time (DT) of Palaeontology

Table 5 shows the Relative Growth Rate and Doubling time of Palaeontology Literature research output. The maximum RGR value is found to be 0.79 in the year 2006 and the minimum value is found to be 0.08 in the year 2018. In the RGR analysis, a steady decrease is found during the study period. However, Doubling Time increases from 0.87 (2006) to 8.28

(2018). RGR has shown a decreasing trend while the DT shows an increasing and decreasing trend. From the study (Figure 5),

Table 5 : Relative Growth Rate (RGR) and Doubling Time (DT) of Palaeontology

S. No	Year	Publications	Cumulative	W1	W2	RGR	DT
1	2005	371	371		5.92		
2	2006	449	820	5.92	6.71	0.79	0.87
3	2007	547	1367	6.71	7.22	0.51	1.36
4	2008	614	1981	7.22	7.59	0.37	1.87
5	2009	739	2720	7.59	7.91	0.32	2.19
6	2010	909	3629	7.91	8.20	0.29	2.40
7	2011	974	4603	8.20	8.43	0.24	2.91
8	2012	919	5522	8.43	8.62	0.18	3.81
9	2013	858	6380	8.62	8.76	0.14	4.80
10	2014	944	7324	8.76	8.90	0.14	5.02
11	2015	985	8309	8.90	9.03	0.13	5.49
12	2016	873	9182	9.03	9.13	0.10	6.94
13	2017	985	10167	9.13	9.23	0.10	6.80
14	2018	887	11054	9.23	9.31	0.08	8.28
15	2019	998	12052	9.31	9.40	0.09	8.02
Total		**12052**					

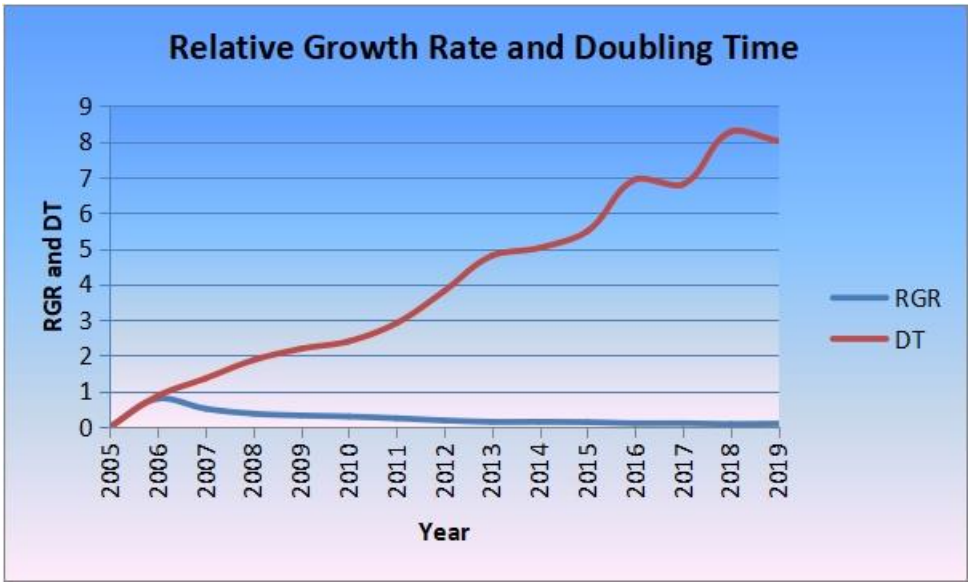

Figure 5: Relative Growth Rate (RGR) and Doubling Time (DT) of Palaeontology

Time Series Analysis of Palaeontology

Time Series Analysis is used to estimate the productivity of publications in the future. Table 6 applies the technique is used to estimate the literature output for the year 2025 and 2030.

Based on the calculation, it is found that the predicted value of literature output has

increased from 12052 (2019) to 1311.16 (2025) and the value further increased in the year 2030 (1506.43). Hence from the results, it is clearly observed that productivity of Palaeontology Literature may increase in the future. Table 6 shows the estimated future growth. Based on the analysis, the estimated future productivity of Palaeontology Literature in 2025 and 2030 is declining and analysis has been discussed from figure 6.

Straight Line equation $Yc = a + bX$

Since $\sum X = 0$

$a = \sum Y/N = 803.467$

$b = \sum XY/\sum X^2 = 39.0536$

Estimated literature in 2025 = 1311.16

Estimated literature in 2030 = 1506.43

Table 6: Time Series Analysis of Palaeontology

S. No	Year	Publications Y	X	X^2	XY
1	2005	371	-7	49	-2597
2	2006	449	-6	36	-2694
3	2007	547	-5	25	-2735
4	2008	614	-4	16	-2456
5	2009	739	-3	9	-2217
6	2010	909	-2	4	-1818
7	2011	974	-1	1	-974
8	2012	919	0	0	0
9	2013	858	1	1	858
10	2014	944	2	4	1888
11	2015	985	3	9	2955
12	2016	873	4	16	3492
13	2017	985	5	25	4925
14	2018	887	6	36	5322
15	2019	998	7	49	6986
Total		**12052**	**0**	**280**	**10935**

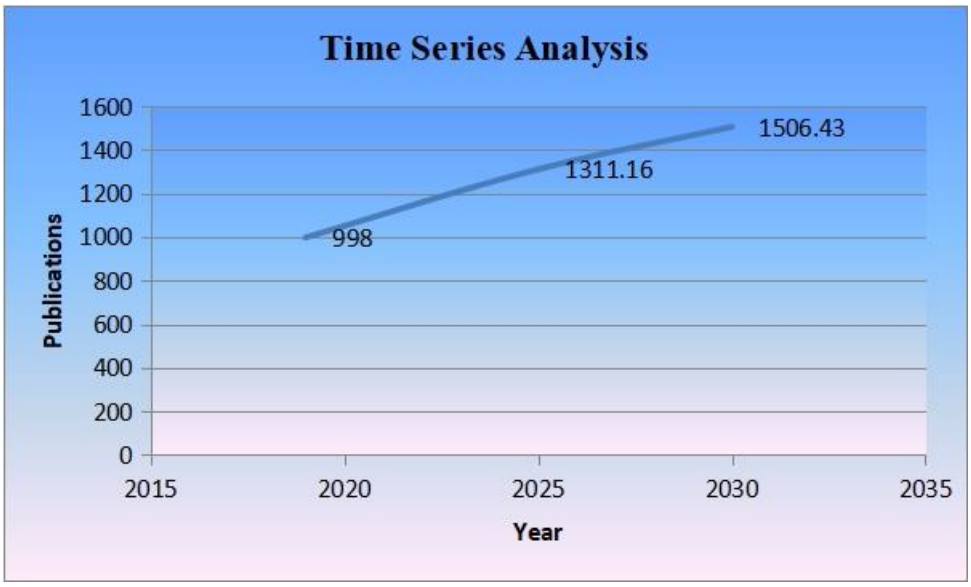

Figure 6: Time Series Analysis of Palaeontology Literature

Correlation between Publications and Citations in Palaeontology

Table 7 shows the correlation between the Publications and the Citations in Palaeontology Literature. The Pearson‘s correlation coefficient is used here to find the degree of relationship between the two variables, the Publications and the Citations. Here it is applied to find the Positive relationship between the Publications and the Citations. Here the correlation coefficient of these two variables is -0.24. Since the r value is negative, we can say that the relationship between the variables is negatively correlated. Therefore whenever the publications increase, then there will be an decrease in the number of citations.

Table 7: Correlation between Publications and Citations in Palaeontology

S. No	Year	Publications X	Citations Y	XY	X^2	Y^2
1	2005	371	14295	5303445	137641	204347025
2	2006	449	17635	7918115	201601	310993225
3	2007	547	20895	11429565	299209	436601025
4	2008	614	18242	11200588	376996	332770564
5	2009	739	21689	16028171	546121	470412721
6	2010	909	24219	22015071	826281	586559961
7	2011	974	24683	24041242	948676	609250489
8	2012	919	19192	17637448	844561	368332864
9	2013	858	14667	12584286	736164	215120889
10	2014	944	15218	14365792	891136	231587524
11	2015	985	16862	16609070	970225	284327044
12	2016	873	9177	8011521	762129	84217329
13	2017	985	7373	7262405	970225	54361129
14	2018	887	5356	4750772	786769	28686736

15	2019	998	3115	3108770	996004	9703225
Total		**12052**	**232618**	**182266261**	**10293738**	**4227271750**

Correlation between Contributor and Contributions in Palaeontology

Table 8 shows the correlation between the Contributor and Contributions in Palaeontology Literature. The Pearson's correlation coefficient is used here to find the degree of relationship between the two variables, the Contributor and Contributions. Here it is applied to find the Positive relationship between the Contributor and Contributions. Here the correlation coefficient of these two variables is 0.96. Since the r value is positive, we can say that the relationship between the variables is positively correlated. Therefore whenever the contributor increases, then there will be an increase in the number of contributions.

Table 8: Correlation between Contributor and Contributions in Palaeontology

S. No	Year	Contributor X	Contributions Y	XY	X^2	Y^2
1	2005	1001	371	371371	1002001	137641
2	2006	1197	449	537453	1432809	201601
3	2007	1651	547	903097	2725801	299209
4	2008	1866	614	1145724	3481956	376996
5	2009	2340	739	1729260	5475600	546121
6	2010	2966	909	2696094	8797156	826281
7	2011	3315	974	3228810	10989225	948676
8	2012	3224	919	2962856	10394176	844561
9	2013	3093	858	2653794	9566649	736164
10	2014	3507	944	3310608	12299049	891136
11	2015	3893	985	3834605	15155449	970225
12	2016	3552	873	3100896	12616704	762129
13	2017	3951	985	3891735	15610401	970225
14	2018	3669	887	3254403	13461561	786769
15	2019	4313	998	4304374	18601969	996004
Total		**43538**	**12052**	**37925080**	**141610506**	**10293738**

Collaborative Coefficient in Palaeontology

The Collaboration Coefficient is calculated to find out the extent of collaboration in Palaeontology Literature. Table 9, the CC for Palaeontology publications has grown from 0.40 in (2006) to 0.61 in (2019). The lowest CC 0.40 is reported in the year 2006. The highest CC 0.61 is reported in the year 2019. The overall CC =0.53 which is far from 0. The above mentioned value clearly indicates the growing importance of Collaboration in Palaeontology Literature (Figure 6).

Table 9: Collaborative Coefficient in Palaeontology Literature

Year	Single	Two	Three	Four	Five	More than Five	Anonymous	Total	Collaborative Coefficient
2005	140	80	62	30	18	38	3	368	0.41
2006	166	122	56	37	19	46	3	446	0.40
2007	167	126	95	60	33	65	1	546	0.46
2008	184	154	104	62	39	67	4	610	0.46
2009	206	174	126	64	64	104	1	738	0.48
2010	215	234	172	94	65	122	7	902	0.51
2011	216	205	180	140	90	138	5	969	0.53
2012	220	210	148	116	75	145	5	914	0.52
2013	176	196	163	98	78	147	0	858	0.54
2014	183	201	171	122	93	170	4	940	0.56
2015	188	185	178	147	84	198	5	980	0.56
2016	133	170	170	138	84	175	3	870	0.59
2017	157	224	152	148	93	205	6	979	0.58
2018	144	166	150	132	91	199	5	882	0.59
2019	152	142	180	174	94	250	6	992	0.61
Total	**2647**	**2589**	**2107**	**1562**	**1020**	**2069**	**58**	**11994**	**0.53**

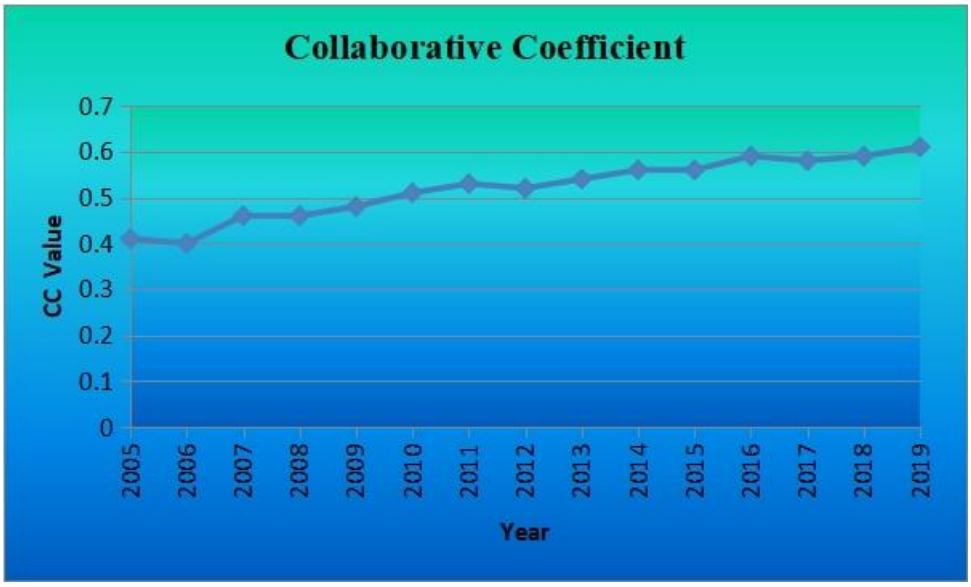

Figure 6 : Collaborative Co-efficient in Palaeontology

Modified Collaborative Co-efficient in Palaeontology

Modified Collaboration Coefficient is almost the same as that of CC. In MCC, every paper takes a single "credit" and this credit is being shared with the collaborated authors. Therefore if a paper has a single author, the author receives one credit, likewise if a paper has 2 authors, then each author receives ½ credit. It has been found from Table 10, the MCC ranges from 0.40 in 2006 to 0.61 in 2019. The highest MCC 0.61 has been reported in the year 2019. The lowest MCC 0.40 has been reported in the year in 2006. The overall MCC is 0.53.

Table 10: Modified Collaborative Coefficient in Palaeontology

Year	Single	Two	Three	Four	Five	More than Five	Anonymous	Total	Modified Collaborative Co-efficient
2005	140	80	62	30	18	38	3	368	0.41
2006	166	122	56	37	19	46	3	446	0.40
2007	167	126	95	60	33	65	1	546	0.46
2008	184	154	104	62	39	67	4	610	0.46
2009	206	174	126	64	64	104	1	738	0.48
2010	215	234	172	94	65	122	7	902	0.51
2011	216	205	180	140	90	138	5	969	0.53
2012	220	210	148	116	75	145	5	914	0.52
2013	176	196	163	98	78	147	0	858	0.54
2014	183	201	171	122	93	170	4	940	0.56
2015	188	185	178	147	84	198	5	980	0.57
2016	133	170	170	138	84	175	3	870	0.59
2017	157	224	152	148	93	205	6	979	0.58
2018	144	166	150	132	91	199	5	882	0.59
2019	152	142	180	174	94	250	6	992	0.61
Total	**2647**	**2589**	**2107**	**1562**	**1020**	**2069**	**58**	**11994**	**0.53**

Co-Authorship Index (CAI) in Palaeontology

Table 11 represented the Co-Authorship Index (CAI) of Palaeontology Literature. It was noted that the value of Co-authorship Index in the case of single authorship declined from 172.38 in the year 2005 to 69.43 in the year 2019. The CAI for two authors as an increased from 80 to 142 The CAI for three authorship pattern increased from 62 to 180. Similarly, The CAI for four, five and more than five authorship pattern increased from 62.60 to 134.69; 57.52 to 111.42 and 59.86 to 146.09 respectively (Figure 7).

Table 11: Co-Authorship Index (CAI) in Palaeontology

Year	Single	CAI	Two	CAI	Three	CAI	Four	CAI	Five	CAI	More than Five	CAI	Total
2005	140	172.38	80	100.71	62	95.91	30	62.60	18	57.52	38	59.86	368
2006	166	168.65	122	126.72	56	71.47	37	63.70	19	50.09	46	59.79	446
2007	167	138.59	126	106.91	95	99.04	60	84.38	33	71.07	65	69.01	546
2008	184	136.68	154	116.96	104	97.05	62	78.04	39	75.18	67	63.67	610
2009	206	126.48	174	109.23	126	97.19	64	66.59	64	101.97	104	81.69	738
2010	215	108.00	234	120.18	172	108.55	94	80.02	65	84.74	122	78.41	902
2011	216	101.00	205	98.01	180	105.74	140	110.94	90	109.22	138	82.56	969
2012	220	109.07	210	106.44	148	92.18	116	97.45	75	96.49	145	91.97	914
2013	176	92.95	196	105.83	163	108.14	98	87.70	78	106.90	147	99.32	858

2014	183	88.21	201	99.06	171	103.55	122	99.66	93	116.34	170	104.84	940
2015	188	86.92	185	87.45	178	103.39	147	115.18	84	100.79	198	117.12	980
2016	133	69.27	170	90.52	170	111.23	138	121.80	84	113.53	175	116.61	870
2017	157	72.67	224	106.00	152	88.38	148	116.08	93	111.70	205	121.39	979
2018	144	73.98	166	87.19	150	96.81	132	114.92	91	121.32	199	130.79	882
2019	152	69.43	142	66.31	180	103.29	174	134.69	94	111.42	250	146.09	992
Total	**2647**		**2589**		**2107**		**1562**		**1020**		**2069**		**11994**

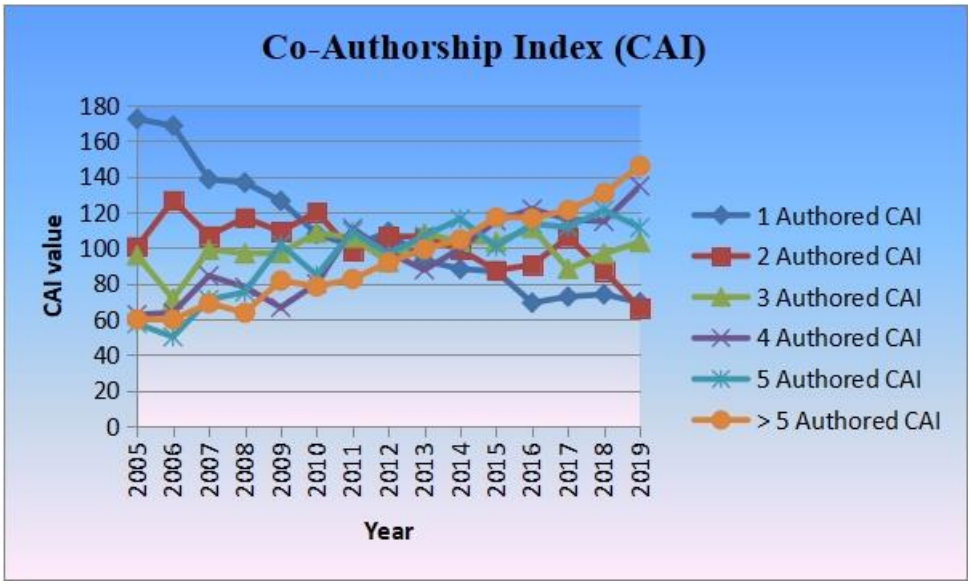

Figure 7: Co-Authorship Index (CAI) in Palaeontology

Keyword Analysis Zipfs' Law in Palaeontology

To apply Zipf's law, the keywords (terms) were collected from the title of the publications and ranked according to their frequency of occurrence in decreasing order. Table 12, On applying this law, it was found that log of frequency, occurrence of words when added to log of their rank, the results are almost same for each word. The log of frequency most productive words have been taken among the top 20 keywords which appeared in the title, 'Palaeontology' (Figure 8 , Network Visualization).

Table 12: Keyword Analysis Zipfs' Law in Palaeontology

S. No	Keyword	Frequency	Rank	Log F	Log R	C=Log F+Log R
1	Palaeontology	9970	1	4.00	0	4.00
2	Fossil	2620	2	3.42	0.30	3.72
3	Fossil Record	2619	3	3.42	0.48	3.90
4	Animals	2399	4	3.38	0.60	3.98
5	Taxonomy	2219	5	3.35	0.70	4.05
6	Article	1995	6	3.30	0.78	4.08
7	Fossils	1917	7	3.28	0.85	4.13
8	Animal	1768	8	3.25	0.90	4.15

9	Morphology	1730	9	3.24	0.95	4.19
10	Evolution	1685	10	3.23	1	4.23
11	Nonhuman	1513	11	3.18	1.04	4.22
12	Phylogeny	1359	12	3.13	1.08	4.21
13	New Species	1346	13	3.13	1.11	4.24
14	Cretaceous	1238	14	3.09	1.15	4.24
15	Mammalia	1189	15	3.08	1.18	4.25
16	Paleoecology	1140	16	3.06	1.20	4.26
17	Paleoenvironment	1135	17	3.05	1.23	4.29
18	Dinosaur	1114	18	3.05	1.26	4.30
19	Vertebrata	1073	19	3.03	1.28	4.31
20	Priority Journal	1049	20	3.02	1.30	4.32
21	Human	1027	21	3.01	1.32	4.33
22	United States	918	22	2.96	1.34	4.31
23	Biostratigraphy	908	23	2.96	1.36	4.32
24	Humans	904	24	2.96	1.38	4.34
25	Classification	875	25	2.94	1.40	4.34

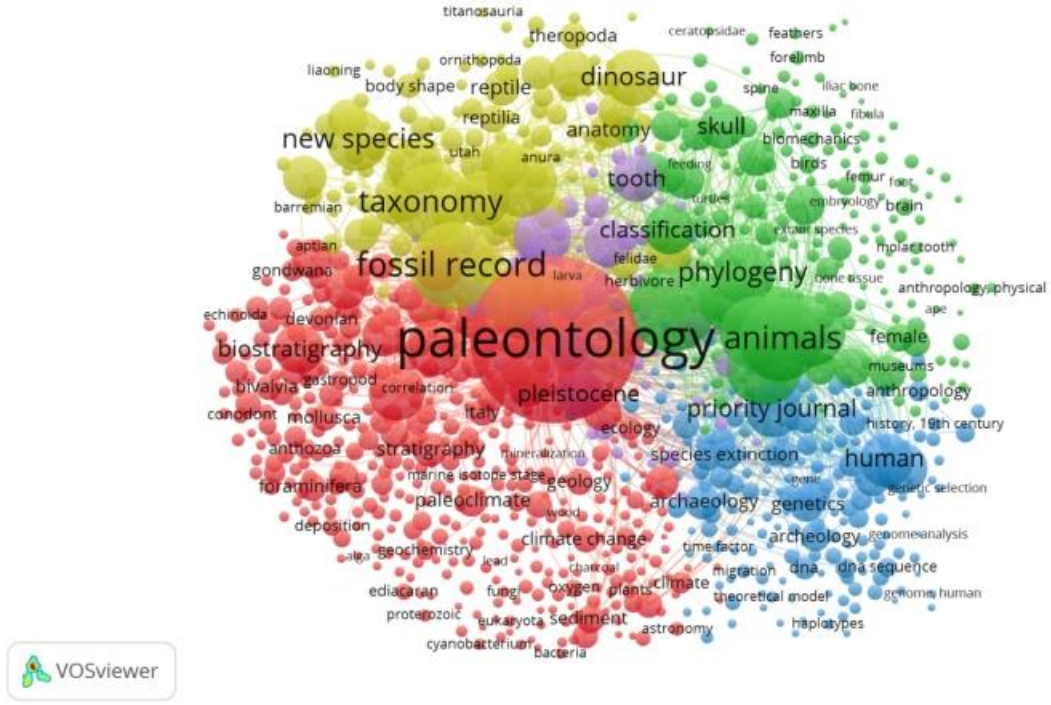

Figure 8: Keyword Analysis in Palaeontology– Network Visualization

Prolific core Journals on Palaeontology

Table 13 displays the top 25 journals ranked up to 25. The ranking of journals based on their productivity are made to help in the selection of core journals and evaluating the

importance of these journals in a particular subject field. The journals are arranged in the frequency of descending order. It has been found that there were 1356 journals which produced 12052 publications. The journal titled " Journal of Vertebrate Palaeontology" occupied the first position with 1494 publications. The second most productive journal was " PLoS ONE " with 471 publications. The third most productive journal was "Cretaceous Research" with 392 publications (Figure 9).

Table 13: Prolific core Journals on Palaeontology

S. No	Name of the Journal	Publications	Rank
1	Journal of Vertebrate Palaeontology	1494	1
2	PLoS ONE	471	2
3	Cretaceous Research	392	3
4	Palaeontologia Electronica	292	4
5	Science	289	5
6	Proceedings of the National Academy of Sciences of the United States of America	284	6
7	Nature	277	7
8	Journal of Human Evolution	235	8
9	Palaeogeography, Palaeoclimatology, Palaeoecology	220	9
10	Acta Palaeontologica Polonica	214	10
11	Quaternary International	212	11
12	Palaeontology	203	12
13	Historical Biology	187	13
14	Journal of Palaeontology	184	14
15	PeerJ	129	15
16	Proceedings of the Royal Society B: Biological Sciences	120	16
17	Alcheringa	120	16
18	American Journal of Physical Anthropology	109	17
19	Scientific Reports	102	18
20	Comptes Rendus - Palevol	100	19
21	Quaternary Science Reviews	85	20
22	Annales de Paleontologie	80	21
23	Geobios	77	22
24	Naturwissenschaften	75	23
25	Journal of South American Earth Sciences	75	23

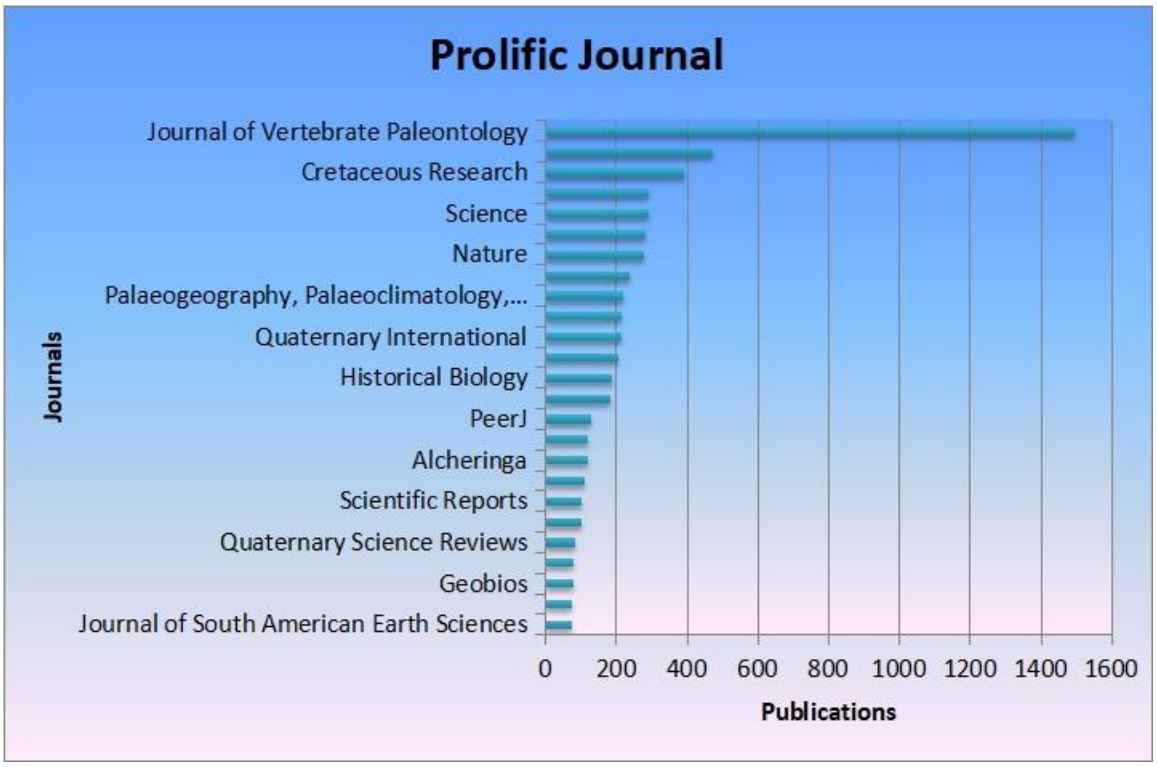

Figure 9: Prolific core Journals on Palaeontology

Conclusions and suggestions

The study has been steered with the aim of assessing the growth of Palaeontology Literature output from 2005 to 2019 with Scientometric tools. The researcher aimed to discover the Publication growth rate, Pattern of publications, Authorship pattern, Prolific authors, Prolific journals, Prolific institutions, Citation analysis, Geographical distributions, and India's research output. The study discloses that the growth of literature is increasing trend in Palaeontology Literature. As per the evaluation, a total of 12052 publications with a yearly average of 803.46 per paper have been found in Palaeontology Literature during the study period covering 2005 – 2019. It is expected that the future growth of Palaeontology Literature output may take an increasing trend during the forthcoming years. It has been found that there were 1356 journals which produced 12052 publications. It has been observed that the journal titled "Journal of Vertebrate Palaeontology" occupied in the first position with 1494 publication. It has been observed from the analysis that most of the publications were published in English Language. Out of the 12052 publications, English language contributed 11124 (92.30%) papers. The findings of the study indicate that the overall growth rate calculated by various Scientometric methods in the field of Palaeontology Literature is significantly growing in the recent years at national and international level. This study will lead to carry out further research efforts in Palaeontology Literature.

References

Alexander W Peters, Michael K Savaglio, Zachary J Gunderson, et al.. (2020). Comparative analysis of authorship trends in the Journal of Hand Surgery European and American volumes: A bibliometric analysis, Annals of Medicine and Surgery, 55, 200–206.

Baskaranc, C. (2019). Research Patterns on the Social Networks and Media: A Scientometric Portrait, Handbook of Research on Emerging Trends and Technologies in Library and Information Science, DOI: 10.4018/978-1-5225-9825-1.ch014

Baskaran Chinnasamy (2021) Mapping the Research on Coronavirus: A Scientometric Study, Journal of Hospital Librarianship, 21:4, 417-432, DOI: 10.1080/15323269.2021.1987123

Braun, T., Schubert, A., & Zsindely, S. (1997), Nanoscience and nanotechnology on the balance, Scientometrics, 38, 321–325.

Calero, C., Buter, R., Valds, C. C., & Noyons, E. (2006), How to identify research groups using publication analysis: an example in the field of nanotechnology, Scientometrics, 66 (2) : 365–376.

Chau, M., Huang, Z., Qin, J., Zhou, Y., & Chen, H. (2006), Building a scientific knowledge web portal: The NanoPort experience, Decision Support Systems, 42 : 1216–1238

Ellen Lutnick, Antonio Cusano, David Sing, et al. (2021). Authorship Proliferation of Research Articles in Top 10 Orthopaedic Journals: A 70-Year Analysis, Journal of the AAOS Global Research and Reviews, 5 (9).

Fleischer, T., Decker, M., & Fieldeler, U. (2005), Assessing emerging technologies: Methodological challenges and the case of nanotechnologies, Technological Forecasting & Social Change, 72 : 1112–1121.

Maria E Squire, Katherine Schultz, Donnell McDonald, et al. (2020). Trends in Gender Authorship and Collaborations: A 30-Year Comparative Bibliometric Analysis of Manuscripts from The Journal of Bone and Joint Surgery and The Bone and Joint Journal, Scientifica, Article ID 5019607.

Meyer , M. S. (2001), Patent citation analysis in a novel field of technology: An exploration of Nano-science and Nano-technology, Scientometrics, 51 (1), 163–183.

Meyer, M. (2006), Knowledge integrators or weak links? An exploratory comparison of patenting researchers with their non-inventing peers in nano-science and technology, Scientometrics, 68 (3) ,545–560.

Meyer, M., & Persson, O. (1998), Nanotechnology-interdisciplinarity, patterns of collaboration and differences in application, Scientometrics, 42 (2), 195–205.

Philip M Frazer , Giuseppe Pastore , Adele K McGarry , et al. (2021). A Bibliometric Analysis of 4 Major Foot and Ankle Surgery Journals, The Journal of Foot and Ankle Surgery , 60 (4), 692-696.

Roco, M. C. (2001). International strategy for nanotechnology research and development, Journal of Nanoparticle Research, 3 : 353–360.

Roco, M. C., Williams, W.S., Alivisatos, P. (Eds) (2000). Nanotechnology Research Directions, Kluwer Academic Publishers, Boston.

Saleh S. Baeesa, Yazid Maghrabi, Abdul KarimMsaddi, and Richard Assaker. (2017). Quality of Spine Surgery Research from the Arab Countries: A Systematic Review and Bibliometric Analysis, , BioMed Research International, Article ID 7560236.