International Journal of Research in Library Science

ISSN: 2455-104X

Volume 3,Issue 2 (July-December) 2017,1-14

Received: 13 July .2017 ; **Accepted**: 29 July 2017 ; **Published**: 11 August 2017 ; **Paper ID**: IJRLS-1251

Bibliometric analysis of Aquatic Microbial Ecology from 2000 – 2014

Ramasamy Kumaresan[1]; Krishnan Vinitha [2]; Kattari Kannan [3]

Deputy Librarian, Fisheries College and Research Institute, Tamil Nadu Fisheries University, Thoothukudi – 628 008, Tamil Nadu, India and Research Scholar, M. S. University, Tirunelveli [1];

Librarian, St. Mary's College (Autonomus), Thoothukudi – 1, Tamil Nadu, India [2];

Assistant Librarian, Manonmanium Sundaranar University, Tirunelveli, Tamil Nadu, India [3]

rkumaresansamy@gmail.com[1]; vinithaksmc@gmail.com[2]; drlkkannan@gmail.com[3]

DOI : https://doi.org/10.26761/ijrls.3.2.2017.1251

ABSTRACT

No such study was carried out so far. Hence, this study is needed. This study was carried out to examine the year-wise output, collaborative patterns, author's productivity, countries productivity, institutional productivity, document types, highly cited articles, and bibliographic coupling. The required data were collected from Web of Science database. This study reveals that 1364 publications were contributed in Aquatic Microbial Ecology during the study period (2000 – 2014). A steady growth was observed from 2000 to 2005. The highest numbers of publications were found in 2007 and lowest numbers of publications were found in 2014. The average doubling time was 8.36 years. Three authors contribution was more predominant than other authorship pattern. The degree of collaboration was 0.959. Herndl, G. J contributed 28 publications and secured first position. USA was contributed 401 publications and secured first position. India secured 25th position with 12 contributions. Consejo Superior de Investigaciones Científicas, Spain was contributed 64 publications and placed first position. From India, National Institute of Oceanography, Goa was secured 73rd position with 9 contributions. Articles (1293, 94.80%) were predominant in Aquatic Microbial Ecology. Porter, Karen G. and Yvette S. Feig (1980) The use of DAPI for identifying and counting aquatic microflora. Limnol. Oceanogr., 25: 943-948. DOI: 10.4319/lo.1980.25.5.0943 was cited 220 times and score first position. Consejo Superior de Investigaciones Científicas, Spain had highest bibliographic coupling with other institutions.

Keywords: Aquatic microbial ecology, Bibliometric analysis, Bibliographic coupling, Collaborative pattern.

1. INTRODUCTION

The aim of ecology is to understand the relationships of all organisms to their environment. Microbial ecology is describes the effects of microbial activities rather than its causes. Microbes cause diseases of macroscopic organisms including human beings. Microbes are also important in supporting life in lakes, ponds, streams and the oceans. Microbes take over the role of macroscopic plants in aquatic environments and are the main primary producers. Under the pressures from increasing intensity of human activities, the global ecosystem experienced highest threatening and challenges such as pollution, river cut-off, lake atrophy, wetland degradation, depletion of underwater, microbial interaction and other problems occurs in the aquatic ecosystem. Hence, the aquatic ecosystem research has gained much attention by the researchers in the field of ecology (Griffitth et al. 2005[1]; Eugene and Oh, 2004[2]). This

paper studies the systematic evolution of knowledge in the journal Aquatic Microbial Ecology.

The term Bibliometrics was first coined by Alan Pritchard in 1969. The word “Bibliometrics” has been derived from the Latin and Greek words “biblio” and “metrics” which means "The application of mathematics and statistical methods to books and other media of communication" (Pritchard, 1969)[3]. Bibliometric studies can be used to study the regional pattern of research, cooperation between researchers, institutions and countries. Major derivatives of bibliometrics include publication counts (year-wise), citation count (author, journal, institution, country), co-citation analysis, co-ward analysis, scientific mapping etc.

2. AQUATIC MICROBIAL ECOLOGY

Aquatic Microbial Ecology (AME) was founded by Otto Kinne, Fereidoun Rassoulzadegan and John Dolan. It is the successor to 'Marine Microbial Food Webs', which was founded by P. Bougis and F. Rassoulzadegan and published by the 'Institut Océanographique, Fondation Albert 1er Prince de Monaco', Paris, from 1985 to 1994. The last issue of 'Marine Microbial Food Webs' was Volume 8, Number 2. The volume 9 onwards published by Inter-Research. AME serves as a worldwide forum for scientific communications on all aspects of aquatic microbial dynamics. In particular, the journal covers research on viruses, prokaryotes and eukaryotes - both planktonic and benthic, autotrophic and heterotrophic - in marine, limnetic and brackish habitats. AME strives for: complete coverage of the ecology of microorganisms in aquatic environments, the highest possible quality of scientific contributions, quick publication (3 months from acceptance to publication), an excellent technical standard of presentation. All articles will become freely accessible to all users 5 years after publication. This journal is available in the following URL: http://www.int-res.com/journals/ame/ame-home/. The ISSN Print version: ISSN 0948-3055, Online version: ISSN 1616-1564. The impact Factor 2014/2015 was 1.967.

3. REVIEW OF LITERATURE

The review of literature is a primary significant component in any research and intended to give a background as well as a broad review of research methods and procedures used by earlier workers in the field of study. Vinith and Kumaresan (2016)[4] were studied the food science and technology research in India and revealed that, there were 15668 publications were contributed during 1975 - 2014. The highest number of publications was recorded during 2010 - 2014. The Central Food Technology and Research Institute, Mysore contributed 2118 publications with 5278 TLCS and 28104 TGCS, followed by National Diary Research Institute, Karnal (742), Indian Institute of Technologies (612). Singh, N were contributed 205 publications with 646 TLCS and 3748 TGCS and placed in first position. Indian authors highly preferred Journal of Food Science and Technology, Mysore to publish their research publications. Kumaresan et al. (2016)[5] studied the Fish & Shellfish Immunology journals based on Web of Science database and found there was an increasing trend of publications productivity. Multi-authorship was predominant than single author publications. The degree of collaboration was 0.958. China was contributed more publications (38.20%) and Chinese institutions were also contributed more in number, where as India was in 5th position. Kumaresan et al. (2016)[6] studied the Aquatic Toxicology journal based on Web of Science database and found that a total of 2126 publications were published during the study period 2005 – 2014. The highest number of publications was published in 2014 with 305 (14.30%). The collaborative research was predominant in Aquatic Toxicology. The degree of collaboration was 0.985. Wood, C. M secured first with 44 (2.07%) contributions. USA contributed 475 (22.30%) publications and place first position. Chinese Academy of Sciences, China contributed 71 publications and score first rank. Research articles were predominant than any other document types. McMaster University, Hamilton, Canada had 60 Publications with 10949 bibliographic coupling with other institutes. Kumaresan et al (2015)[7] studied the global research productivity of seaweed based on Web of Science. they found that a total of 5814 publications were published in

seaweed research globally during the study period 2005 – 2014. The highest number of publications was published in 2014 with 883 (15.19%). The mean relative growth of seaweed research is 0.1015 and the average doubling time is 8.532. The collaborative research is predominant in seaweed research globally. The degree of collaboration is 0.947. Jeon, Y. J secured first position with 51 contributions (0.90%). Chinese Academy of Sciences, China contributed 172 publications and score first rank. Research articles were predominant than any other document types. Journal of Applied Phycology contributed 390 (6.71%) publications and score first position. USA contributed 645 (11.10%) publications and place first position. English is most preferred language of seaweed research publications. Kumaresan et al (2014)[8] studied the research trends in fish stock assessment and shows the maximum number of publications were (202) recorded in 2013. The relative growth rate decreased from 0.45 in 2001 to -0.13 in 2008. The average doubling time is 7.96 years. The original research articles were predominant in fish stock assessment research. Collaborative research is dominant over single author research and the degree of collaboration is 0.88. Regarding the language, 98.48% of the publications were published in English. Fisheries Research journal scored the first place with 293 publications. The National Oceanic and Atmospheric Administration, Washington, DC occupies the first place with 125 publications (6.3%). Overall, the USA contributed 651 publications and scored first place. Kumaresan et al. (2014)[9] studied the global literature productivity on WSSV based on Web of Science database and inferred China as the top literature productive country, followed by India. Chinese Academy of Sciences, Beijing stood first place followed by National Taiwan University, Taipei. C. F. Lo contributed more literature on WSSV. Kumaresan et al. (2014)[10] analysed the Indian contribution in the Aquaculture journal during 1972 – 2011. During this period 374 publications were contributed by Indian authors. The percentage of Indian contribution was 2.74 during this study period. A. S. Sahul Hameed scored first rank with 27 publications. Central Institute of Freshwater Aquaculture (ICAR), Bhubaneswar, Odisha scored first rank with 40 publications among Indian Institutions. Tamil Nadu secured first position with 133 contributions. The publication of I. Karunasagar et al. (1994) has highest citation both in SCOPUS database (240) and Google Scholar database (380). Liao and Huang (2014)[11] studied the global trends in aquatic ecosystem research from 1992 to 2011 and found that North America was leading the subject. Aquatic ecosystem research trends were shifting from water environment to aquatic ecosystem wide issues.

4. OBJECTIVE OF THE STUDY

The main objective of this study is to analyse the Aquatic Microbial Ecology (journal) during the period of study (2000 – 2014) and the objectives are to:

i) study the year-wise distribution and relative growth of literature,
ii) study the high productive authors,
iii) identify the high productive countries,
iv) identify the high productive institutions,
v) identify the document types,
vi) identify the highly cited references and
vii) study the Institutional bibliographic coupling.

5. METHODOLOGY AND SOURCE OF DATA

The required data were collected from Web of Science databases such as Science Citation Index Expanded (SCI-Expanded) for the period of 15 years (2000 – 2014). Advance search was employed SO = "Aquatic Microbial Ecology" and 1364 bibliographic data were retrieved. The downloaded 1364 bibliographic records were analysed using HistCite software (developed by Thomson Reuter), VOSviwer (developed by Universiteit Leiden, Netherlands) and NetDraw is a free programme written by Borgatti.

6. RESULT AND DISCUSSION

The analysis of data was done to measure the literature productivity in Aquatic Microbial Ecology (journal). The analysis was done year-wise distribution, collaborative patterns, author's productivity, country-wise distribution,

institutional productivity, document types, highly cited articles and institutional bibliographic coupling etc.

6.1. Year-Wise Distribution of Publications

The Table 1 shows the year-wise distribution of publications in Aquatic Microbial Ecology. There was a steady growth from 2000 to 2005, and then it was found that an up and downs from 2006 to 2014. The highest number of publications were recorded in 2007 (112, 8.20%) and lowest number of publications were recorded in 2014 (49, 3.60%). The average number of publications per year was 90.93

Table 1 – Year-wise distribution of publications

Years	TNP	(%)	TNC
2000	65	4.76	2770
2001	93	6.82	3942
2002	99	7.26	4679
2003	102	7.48	3634
2004	108	7.92	3280
2005	111	8.13	3407
2006	106	7.80	2694
2007	112	8.21	2081
2008	96	7.03	1673
2009	110	8.06	1840
2010	90	6.60	1061
2011	101	7.40	715
2012	51	3.74	248
2013	71	5.20	211
2014	49	3.59	35
	1364	100.00	32270

TNP- Total Number of Publications; TNC- Total number of citations; %- percentage

6.2. Citation Scores

The fig 1 shows the Total Citation Scores (TCS). The Total citation scores include Total Local Citation Scores (TLCS) and Total Global Citation Scores (TGCS). The TCS were highest in 2002 (4679, 14.50%) and lowest in 2014 (35, 0.11%). The TLCS were highest in 2002 (391, 14.41%) and lowest in 2014 (0) and TGCS were highest in 2002 (4288, 14.51%) and lowest in 2014 (35, 0.12%). Zwart G, Crump BC, Agterveld MPKV, Hagen F, Han SK. Typical freshwater bacteria: an analysis of available 16S rRNA gene sequences from plankton of lakes and rivers. *Aquatic Microbial Ecology*. 2002 JUN 26; 28 (2): 141-155 received highest TGCS (411) and Simon M, Grossart HP, Schweitzer B, Ploug H. Microbial ecology of organic aggregates in aquatic ecosystems. *Aquatic Microbial Ecology*. 2002 JUN 26; 28 (2): 175-211 received highest TLCS (48).

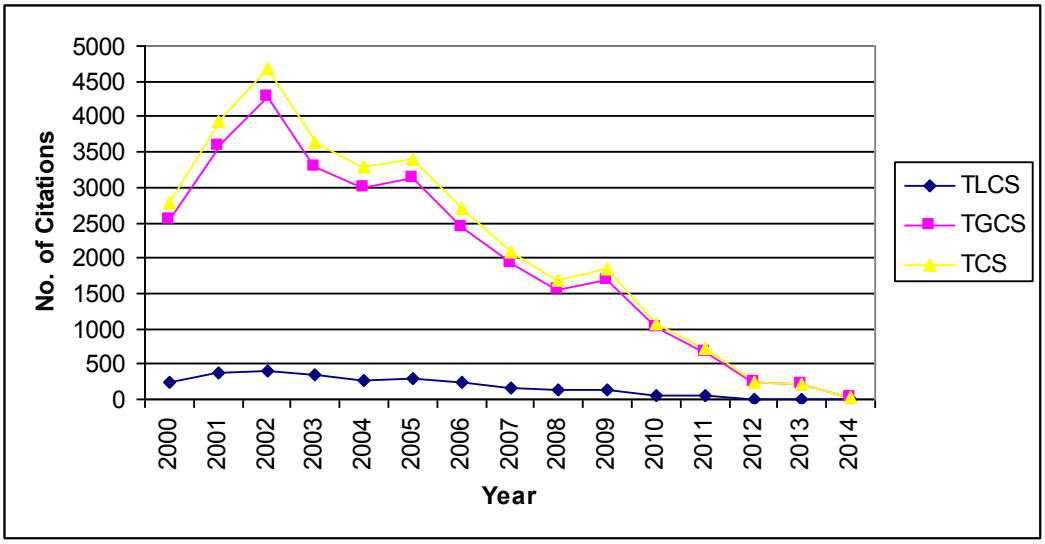

Fig. 1. Year-wise distribution of Citation Scores

6.3. Relative Growth and Doubling Time

One of the most obvious features of science in recent years has been its rate of growth. The relative growth rate of publications is presented in Table 2. It is observed that the relative growth rate is decreased from 0.3582 in 2001 to -0.6833 in 2012. It shows the decreasing trend of publications from 2006. From 2010 onwards the growth rate had negative growth value. The doubling time for publications has decreased from 23.26 in 2003 to 1.01 in 2012. The average doubling time was 8.36 years.

Table 2. Relative growth and doubling time

Sl. No.	Years	No. of Publications	W_1	W_2	$R(a) = (W_2 - W_1)$	Mean R(a)	$D_t = 0.693/R(a)$	Mean D_t
1	2000	65	0.0000	4.1743	-			
2	2001	93	4.1743	4.5325	0.3582		1.94	
3	2002	99	4.5325	4.5951	0.0626		11.07	
4	2003	102	4.5951	4.6249	0.0298	0.1015	23.26	
5	2004	108	4.6249	4.6821	0.0572		12.12	
6	2005	111	4.6821	4.7095	0.0274		25.30	
7	2006	106	4.7095	4.6634	-0.0461		15.03	
8	2007	112	4.6634	4.7184	0.0550	0.0036	12.60	8.36
9	2008	96	4.7184	4.5643	-0.1541		4.50	
10	2009	110	4.5643	4.7004	0.1361		5.10	

11	2010	90	4.7004	4.4998	-0.2006		3.50	
12	2011	101	4.4998	4.6151	0.1153		6.01	
13	2012	51	4.6151	3.9318	-0.6833	-0.1617	1.01	
14	2013	71	3.9318	4.2626	0.3308		2.10	
15	2014	49	4.2626	3.8918	-0.3708		1.87	
		1364			-0.2825		125.41	

6.4. Authorship Pattern and Degree of Collaboration

6.1 Table 3 shows the authorship pattern in Aquatic Microbial Ecology. There were 3276 authors contributed 1364 publications. Out of 1364 publications, 324 (23.75%) publications were contributed by three authors, followed by 288 (21.11%) publications were contributed by four authors, whereas single author publications were 56 (4.11%) only. The degree of collaboration was 0.959. Multi-authorship was predominant in Aquatic Microbial Ecology. Tella and Olabooye (2014)[12] were reported in their bibliometric study on African Journal of Library, Archives and Information Science single authored publications were predominant than that of multi-authorship and contradict with this current findings.

Degree of Collaborations:

The Degree of Collaboration (DC) is measured by proportion of multiple authored papers derived by Subramanyam (1983)[13] as,

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

Where, DC = degree of collaboration in a discipline.

N_m = Number of multiple-authored research papers in the discipline published during a year.

N_s = Number of single-authored research papers in the discipline published during the same year.

Degree of Collaboration:

$$DC = \frac{1308}{1308 + 56} = 0.959$$

Table 3. Authorship pattern

Sl. No.	Authorship pattern	No. of publications	Cumulative publications	Percentage (%)	Cumulative percentage (%)
1	Single	56	56	4.11	4.11
2	Two	260	316	19.06	23.17
3	Three	324	640	23.75	46.92

4	Four	288	928	21.11	68.03
5	Five	171	1099	12.54	80.57
6	Six	115	1214	8.43	89.00
7	Seven	60	1274	4.40	93.40
8	Eight	39	1313	2.86	96.26
9	Nine	28	1341	2.05	98.31
10	Ten	11	1352	0.81	99.12
11	More than ten	12	1364	0.88	100.00
		1364		100.00	

6.5. Most Productive Authors

Table 4 shows the top 12 authors who had contributed 13 and above publications. There were 3276 authors contributed 1364 publications in Aquatic Microbial Ecology. Out of these 3276 authors, the number of publication-wise, Herndl, G. J was contributed 28 (2.10%) publications and secured first position, followed by Gasol, J. M was contributed 27 (2.00%) publications and Grossart, H. P contributed 21 (1.50%) publications secured second and third position respectively. The ranking of scientist according to the number of citation explained by Sen et al (1998)[14], and had divided the scientist into four categories on the basis of citation they were received (i) a few paper receive a large number of citations, (ii) a large number receives a smaller number of citations, (iii) a substantial number receive a very small number of citations, and (iv) the remainder receive no citation at all. The citation-wise analysis reveals that Grossart, H. P received 944 total citations secured first position, followed by Simon, M received 868 total citations and Herndl, G. J received 676 total citations placed second and third position respectively.

Table 4. Most productive authors

Rank	Name of the author	No. of contribution	Total Citations	Rank in Citation	1st author position	Author's country
1	Herndl, G. J.	28	676	3	1	Netherland
2	Gasol, J. M.	27	672	4	4	Spain
3	Grossart, H. P.	21	944	1	4	USA
3	Kirchman, D. L.	21	575	7	3	USA
5	Graneli, E.	15	335	35	0	Sweden
5	Simon, M.	15	868	2	2	Germany

7	Agusti, S.	14	270	54	2	Spain
8	Hansen, P. J.	13	309	43	2	Denmark.
8	Jurgens, K.	13	425	21	1	Germany
8	Lebaron, P.	13	604	6	1	France
8	Nagata, T.	13	120	145	0	Japan
8	Simek, K.	13	410	23	4	Czech Republic

6.6. Country-Wise Contribution of Publications

Table 5 shows the top ten most productive countries in Aquatic Microbial Ecology. Out of 1364 publications, there were 8 publications without author's country information. This analysis was done based on 1356 publications only. These 1356 publications were contributed by 61 counties. Out of 61 countries, USA were contributed 401 (29.57%) publications with 10738 citations and scored first place, followed by Germany were contributed 153 (11.28%) with 4005 citations and France were contributed 141 (10.40%) with 3660 and secured second and third places respectively. Whereas, South Korea were contributed 40 (2.95%) publications with 1502 citations placed in 15th position in publications and 9th position in citations. India secured 25th position with 12 (0.88%) publications with 220 citations.

Table 5 – Top ten most productivity country

Rank.	Name of the country	No. of publications	Percentage (%)	Total citation	Citation Rank
1	USA	401	29.57	10738	1
2	Germany	153	11.28	4005	2
3	France	141	10.40	3660	3
4	Spain	135	09.95	3224	4
5	UK	90	06.64	2422	7
6	Japan	84	6.19	1248	11
7	Denmark	82	6.05	2871	5
8	Netherlands	80	5.90	2512	6
9	Sweden	75	5.53	1730	8
10	Canada	62	4.57	1351	10

6.7. Most Prolific Contributing Institutions

Table 6 shows the top ten most prolific institutions were contributed 25 and above publications. Out of 1364 publications, there were 8 publications without author's institute information. This analysis was done based on 1356 publications only. There were 877 institutions contributed 1356 publications during the study period. Out of 877 institutions, Consejo Superior de Investigaciones Científicas (CSIC), Spain contributed 64 (4.70%) publications with 1954 citations and University of Paris VI, France were contributed 52 (3.80%) publications with 1607 citations scored first and second position in publication count and citation count. Centre national de la recherche scientifique (CNRS), France was contributed 42 (3.10%) with 1088 citations and secured third place in publication count and fourth place in citation count. National Institute of Oceanography, Goa was contributed 9 (0.66%) was placed in 73rd position from India with 207 citations.

Table 6 – Top ten highly contributed institutions

Rank	Name of the Institution	No. of Contributions	Percentage (%)	Total Citation	Citation Rank
1	Consejo Superior de Investigaciones Científicas (CSIC), Spain	64	4.70	1954	1
2	University of Paris VI, France	52	3.80	1607	2
3	Centre national de la recherche scientifique (CNRS), France	42	3.10	1088	4
4	University of Copenhagen, Denmark	40	2.90	1578	3
5	University of Delaware, USA	32	2.30	975	5
6	Max Planck Institute for Marine Microbiology, Germany	27	2.00	832	11
6	Plymouth Marine Laboratory, United Kingdom	27	2.00	845	9
6	University of Southern California, USA	27	2.00	880	7
9	University of Maryland, College Park, MD 20742, USA	26	1.90	836	10
10	Kyoto University, Japan	25	1.80	419	28

6.8. Document-Wise Distribution of Publications

Table 7 shows the document-wise distribution of publications in Aquatic Microbial Ecology. There were 6 types of documents contributed 1364 publications. Out of 6 document types, articles were major type of publications 1293 (94.80%) with 29519 citations, followed by Conference proceedings paper 26 (2.10%) with 759 citations and Review 23 (1.70%) with 1958 citations.

Table 7 – Document-wise distribution

Sl. No.	Document type	No. of Publications	Percentage (%)	TLCS	TGCS	Total Citations
1	Article	1293	94.80	2470	27049	29519
2	Proceedings Paper	29	2.10	67	692	759
3	Review	23	1.70	176	1782	1958
4	Editorial Material	11	0.80	0	34	34
5	Correction	7	0.50	0	0	0
6	Biographical-Item	1	0.10	0	0	0
		1364	100.00	2713	29557	32270

6.9. Highly Cited References

Table 8 shows the top ten highly cited references in the Aquatic Microbial Ecology journal during the study period (2000 – 2014). There were 34705 references were appended in the 1364 publications. Out of these, Porter, Karen G and Yvette S. Feig. 1980. The use of DAPI for identifying and counting aquatic microflora. *Limnol. Oceanogr*., 25: 943-948. DOI: 10.4319/lo.1980.25.5.0943 was cited 220 times and secured first position.

Table 8. Top ten highly cited references

Sl. No.	**Author/year/Journal**	No. of citation
1	Porter, Karen G. and Yvette S. Feig. 1980. The use of DAPI for identifying and counting aquatic microflora. Limnol. Oceanogr., 25(S): 943-948. DOI: 10.4319/lo.1980.25.5.0943	220
2	Azam, F., Fenchel, T., Field, J. G., Gray, J. S., Meyer-Reil, L. A., Thingstad, F. The Ecological Role of Water-Column Microbes in the Sea. Mar. Ecol. Prog. Ser., 10:257-263.	128
3	Parsons T., 1984, MANUAL CHEM BIOL MET	95
4	Fuhrman JA. 1999. Marine viruses and their biogeochemical and ecological effects. Nature, 399(6736):541-548.	94
5	Simon, M., Azam, F. 1989. Protein content and protein synthesis rates of planktonic marine bacteria. Mar. Ecol. Prog. Ser., 51:201-213	93
6	Cole, J. J., Findlay, S., Pace, M. L. 1988. Bacterial production in fresh and saltwater ecosystems: a cross-system overview. MEPS 43:1-10.	85
7	Muyzer, G., E C de Waal, and A G Uitterlinden. 1993. Profiling of complex microbial populations by denaturing gradient gel electrophoresis analysis of polymerase chain reaction-amplified genes coding for 16S rRNA. Appl Environ. Microbiol., 59(3): 695–700.	81

8	Smith, David C. and Farooq Azam. 1992. A simple, economical method for measuring bacterial protein synthesis rates in seawater using 3H-leucine. Mar. Microb. Food Webs, 6 (2): 107-114.	76
9	Hobbie, J. E., R J Daley and S Jasper. 1977. Use of nuclepore filters for counting bacteria by fluorescence microscopy. Appl. Environ. Microbiol. May 1977 33:1225-1228.	75
10	Wommack, K. Eric and Rita R. Colwell. 2000. Virioplankton: Viruses in Aquatic Ecosystems. Microbiol Mol Biol Rev., 64(1): 69–114.	74

6.10. Bibliographic Coupling of Institutions

The bibliographic coupling can be defined as "papers are bibliographically coupled when different authors cite one or more papers in common" (Garfield, 2001)[15]. VOSviewer is used for analysing institutional bibliometrics networks. The Web of Science source ".txt" data file was exported to VOSviewer to prepare the institutional bibliographical coupling. Fig. 2 shows the institutional-wise bibliographic coupling in Aquatic Microbial Ecology. The institutional network on Aquatic Microbial Ecology was prepared using NetDraw. Bibliographic coupling was estimated with following criteria, minimum number of documents of an institute 18 and above. Out of 877 institutions, 20 institutions meet the threshold. For each of the 20 institutes, the number of bibliographic coupling link was calculated. The institutes with the largest number of link were selected. Full count method was applied. Consejo Superior de Investigaciones Científicas (CSIC), Spain had 64 Publications with 15024 bibliographic coupling with other institutes globally.

Selected	Organization	Documents	Bib. coupling
☑	csic	64	15024
☑	univ paris 06	52	14709
☑	cnrs	42	11685
☑	univ copenhagen	40	6957
☑	univ delaware	32	9597
☑	max planck inst marine microbiol	27	5345
☑	plymouth marine lab	27	5880
☑	univ so calif	27	5520
☑	univ maryland	26	5782
☑	kyoto univ	25	4984
☑	seoul natl univ	22	5809
☑	univ helsinki	22	3216
☑	hong kong univ sci & technol	21	3315
☑	alfred wegener inst polar & marine r...	20	4297

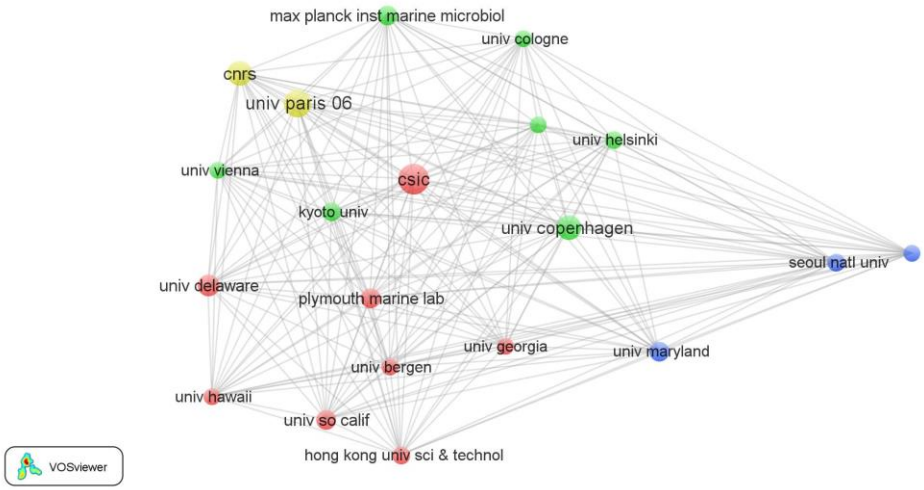

Fig. 2. Bibliographic coupling of institutes using VOSviewer

The institutional network in Aquatic Microbial Ecology was prepared using NetDraw. In VOSviewer, the source file was opened and saved as Pajek ".net" file. Using this ".net" file, institutional network was obtained. Fig. 3 shows the institutional network among the institutions performing research in aquatic microbial ecology.

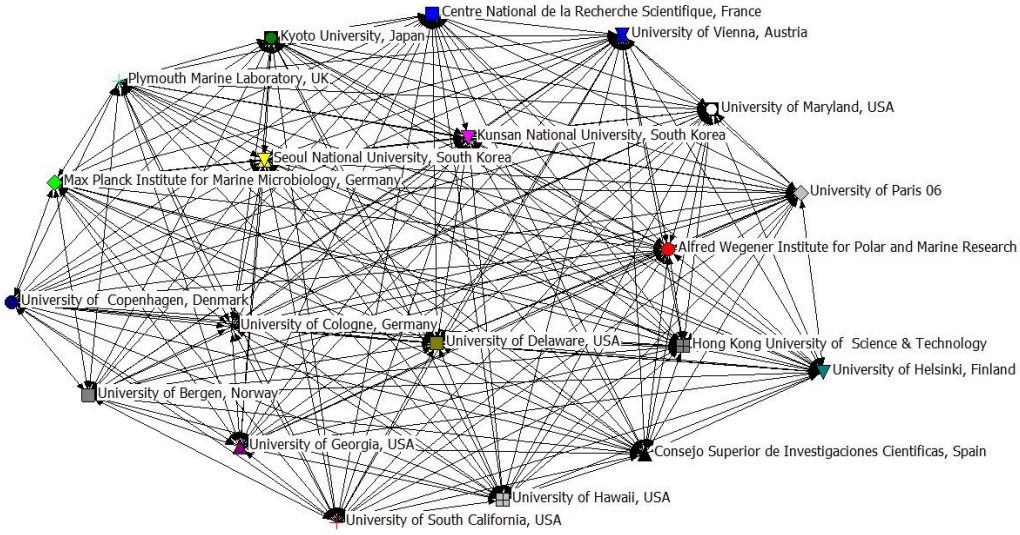

Fig. 3. Institutional network using NetDraw

7. Finding and Conclusion

The study reveals that 1364 publications were contributed in Aquatic Microbial Ecology during the study period (2000 – 2014). A steady growth was observed from 2000 to 2005. The highest numbers of publications were found in 2007 and lowest numbers of publications were found in 2014. The average doubling time was 8.36 years. Three authors contribution was more predominant than other authorship pattern. The degree of collaboration was 0.959. There were 3276 authors contributed 1364 publications, out of which Herndl, G. J contributed 28 publications with 676 citations and secured first position in publication count. USA was contributed 401 publications, among the 61 countries and secured first position. India secured 25th position with 12 contributions. There were 877 institutions contributed 1356 publications, out of these, Consejo Superior de Investigaciones Científicas (CSIC), Spain was contributed 64 publications and placed first position. From India, National Institute of Oceanography, Goa was secured 73rd position with 9 contributions. Articles (1293, 94.80%) were predominant in Aquatic Microbial Ecology. There were 34705 references were appended in the 1364 publications. Porter, Karen G. and Yvette S. Feig (1980) The use of DAPI for identifying and counting aquatic microflora. *Limnol. Oceanogr*., 25(S): 943-948. DOI: 10.4319/lo.1980.25.5.0943 was cited 220 times and score first position. Consejo Superior de Investigaciones Científicas (CSIC), Spain had highest bibliographic coupling with other institutions. Further study is needed to know the complete research pattern in Aquatic Microbial Ecology.

8. References

[1]. M. B. Griffitth, B. H. Hill, and F. H. McCormick, "Comparative application of indices of biotic integrity based on periphyton macroinvertebrates, and fish to southern Rocky Mountain streams," *Ecological Indicators*, vol. 5, pp. 7-136, 2005.

[2]. A. S. Eugene, and I. H. Oh, "Aquatic ecosystem assessment using exergy", *Ecological Indicators*, vol. 4, pp. 189 – 198, 2004.

[3]. A. Pritchard, "Statistical bibliography or bibliornetrics?," Journal of Documentation, vol. 25(4), pp. 348-349, 1969.

[4]. K. Vinitha, and R. Kumaresan, "Mapping of Food Science and Technology Research in India", in Emerging Trends and Issues in Scientometrics, Informetrics and Webometrics, P. K. Jain, Ed.. New Delhi: Ane Books Pvt. Ltd., 2016, pp. 231-240.

[5]. R. Kumaresan, K. Vinitha, and K. Kannan, "Fish & Shellfish Immunology (2010 – 2014): a bibliometric study," in International Conference on Re-Engineering of Library Resources and Services: challenges and opportunities [ICRLRS – 2016], 5th & 6th February 2016, Annamalai University, Annamalainagar, India, P. Ravichandran Ed. Annamalainagar: Annamalai University, 2016, pp. 275-279.

[6]. R. Kumaresan, K. Vinitha, and K. Kannan, "Aquatic Toxicology (2005 – 2014): a bibliometric study," in Research trends in library and information science: a festschrift volume in honour of Prof. V. Geetha, T. Muruganantham, Ed.. Tiruchirappalli: Alumni Association of Library and Information and P. G. & Research Department of Library and Information Science, Bishop Heber College (Autonomous), 2016, pp. 95 - 106.

[7]. R. Kumaresan, K. Vinitha, and K. Kannan, "Scientometric Analysis of Seaweed Research with reference to Web of Science", . *Library Philosophy and Practice* (e-journal). Paper 1348, 2015.

[8]. R. Kumaresan, R. Ezhilrani, K. Vinitha, P. Sivaraman, and R. Jayaraman, "Research trends in fish stock assessment during 1999 - 2013: a scientometrics study," *International Journal of Library and Information Science*, 3(2), pp. 24-36, 2014.

[9]. R. Kumaresan, R. Ezhil Rani, and R. Jayaraman, "Global literature productivity on White Spot Syndrome Virus (WSSV) during 1999 – 2013: a scientometric study," *International Journal of Current Research and Development*, 2(2), pp. 71-83, 2014.

[10]. R. Kumaresan, R. Ezhil Rani, K. Vinitha and R. Jayaraman, (2014). "Indian research contributions in the *Aquaculture* journal during 1972 – 2011: a scientometric study," *Library Philosophy and Practice* (e-journal). Paper 1185, 2014.

[11]. J. Liao, and Y. Huang, "Global trend in aquatic ecosystem research from 1992 to 2011," *Scientometrics,* 98: 1203-1219. DOI 10.1007/s11192-013-1071-z, 2014.

[12]. A. Tella, and A. A. Olabooye, "Bibliometric analysis of African journal of Library, Archives and Information Science from 2000 – 2012," Library Review, vol. 63(4/5), pp. 305-323, 2014.

[13]. K. Subramanyam, "Bibliometric studies of research collaboration: a review," Journal of Information Science, vol. 6(1), pp. 33-38, 1983.

[14]. B. K. Sen, T. A. Pandalai, T. A. and A. Karanjai, "Ranking of scientists – a new approach," Journal of Documentation, vol. 54(5), pp. 622-628, 1998.

[15]. E. Garfield, "From Bibliographic Coupling to Co-Citation Analysis via Algorithmic Historio-Bibliography: A Citationist's Tribute to Belver C. Griffith," Available at: http://garfield.library.upenn.edu/papers/drexelbelvergriffith92001.pdf , 2001.(accessed on 03.11.2014)