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Authorship Patterns and Collaborative Research in the Astrobiology, 2012-2017

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Abstract: This paper presents a bibliometric study of Astrobiology during the period of 2012-2017. A total of 519 articles and 3048 authors in the journal were examined by year to ascertain authorship patterns, author productivity, and degree of collaboration. The average number of authors per paper is 5.872 % and the average productivity per author is 0.170%. The average degree of collaboration is 0.861, which clearly indicates its dominance upon multi authored contributions.

Key Words: Bibliometrics; Publication Analysis; Authorship Patterns; Degree of Collaboration; Research Trends; Astrobiology; Collaborative Research.

Introduction

The *Astrobiology* is the leading peer-reviewed international journal for astronomers, biologists, chemists, geologists, microbiologists, paleontologists, and planetary scientists designed to advance our understanding of life's origin, evolution, and distribution in the universe. This authoritative journal disseminates the most current findings and discoveries coming out of recent interplanetary exploration and laboratory - and field-based research programs. Astrobiology was launched in 2001 and published monthly by Mary Ann Liebert, Inc. is a privately held independent publishing company founded by its president, Mary Ann Liebert, in 1980. The company publishes peer-reviewed academic journals, books, and trade magazines in the areas of biotechnology, biomedical research/life sciences, clinical medicine, alternative/integrative medicine, surgery, and law. Its headquarters are in New Rochelle, New York, United States.

The journal's scope includes astrophysics, astropaleontology, bioastronomy, cosmochemistry, ecogenomics, exobiology, extremophiles, geomicrobiology, gravitational biology, life detection technology, meteoritics, origins of life, planetary geoscience, planetary

protection, prebiotic chemistry, space exploration technology and terraforming Astrobiology is Indexed/Abstracted in: MEDLINE; PubMed Central; Current Contents®/Agriculture, Biology & Environmental Sciences; Current Contents®/Physical, Chemical & Earth Sciences; Science Citation Index Expanded; Biological Abstracts; BIOSIS Previews; Journal Citation Reports/Science Edition; EMBASE/Excerpta Medica; EMBiology; Scopus; Geobase; Compendex; Chemical Abstracts; PsycINFO; GeoRef; Astrophysics Data System.

Literature Review

Arya² studied authorship pattern and collaborative research trends in the field of veterinary medicine based on the data collected from 'Indian Journal of Veterinary Medicine' published during the period 1999 - 2007. Thavamani & Velmurugan³, studied the publication trends of scholarly papers in *Annals of Library and Information Studies*, through a bibliometric analysis of 310 contributions in the journal during the year 2002–2012. Thavamani⁴, identified the growth and authorship pattern of productivity of articles of source journal "DESIDOC Journal of Library & Information Technology". It was observed from the study that the year 2008 was most participating year during the study period 2007 - 2011. Thavamani⁵, analyzed the Malaysian Journal of Library and Information Science. A total of 279 research articles and 575 authors were examined by growth of contributions by year and volume, authorship patterns by year and volume, authorship patterns, author productivity, single and multi authored papers by year, authorship patterns by global, most prolific contributors and degree of collaboration.

Thavamani⁶, studied of Collaborative Librarianship (CL) during the period of 2009-2014. A total of 223 research contributions and 343 authors were examined by growth of contributions by year and volume, authorship patterns by year and volume, growth of authors by year, authorship patterns, author productivity, authorship patterns by global, most prolific contributors and degree of collaboration. Thavamani⁷, studied the authorship trend in the "Chinese Librarianship: an International Electronic Journal (CLIEJ)" during the period of 1996-2013. A total of 133 articles and 221 authors in the Journal were examined by year and volume to ascertain authorship patterns, author productivity, and degree of collaboration. Velmurugan & Radhakrishnan⁸, conducted with 448 contributions published in the journal selected six years for a period between 2007 and 2012. Taşkın & Aydinoglu⁹, studied the bibliometric investigation of the NASA Astrobiology Institute (NAI) funded research that was published between 2008 and 2012.

Objectives

The objectives of the present study are as follows:

- ❖ To identify the Contributions by Type of Documents, to trace Research Contributions by Year.
- ❖ To study Authorship Patterns, to trace Author's Productivity and to identify Most Prolific Authors and to trace Authorship patterns by Country.
- ❖ To identify affiliated Institution by authors and to identify degree of author collaboration.

Methodology

The data was collected from the website (LiebertOpenAccess.com) of the Astrobiology. Seventy Two (72) issues from six (6) volumes from 2012 to 2017 have been selected for the study. All articles are source article published in the last six years (2012 – 2017) were recorded in a separate white sheet and results were entered in Microsoft Excel. Statistical Package for Social Sciences (SPSS) was used for the analysis. These data were organized, calculated, tabulated, analyzed, and presented by using simple arithmetic and statistical methods in order to provide analysis.

Data Analysis

Data on the bibliographic records were collected from the online version of the Astrobiology pertaining to the period 2012 – 2017. A total of 519 contributions and 3048 authors were analyzed the journal. The flowing tables and brief analyses represent the substance of this research.

Table 1: Contributions by Type of Documents

Sl. No.	Type of Contributions	Total No. of Contributions	Percentage (%)
1	Research Articles	364	70.134
2	News & Views	28	5.394
3	Review Articles	24	4.624
4	Hypothesis Articles	30	5.780
5	Rapid Communications	12	2.312
6	Education Articles	10	1.926

7	Forum Articles	12	2.312
8	Essays	7	1.348
9	Reflections	7	1.348
10	Tributes	5	0.963
11	Mini Reviews	3	0.578
12	Book Reviews	3	0.578
13	Pioneers of Astrobiology	3	0.578
14	Others	11	2.119
	Total	519	100.000

Table 1 shows the contribution by type of documents published in the astrobiology from 2012 to 2017. The highest numbers of contributions are research articles 364(70.134%). Followed by hypothesis articles 30(5.780%), news & views 28(5.394%), review articles 24 (4.624%), rapid communications and education articles 10(1.926%) forum articles 12 (2.312%), essays and reflections 7(1.348%), tributes 5(0.963%). Minimum contributions are mini reviews 3(0.578%), book reviews 3(0.578%), pioneers of astrobiology 3 (0.578%) and others 11(2.119%).

Table 2: Research Contributions by Year

Sl. No.	Year	Total No. of Contributions	Percentage (%)
1	2012	112	21.579
2	2013	96	18.497
3	2014	67	12.909
4	2015	84	16.184
5	2016	70	13.487
6	2017	90	17.341
	Total	519	100.000

Table 2 show the growth of research articles published in the Astrobiology from 2012 to 2017. Altogether, there are 519 research articles. The highest number of research contributions 112(21.579%) were published in 2012, while the lowest number 67(12.909%) of research contributions were published in the year of 2014.

Table 3: Authorship Patterns

Sl. No.	Author	Total	Percentage (%)
1	Single Author	72	13.872
2	Two Authors	87	16.763
3	Three Authors	60	11.560
4	Four Authors	66	12.716
5	Five Authors	54	10.404
6	Six Authors	42	8.092
7	Seven Authors	31	5.973
8	Eight Authors	22	4.238
9	Nine Authors	20	3.853
10	Ten Authors	10	1.926
11	Eleven Authors	10	1.926
12	Twelve Authors	6	1.156
13	Thirteen Authors	7	1.348
14	Fourteen Authors	5	0.963
15	Eighteen Authors	4	0.770
16	Fifteen Authors	3	0.578
17	Seventeen Authors	3	0.578
18	Twenty six Authors	3	0.578
19	Twenty Authors	2	0.385
20	Twenty two Authors	1	0.192
21	Twenty three Authors	1	0.192
22	Twenty four Authors	1	0.192
23	Twenty five Authors	1	0.192
24	Twenty eight Authors	1	0.192
25	Twenty nine Authors	1	0.192
26	Thirty seven Authors	1	0.192
27	Forty nine Authors	1	0.192
28	Seventy Authors	1	0.192
29	Seventy three Authors	1	0.192
30	Seventy five Authors	1	0.192

31	Seventy eight Authors	1	0.192
Total		519	100.000

Table 3 shows 447 (86.127%) papers have been written in joint authorship. It is seen that only 72 (13.872%) of the publications were single authored articles. Followed by two authors 87(16.763%), three authors 60 (11.560%), four authors 66(12.716%), five authors 54 (10.404%), six authors 42(8.092%), etc. The lowest number 1(0.192%) of contributions was made by twenty two, twenty three, twenty four, twenty five, twenty eight, twenty nine, thirty seven, forty nine, seventy, seventy three, seventy five and seventy eight authors.

Table 4: Author's Productivity

Sl. No.	Year	Total No. of Papers	Total No. of Authors	AAPP*	Productivity per Author
1	2012	112	536	4.785	0.208
2	2013	96	511	5.322	0.187
3	2014	67	597	8.910	0.112
4	2015	84	393	4.678	0.213
5	2016	70	368	5.257	0.190
6	2017	90	643	7.144	0.139
	Total	519	3048	5.872	0.170

Notes: *Average Authors per Paper (AAPP) = Number of authors/Number of papers.

Productivity per author = Number of papers/Number of authors.

Table 4 shows the data related to author's productivity. The total average number of authors per paper is 5.872 and the average productivity per author is 0.170. The highest number of author's productivity (643, 0.139%) was in 2017. The minimum number of author's productivity (597, 0.112%) was in 2014.

Table 5: Most Prolific Authors

Sl. No.	Name	No. of Contributions	Country	Rank
1	Charles S. Cockell	14	UK	1
2	Gerda Horneck	13	USA	2

3	Ralf Moeller	13	Germany	2
4	Frances Westall	13	France	2
5	Petra Rettberg	11	Germany	3
6	Wayne L. Nicholson	10	USA	4
7	Mark A. Sephton	9	UK	5
8	Jorge L. Vago	9	The Netherlands	5
9	Christopher P. McKay	9	USA	5
10	Valeria Souza	8	México	6
11	Steven A. Benner	8	USA	6
12	Kasthuri Venkateswaran	7	USA	7
13	Dirk Schulze-Makuch	7	USA/ Germany	7
14	Alison Olcott Marshall	7	USA	7
15	Howell G.M. Edwards	7	UK	7
16	René Heller	6	Germany/Canada	8
17	Marina Raguse	6	Germany	8
18	Elke Rabbow	6	Germany	8
19	Alfonso F. Davila	6	USA	8
20	Andrew C. Schuerger	6	USA	8
21	Craig P. Marshall	6	USA	8
22	Laura M. Barge	6	USA	8
23	Victoria S. Meadows	6	USA	8
24	Ian Hutchinson	6	UK	8
25	Ariel D. Anbar	5	USA	9
26	Christine Moissl-Eichinger	5	Germany	9
27	Eugene Grosch	5	Norway	9
28	Gernot Groemer	5	Austria	9

29	Günther Reitz	5	Germany	9
30	Isabella Pfeil	5	Austria	9
31	Gian Gabriele Ori	5	Italy	9
32	Alexander Soucek	4	Austria	10
33	Andrea Boyd	4	Austria	10
34	Anna Losiak	4	Austria/Poland	10
35	Barnes. R	4	USA	10
36	Birgit Sattler	4	Austria	10
37	Christoph Ragonig	4	Austria	10
38	Csilla Orgel	4	Austria/Hungary	10
39	Daniel Schildhammer	4	Austria	10
40	Eva Hauth	4	Austria	10
41	Frédéric Foucher	4	France	10
42	Gabriela Olmedo-Alvarez	4	México	10
43	Helmut Lammer	4	Austria	10
44	Isik Kanik	4	USA	10
45	Izabella Gołębiowska	4	Poland	10
46	Jack D. Farmer	4	USA/ Austria	10
47	James F. Kasting	4	USA	10
48	Jane McArthur	4	UK	10
49	Janet Siefert	4	USA	10
50	Jarno Peschier	4	Austria	10
51	Three author contributions	397		11
52	Two author contributions	443		12
53	One author contributions	1898		13
	Total	3048		

Table 5 shows that a total of 3048 authors have contributed 519 research contributions over a period of six years (2012-2017). The most prolific contributor Charles S. Cockell (UK) who stood in the first position, he contributed the highest number (14) of publications. This is followed by Gerda Horneck (United States), Ralf Moeller (Germany) and Frances Westall (France) those stood in second highest contributions with 13 publications; Petra Rettberg (Germany) 11 publications; Wayne L. Nicholson (USA) with 10 publications; Mark A. Sephton (UK), Jorge L. Vago (The Netherlands), Christopher P. McKay (USA) with 9 publications; Valeria Souza (México) and Steven A. Benner (USA) with 8 publications; Besides, there are four who have contributed 7 research articles each; nine authors by six contributions; seven authors by five papers; nineteen authors by four papers. And the remaining 397 contributions by three authors, 443 by two authors and 1898 contributions have been contributed by single authors.

Table 6: Authorship by Country

Sl. No.	Country	No. of Contributions	Percentage (%)
1	USA	1152	37.795
2	Germany	283	9.284
3	UK	232	7.611
4	Austria	231	7.578
5	France	221	7.250
6	Spain	100	3.280
7	Italy	84	2.755
8	The Netherlands	82	2.690
9	China	80	2.624
10	Canada	74	2.427
11	Japan	70	2.296
12	Russia	55	1.804
13	México	45	1.476
14	Switzerland	38	1.246
15	Sweden	37	1.213
16	Brazil	32	1.049
17	Poland	24	0.787
18	Norway	20	0.656

19	Belgium	20	0.656
20	Australia	19	0.623
21	Ukraine	18	0.590
22	India	13	0.426
23	Czech Republic	12	0.393
24	Denmark	11	0.360
25	Greece	11	0.360
26	Taiwan	7	0.229
27	Argentina	6	0.196
28	Georgia	6	0.196
29	Hungary	5	0.164
30	New Zealand	5	0.164
31	Romania	3	0.098
32	Hong Kong	3	0.098
33	USA/UK	2	0.065
34	Turkey	2	0.065
35	Chile	2	0.065
36	Morocco	2	0.065
37	Ireland	2	0.065
38	Israel	2	0.065
39	Korea	2	0.064
40	Bulgaria	1	0.032
41	Colombia	1	0.032
42	Iceland	1	0.032
43	Morocco	1	0.032
44	North Africa(Tunisia)	1	0.032
45	Portugal	1	0.032
46	Republic of Macedonia	1	0.032
47	Serbia	1	0.032
48	Slovakia	1	0.032
49	Finland	1	0.032
50	Saudi Arabia	1	0.032

51	South Africa	1	0.032
52	Place not mentioned	23	0.754
Total		3048	100.00

Table 6 show the distribution of authors by country. The 519 research contributions were contributed by 3048 authors from 51 countries. The highest number of authors 1152(37.795%) were from the USA, followed by Germany 283(9.284%), UK 232(7.611%), Austria 231(7.578%), France221(7.250%), Spain 100(3.280%), Italy 84(2.755%), The Netherlands 82(2.690%), China 80(2.624%), Canada 74(2.427%),Japan 70(2.296%), Russia 55(1.804%),México45(1.476%),Switzerland38(1.246%),Sweden37(1.213%),Brazil32(1.049), Poland 24(0.787%), Norway 20(0.656%), Belgium 20(0.656%),Australia9(0.623%),Ukraine 18(0.590%), India 13(0.426%), Czech Republic12(0.393%), Denmark11(0.360%), Greece11(0.360%), Taiwan 7(0.229%), etc., The lowest numbers of contributions 1(0.0754%) were from twelve countries. And the 23 (0.754%) are place not mentioned.

Table 7: Contributions by Institution

Sl. No.	Institutions/Universities	No. of Contributions	Percentage (%)
1	Academic	1580	51.837
2	Research	1349	44.258
3	Others	71	2.329
4	Institutions Not Mentioned	48	1.574
Total		3048	100.00

Table 7 shows the type of institutions with which the authors of the articles were affiliated. Out of 3048 contributions, the highest number i.e. 1580(51.837%) were from authors affiliated with academic institutions; whereas the lowest number i.e. 71(2.329%) has been contributed by other institutions. The second highest number i.e. 1349(44.0258%) were from research institutions. And 48(1.574%) of the contributions were not mentioned their affiliated institutions.

Table 8: Degree of Author Collaboration

Sl. No.	Year	Single Authored Paper (Ns)	Multi Authored Papers (Nm)	Total (Nm+N _s)	Degree of Collaboration
1	2012	30	82	112	0.732
2	2013	8	88	96	0.916
3	2014	5	62	67	0.925
4	2015	8	76	84	0.904
5	2016	10	60	70	0.857
6	2017	11	79	90	0.877
Total		72	447	519	0.861

Degree of Collaboration

The extent of Degree of Author Collaboration in the astrobiology research has been measured with the help of the formula devised by K. Subramaniam²,

The formula is where

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

C = Degree of Collaboration in a discipline

N_m = Number of multiple authored papers

N_s = Number of single authored papers

Accordingly, the Degree of Collaboration has been calculated as follows:

$$C = \frac{447}{72 + 447} = \frac{447}{519} = 0.861$$

As a result, the average degree of author collaboration in the Astrobiology is 0.861, which clearly indicates its dominance upon multi-author contributions.

Findings and Conclusion

In this article present an overview of global collaborative research trends the in Astrobiology. Eight topics are considered: contributions by research article contributions by year, authorship patterns, author's productivity, identify most prolific authors, authorship by country; contributions by institution and degree of author collaboration.

- There are 519 research contributions by 3048 authors. The highest numbers of contributions are research articles 364(70.134%). Followed by hypothesis articles 30(5.780%), news & views 28(5.394%), review articles 24 (4.624%), rapid communications and education articles 10(1.926%) forum articles 12 (2.312%), essays and reflections 7(1.348%), tributes 5(0.963%). Minimum contributions are mini reviews 3(0.578%), book reviews 3(0.578%), pioneers of astrobiology 3 (0.578%) and others 11(2.119%).
- Altogether, there are 519 research articles. The highest number of research contributions 112(21.579%) were published in 2012, while the lowest number 67(12.909%) of research contributions were published in the year of 2014.
- 447 (86.127%) papers have been written in joint authorship. It is seen that only 72 (13.872%) of the publications were single authored articles. Followed by two authors 87(16.763%), three authors 60 (11.560%), four authors 66(12.716%), five authors 54 (10.404%), six authors 42(8.092%), etc. The lowest number 1(0.192%) of contributions was made by twenty two, twenty three, twenty four, twenty five, twenty seven, twenty eight, twenty nine, thirty seven, forty nine, seventy, seventy three, seventy five and seventy eight authors.
- The total average number of authors per paper is 5.872 and the average productivity per author is 0.170. The highest number of author's productivity (643, 0.139%) was in 2017. The minimum number of author's productivity (597, 0.112%) was in 2014.
- A total of 3048 authors have contributed 519 research contributions over a period of six years (2012-2017). The most prolific contributor Charles S. Cockell (UK) who stood in the first position, he contributed the highest number (14) of publications. This is followed by Gerda Horneck (United States), Ralf Moeller (Germany) and Frances

Westall (France) those stood in second highest contributions with 13 publications; Petra Rettberg (Germany) 11 publications; Wayne L. Nicholson (USA) with 10 publications; Mark A. Sephton (UK), Jorge L. Vago (The Netherlands), Christopher P. McKay (USA) with 9 publications; Valeria Souza (México) and Steven A. Benner (USA) with 8 publications; Besides, there are four who have contributed 7 research articles each; nine authors by six contributions; seven authors by five papers; nineteen authors by four papers. And the remaining 397 contributions by three authors, 443 by two authors and 1898 contributions have been contributed by single authors.

- The 519 research contributions were contributed by 3048 authors from 51 countries. The highest number of authors 1152(37.795%) were from the USA, followed by Germany 283(9.284%), UK 232(7.611%), Austria 231(7.578%), France221(7.250%), Spain 100(3.280%), Italy 84(2.755%), The Netherlands 82(2.690%), China 80(2.624%), Canada 74(2.427%),Japan 70(2.296%), Russia 55(1.804%),México45(1.476%),Switzerland38(1.246%),Sweden37(1.213%),Brazil32 (1.049), Poland 24(0.787%), Norway 20(0.656%), Belgium 20(0.656%), Australia9(0.623%),Ukraine 18(0.590%), India 13(0.426%), Czech Republic12(0.393%), Denmark11(0.360%), Greece11(0.360%), Taiwan 7(0.229%), etc., The lowest numbers of contributions 1(0.0754%) were from twelve countries..
- Out of 3048 contributions, the highest number i.e. 1580(51.837%) were from authors affiliated with academic institutions; whereas the lowest number i.e. 71(2.329%) has been contributed by other institutions. The second highest number i.e. 1349(44.0258%) were from research institutions. And 48(1.574%) of the contributions were not mentioned their affiliated institutions.
- As a result, the average degree of author collaboration in the Astrobiology is 0.861, which clearly indicates its dominance upon multi-author contributions.

The multi-author collaborations are leading role from early onwards. The Astrobiology has been accepting articles from all over the world as of today, there are 51 countries contributing research articles to the journal. It is getting world-wide popularity and identification by publishing scholarly articles from authors across the world. The journal encourages contribution about professional policies, practices, principles and progress in the Astrobiology fields.

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BIO-DATA

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I have been participated and presented papers in more than 50 International, National and Regional Conferences/ Seminars/ workshops, and published many research papers in Conference proceedings. And also Published more than 45 research papers in peer reviewed international (35) and national (10) journals, and also contributed 7 chapters in edited books.

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