

ROLE MODEL SCIENTIST, PROF. G.K. KULKARNI: A SCIENTOMETRIC PORTRAIT

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Abstract

G. K Kulkarni, the well known Zoological Scientist is widely recognized as a very successful scientist. His publications were analyzed by year, collaboration pattern; Channels of communication used, domain & Keywords, etc. The results (Impact factor, G- index, H- Index, h-b index, etc.) indicate that the temporal variation of his productivity and of the types of papers published by him is of such a nature that he is eminently qualified to be taken as a 'role model' for the younger generation to try to do better.

In all he has published 170 publications. He has published 95.76% publications when he was working with the funded research projects during 1977-87; 1989-92, 1995-99, 2001-2006 and 2008-2009. He has published most frequently during 3rd, 4th, & 6th decades of his life. He has a cluster of 49 collaborators. The highest collaboration coefficient (1.0) was observed during 1978-1982, 1984-1988, 1990-1994, 1996-1997, 2000-2001 and 2004. The Collaboration coefficient 0.8424 and productivity coefficient was 0.3636. The Collaborative Index 2.47, Equalence Index 0.0009603, and Salton index was 0.03099. His productivity age 33 and fifty percentile age 13 and Impact Factor is 25.33.

He has published his papers through 36 journals. The core journals wherein he has published his papers were 'Hydrobiologia, Biology, Bioinfollet, etc. publication density was 2.36 and publication concentration was 19.44. G - Index 227, H-Index is 20.636.

Introduction

Scientometric means analysis of quantitative characteristics of science as enterprise, (Voveriene and Triempiene, 1994; Egghe, et.al., 2008). Scientometric studies relate to the mathematical regularities and statistical aspects of data on scientific innovation, area of science and technology. Kalyane, et.al. (2001) expressed that; scientometrics is a powerful tool for visualizing the cognitive landscape of R & D field.

The branch of scientometrics that studies the contributions of scientists and others and the citations received by the contributions made by them is known as Bio-bibliometrics. However, an appropriate phrase for the studies on scientists or group of scientists to analyze bio-bibliographic data is 'Scientometric Portrait'. There has been growing interest among scientometrists to publish data on individuals who are role model scientists or mentors.

There are individual scientists in all the fields, who have done and are doing good work in their field inspite of all sorts of hurdles. The field of Zoological sciences is not exception to it. If contributions of such scientists are properly projected, it may be possible to attract talented younger generation to the field of Zoological Sciences.

2. Biographical Note

Prof. G. K. Kulkarni, born on 12/10/1950. Sum total of the number comes to 1. As per schedule mnemonics of Colon Classification (Ranganathan, 1996); one is uniqueness, linear, world. It indicates that he is unique, straight forward, geneous researcher, world famous, scientist par excellence, and role model scientist. Born and brought up in Marathwada region of Maharashtra State. Meritorious student of Udayagiri

Mahavidyalaya, Udgir, Dist. Osmanabad (Latur) and Dept. of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (BAMU), serving university department of Zoology since last 34 years in different capacity as a Researcher, Lecturer, Reader, Professor & Head of the Department, and has attained recognitions as distinguished educationist viz. Ideal Teacher Award from Lion's club International, Aurangabad; Prof. J.S. Datta Munshi Gold Medal awarded by Zoological society of India and International Society of Ecological Communication for his outstanding contributions in the field of Zoology and Environmental sciences; received Congress of Zoology Gold Medal from Zoological Society of India; completed Post-Doctoral Work in research project funded by ICAR, New Delhi, at Central Institute of Fisheries Education, Mumbai (1977-1980); Post- Doctoral Fellow at Tulane University, New Orleans, USA under National Science Foundation Grant (1984-86); Visiting Scientist at University of Southern California, Los Angeles, USA and at Marine Research Laboratory of Duke University Beaufort, USA funded by Naval Research Programme, Washington (1986-87); Post- Doctoral Fellow at Dept. of Ecology, Evolution and Organismic Biology, Tulane University, USA under US-Israel Binational Agriculture Research Development Programme (1990-92); Recognized Research Guide in Zoology, Environmental Sciences and Interdisciplinary studies i.e. Pharmacy. Under his able supervision 22 students have been awarded Ph.D. degree and 5 more are in pipeline. Completed successfully 7 major research projects funded by UGC, DST, Ministry of Environment and Forest, New Delhi as Principle Investigator. One research project is ongoing. He has brought special recognition to the BAMU in general and Zoology department in particular with special grant of Rs. 34 lakhs from DST under FIST programmes; authored 140 research articles, 25 chapters in the book and 5 books.

He is a life member of 10 various National level Research societies including Indian Science Congress Association, Kolkata; Member on Editorial Advisory Board of at least a dozen of national level research journals; associated with more than 20 universities in India including BAMU as a member, Board of studies, Research and Recognition Committee, Screening Committee, Advisory Committee, Referee for M. Phil.,

Ph.D. thesis, Visiting Fellow, Paper Setter/ Examiner, Quality Assurance Cell Section, Committee member faculty of Science, Organizing Committee of Ashwamedh, assessment committee for teachers, observer for UGC NET/SET examination. Also served as member of Advisory Committee of European Economic Cooperation (EEC) project from Belgium; He has traveled extensively throughout India and abroad in pursuit of research activities. The countries visited are Singapore, Thailand, Malaysia, U.K., and USA.

In BAMU he has revised M.Sc. (Zoology) syllabi in tune with NET/SET and other competitive examinations, implemented semester system, introduced a paper on computer Applications in Zoology keeping tune with modern era of IT; for the first time introduced project work for M. Sc. Final year. Guided teachers in the department to prepare research proposals.

Apart from research publications and educational activities, he has been elected unopposed 3 times as Secretary of BAMUTA; secretary of MFUTA, Founder Member and captain of BAMU Badminton team, NCC certificate 'C' holder, etc.

Recently he has been elected as President of Section on Animal, Veterinary and Fishery Sciences for 97th session of Indian Science Congress Association, going to be held from Jan 03 to 07, 2009 at Kerala University Thiruvananthapuram.

Objectives

Objectives of this paper are to quantitatively document the publication behavior of G. K. Kulkarni:

1. to find out publication productivity;
2. to analyze domain wise productivity ;
3. to tabulate collaboration activity with all collaborators;
4. to identify prominent collaborators;
5. To know the communication outlets used.

Methodology

Scientific publications seem to provide the best available basis for measuring research output. Present study attempts to highlight contributions of G. K. Kulkarni by using scientometric techniques. It has listed 140 research papers, 25 chapters in books, 5 books. For analysis of data methods given by Sen and Gan (1990), Lancaster (1991), Kalyane (1994), Leydesdroff (1995), Kalyane and Vidyasagar Rao (1995), Dodgso and Hinze (2000), Vaishnav (2003), Sonawane and Vaishnav (2007) were used.

Attempt has also been made to define certain concepts, viz. An author who writes an article in a journal or periodical or writes a book and expresses his own views is called single author. When two or more authors jointly produce a publication, the act is operationally termed as collaboration. It is used synonymously in this work as co- authorship or multi authorship. Credit given to an author of a collaborative paper in terms of number. Normally each author figuring in collaborative paper gets one credit. (Vaishnav, 2003). To find out the authorship credits full credit is given to each author regardless of whatever happens to be the first or the last author. The term Principle author, primary author, chief author, main author and core author are used synonymously. Principle author means chief author or main author of a paper. Principle author means the common author among the authors forming a collaborative group. (Munnoli and Kalyane, 2003). Authorship status means the position of an author i.e. first, second, third, etc. sequence in the byline of a paper. Kalyane and Sen, (2003), have stated that, authorship status changes from paper to paper. In some paper he may be the first author, in some others his position may be second, third, fourth and so on. Collaborative Index means number of authors per paper. The terms collaboration coefficient and degree of collaboration are used synonymously. Collaboration coefficient means the ratio of the number of collaborative papers to the total number of papers published. (Munnoli and Kalyane, 2003; Vaishnav, 2003; Sonwane and Vaishnav, 2007; Sivasubramaniyam, 1983). An aggregation of a key author and all his / her co-authors during a year / period is called as cluster. Most prolific author is a collaborator of a principle author, but he produces more publications than the other collaborators. Core collaborator means chief

collaborators of papers or core collaborators, mean those authors who have made substantial contributions (in terms of number of papers) in association with the principal author. (Munnoli and Kalyane, 2003; Sonwane and Vaishnav, 2007). Equivalence Index (EI) is a statistical measure of the linkage/association between two authors in a cluster. EI for a pair of authors (a key author and one co-author) has been calculated using the formula:

$$E_{ij} = \frac{(C_{ij})^2}{(C_i) * (C_j)}$$

Where (ci) and (cj) are respectively the frequencies of occurrence of the authors (i) and (Cij) is the frequency of co-occurrence of the authors (i) and (j). Salton Index (SI) is a statistical measure of the co-author strength in a cluster. This has been calculated using the formula

$$S_{ij} = \frac{C_{ij}}{\sqrt{C_i * C_j}}$$

The term productivity patterns reflects an author productivity, authorship pattern, channels of communication, impact factor of author as well as journals, etc. Productivity age means the count from the year in which first paper by an author was published till the latest year of publication". (Munnoli and Kalyane, 2003; Vaishnav, 2003; Sonwane and Vaishnav, 2007). Fifty percentile age means the numbers of years during which 50% of the papers were published starting from the year of the first paper. (Vaishnav, 2003; Munnoli and Kalyane, 2003; Sonwane and Vaishnav, 2007). Productivity co-efficient means the ratio of 50 percentile age to total productivity age. Publication outlets means the sources preferentially chosen by the author to communicate results of research. Publication concentration (PC) means the ratio in percentage of the number of channels accounting for half of the papers to the channels used. (Munnoli and

Kalyane, 2003; Sen & Chatterjee, 1990; Panda, 1997; Vaishnav, 2003; Sonwane and Vaishnav, 2007 & Kademani, 2007). Publication density Frequency of papers per channel. . (Munnolli and Kalyane, 2003). This term is also defined by Kademani et.al. (1996); Vaishnav (2003); Sonwane and Vaishnav (2007), Kademani (2007) as "Publication density is the ratio of the total number of papers published to the total number of journals in which the papers are published

H-index is an index that quantifies both the actual scientific productivity and the apparent scientific impact of a scientist. The index is based on the set of the scientist's most cited papers and the number of citations that they have received in other people's publications. The index can also be applied to the productivity and impact of a group of scientists, such as a department or university or country. The index was suggested by Jorge E. Hirsch, a physicist at UCSD, as a tool for determining theoretical physicists' relative quality (Hirsch, 2005) and is sometimes called the *Hirsch index* or *Hirsch number*.

Hirsch suggested that, for physicists, a value for h of about 10-12 might be a useful guideline for tenure decisions at major research universities. A value of about 18 could mean a full professorship; 15–20 could mean a fellowship in the American Physical Society, and 45 or higher could mean membership in the United States National Academy of Sciences (Peterson, 2005).

The ***h-b-index*** is an extension of the h-index suggested in 2005 by Jorge E. Hirsch of the University of California, San Diego to quantify the scientific productivity of physicists and other scientists based on their publication record. The ***h-b-index*** developed by Michael Banks of the Max Planck Institute for Solid State Research in Germany, takes the index further by evaluating the impact of compounds used in solid-state physics and scientific topics in general.

The ***h-b-index*** is defined in the same manner as the h-index, but is based on a topic (or compound) search instead of a scientist's name. The h-index defined by J. Hirsch is:

A scientist has index h if h of his/her N_p papers have at least h citations each, and the other $(N_p - h)$ papers have at most h citations each.

For the case of a topic it is useful to define the ***h-b*** index in terms of the number of years, n as $h = nm$. If the ***h-b*** index is linear with the number of years, then m is given as the gradient. In this respect, a compound or topic with a large m and ***h-b*** index can be defined as a hot topic. **G-Index** was suggested in 2006 by Egghe. The index is calculated based on the distribution of citations received by a given researcher's publications. Given a set of articles ranked in decreasing order of the number of citations that they received, the g - index is the (unique) largest number such that the top g articles received (together) at least g^2 citations. Impact factor is a ratio. In essence this ratio is a measure that an item in asset of citable items receives on average the citations during a particular period, usually a year after the publication of citing items.

Scientometric portrait of Prof. G.K.Kulkarni

Attempts have been made to analyze 170 publications of G. K. Kulkarni by using different methods.

Yearwise frequency of publication:

Prof. G.K. Kulkarni has published 170 publications during the 33 years of his productivity life (Table-1). His productivity age began in the year 1976 at the chronological age of 26 years when he was a research fellow in Dept. of Zoology in BAMU. He has published highest number of 20 research papers during 2007 at the productivity age of 32 and chronological age of 57 years. At the productivity age of 13 and chronological age of 38 he has attained fifty percentile age as on today.

His most productive years were 1978, 1979, 1980, 1987, 2007 & 2008 having 13, 15, 15, 10, 20 & 12 papers respectively. It can be further noted that, 95.76% publications have been published when he was working with the funded research projects during 1977-87; 1989-92; 1995-99; 2001-2006 and 2008-2009 of

which 17.58% papers were published when he was working in USA as Post doctoral fellow, visiting scientists etc. during 1984-87 and during 1990-92. Three peak periods of high productivity during five years periods 1977-81 (having 50 papers), 1987-1991 (having 25 papers), and 2007-2009 (having 40 papers) were observed in case of G.K.Kulkarni. It can also be noted that, he has published most frequently during 3rd (47 papers), 4th (43 papers) & 6th (62 papers) decades of his life. The general finding is that biologists work more in middle of their careers (Sen and Gan, 1990) is not true in case of Prof. G. K. Kulkarni. His productivity co-efficient (PC) is 0.3636. The PC value smaller than 0.5 indicates rapid publication in early period of career (Kalyane and Munnoli, 1995). The general finding is that scientists publish most frequently in their fourth decade of life and thereafter publication rate drops. (Cole, 1979; Over, 1982; Simonton, 1985; and Horner, et.al. 1986) is not true in case of G.K. Kulkarni as in 6th decade of life his productivity is increasing. During 2004-2006 G K Kulkarni was appointed as Head of the Department. He has become more productive researcher with 19 publications during his tenure of headship.

Table-1
Yearwise frequency of publications

Year	Total publication	Cumulative	Productivity age	Actual age
1976	01	01	01	26
1977	06	07	02	27
1978	13	20	03	28
1979	15	35	04	29
1980	15	50	05	30
1981	03	53	06	31
1982	02	55	07	32
1983	06	61	08	33
1984	05	66	09	34
1985	02	68	10	35

1986	05	73	11	36
1987	10	83	12	37
1988	05	88	13	38
1989	06	94	14	39
1990	01	95	15	40
1991	03	98	16	41
1992	03	101	17	42
1993	01	102	18	43
1994	02	104	19	44
1995	00	104	20	45
1996	02	106	21	46
1997	01	107	22	47
1998	00	107	23	48
1999	00	107	24	49
2000	01	108	25	50
2001	03	111	26	51
2002	00	111	27	52
2003	00	111	28	53
2004	01	112	29	54
2005	09	121	30	55
2006	09	130	31	56
2007	20	150	32	57
2008	12	162	33	58
2009	08	170	34	59

Collaborative pattern

Presumably, the advantages of collaboration including the fruitful exchange of ideas, the higher quality of collaborative papers, receiving much more citations, are some reasons for this fast increase. In other words, useful science is good science. Government initiatives are promoting international scientific programs, providing funding for travels, and peripheral countries benefit from international collaboration are some other encouraging matters. In addition, inexpensive communication systems such as electronic mail, remote access to online database and facilities through the web seem reasonable for such a rapid growth (Osareh, 2005). Sharing of ideas in the same work area or over interrelated disciplines and opportunity to use modern technologies, instruments etc., availability of funds and sponsorship (Roy, 2004). Schubert & Braun, (1990) identified important once of collaboration as: access to expertise, access to equipment, resources, or "stuff one doesn't have, improve access to funds, to obtain prestige or visibility; for professional advancement, efficiency: multiplies hands and minds; easier to learn the tacit knowledge that goes with a technique, to make progress rapidly, to tackle "bigger" problems (more important, more comprehensive, more difficult, global), to enhance productivity, to get to know people, to create a network, like an "invisible college", to retool, learn new skill or techniques, usually to break into a new field, sub field of problem, to satisfy curiosity, intellectual interest, to share the excitement of an area with other people, to find flaws more efficiently, reduce errors and mistakes, to keep one more focused on research, because others are counting on one to do so, to reduce isolation, and to recharge one's energy and excitement, to educate (a student, graduate student, or, oneself), to advance knowledge and learning.

Prof. G. K. Kulkarni's research group during 1976-2009 consisted of prominent collaborators; their period of association is shown in Table -2. A cluster of 49 collaborators were in the group of G.K. Kulkarni. Five to sixty three papers producing authors in collaboration with G.K.Kulkarni are considered as active core collaborators and they are 10 in number. The high productivity group/ core collaborators consists of active researchers having collaboration in number of papers as R. Nagbhusanam (67 , 39.41%), M. Fingerman (16, 9.41%), A Bhaskarrao (13, %), M M Hanumante (14, 8.23%), P K Joshi (13, 7.64%), P.P.Joshi (12, 7.05%), C S K Anand (09, 5.29%), R. Sarojini (08, 4.70%), A K Khan (07, 4.11%), V. D.

Kulkarni (07, 4.11%), V V Vaidya (07, 4.11%), S.D.Kondekar (06, 3.52%), R. V. Berde (05, 2.94%), and G.K. Kulkarni (165). Which indicates that indeed G. K. Kulkarni is highly influential as mentor and his mentors are Dr. R. Nagbhusanam and M. Fingerman.

He has longest association with R.Nagbhusanam for 17 years, Hanumante 9 years, M. Fingerman 9 years, A Bhaskarrao 8 years, P K Joshi 7 years, C S K Anand 7 years, etc. The most prolific authors are R Nagabhusanam, M. Fingerman, M M Hanumante, P K Joshi, A Bhaskarrao, P P Joshi etc.

As regards the authorship status, it is interesting to note that he had contributed for 144 multiauthored research publications of which he was first author for 63 (43.75%) research papers, second author for 56 (38.89%) publications, while for 18 (12.5%) papers he was third author, he was fourth author for 05 (3.47%) publications and he was fifth & sixth author for one paper each only.

Collaborators with first position in the byline of the number of publications with G K Kulkarni were: G K Kulkarni (63), R Nagbhusanam (26), P P Joshi (6) M M Hanumante (5), S D Kondekar (4), M Fingerman (3), R V Bedre (3), S G Kulkarni (3), M K Kale (3), S A Kasture (3), Zeba Praveen (3), V V Vaidya (3), T J Jadhav (3), B N Pande (3), A Bhaskarrao (2), R Sarojini (2), S R Naik (2), R B Gaikwad (2), C A Jawale (2) P K Joshi (1), K Parvathi (1), V D Kulkarni (1), P D Chaudhary (1), S V Rankhamb (1), N B Patil (1), S D Shelar (1), G R Bharswadkar (1), G V Deshpande (1).

Impact Factor of G K Kulkarni

Total citations received
Impact factor can be calculated as -----
Articles covered in database

An attempt was made to find out the Impact Factor of G K Kulkarni. The databases of Google Scholar which is free site, ISI Web of knowledge & Scopus are paid sites were searched. As the databases searched

on the above sites the citations & cited articles were found for the year 2008 as shown in table No.2 It can

be noted that as per web of science i.e. Science Citation Index , G K Kulkarni's Impact Factor is 25.33 which is highest.

Table No. 2: Impact Factor of G K Kulkarni

Sr. No	Web Sites Searched	Citation received	Cited articles	Impact Factor
1	Google Scholars	302	36	8.38
2	Web of Knowledge	152	06	25.33
3	Scopus	111	36	3.08

G K Kulkarni's 11 highly cited articles & number of citations they have received were taken into consideration to calculate H Index. H- Index of G K Kulkarni was observed 20.636, it indicates that he belongs to full professorship as well as it means a fellowship in the United State National Academy of Sciences (Peterson, 2005). Attempt was also made to calculate G Index of G K Kulkarni by arranging the 11 articles in decreasing order of citations they have received, the citations taken together were 227 citations; which comes more than the square of 11.

Table No. 3: Authorship pattern of Prof. G K Kulkarni

Sr. No	Researcher	FPY	LPY	One	Two	Three	Four	Five	Six	Seven	Total
1	G. K. Kulkarni	1977	2009	26	74	49	12	4	4	1	170
2	R. Nagabhushanam	1977	1992		31	22	8	2	3	1	67
3	M.M. Hanumante	1977	1985		01	8	4	1			14
4	P. K Joshi	1978	1984		1	12					13
5	U. D. Deshpande	1979	1979				1				1
6	U. M. Farooqui	1979	1979				2				2
7	M. U. Patil	1979	1987				1		3		4
8	A Bhaskarrao	1982	1989		2	10	1				13
9	C.S.K.Anand	1982	1988			8	1				9
10	M. Fingerman	1985	1993		12	1		2		1	16
11	R.Ikeda	1985	1985					1			1
12	L. L.Vacca	1985	1985					1			1
13	A. K. Khan	1987	1987				3	1	3		7
14	P. R. Machale	1987	1987					1	3		4
15	R. Sarojini	1987	1987			1	3	1	3		8
16	V. D. Kulkarni	1988	1990			6	1				7
17	R. V. Bedre	1988	1990		1	3	1				5
18	C. R. Sagar	1990	1990				1				1
19	L. Glade	1991	1991			1					1
20	G. Amaldoss	1992	1992					1		1	2
21	R. B.Jaiswal	1992	1992					1			1
22	S. D. Kondekar	1994	2001		4	2					6

23	P. D. Chaudhary	1994	1994			2						2
24	S. R. Naik	1996	1996			2						2
25	K Parvathi	2001	2001		1							1
26	S. G. Kulkarni	2005	2007		1	1	1					3
27	V. V. Vaidya	2005	2008		3	2	1	1				7
28	M. K. Kale	2005	2005		1	2						3
29	P. P. Joshi	2005	2008		6	5	1					12
30	S A. Kasture	2006	2006		1	2						3
31	Zeba Parveen	2007	2007		2		1					3
32	R.B. Gaikwad	2007	2007		1			1				2
33	S.D.Deshpande	2007	2007					1				1
34	J.A.Kulkarni	2007	2007					1				1
35	S V Rankhamb	2008	2008			1						1
36	B. N Pande	2006	2007		3							3
37	T.S.N.Reddy	1997	1997								1	1
38	Otto O. Stierle Jr.	1997	1997								1	1
39	S.W.Fingerman	1997	1997								1	1
40	T.J.Jadhav	2004	2008		1	1	2					4
41	N.B.Patil	2007	2007		1							1
42	S.D.Shelar	2007	2007			2						2
43	G.V.Deshpande	2007	2007			2						2
44	G.R.Bharaswadkar	2007	2007		2							2
45	C.A.Jawale	2007	2007				2		1			3
46	S.S.Mokase	2009	2009						1			1
47	Atul Chorpagar	2009	2009				1		1			2
48	Sheetal Katre	2009	2009						1			1

49	Shaikh Rumana	2009	2009							1		1
	Total	1977	2009	26	148	147	48	20	24	7		420

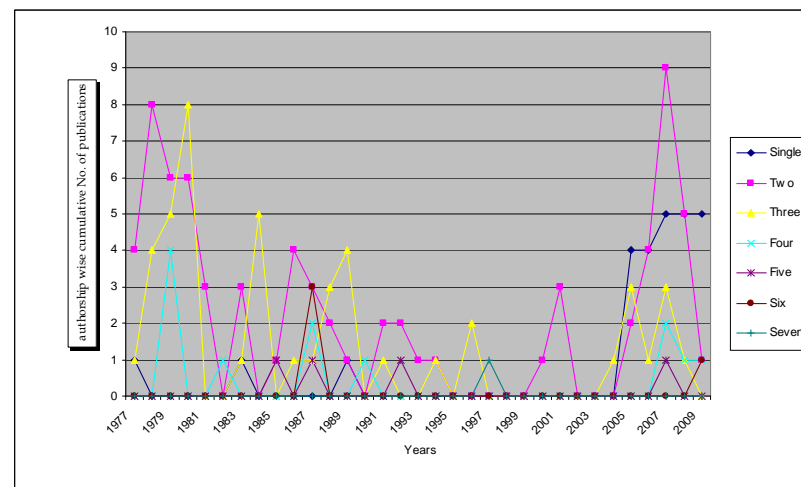
Of the 170 research publications, G K Kulkarni had only 26 (15.30%) single authored papers. While 144 (84.70%) were multi authored papers. Among multi authored papers he had two authored 74 (51.38%), three authored 49 (34.02%), four authored 12 (8.33%), five and six authored publication were 4 (2.77%) each and 7 authored publications was 1 (0.69%) only. His collaborative index is 2.47. Equivalence index of G. K. Kulkarni and M U Patil is 0.0009603; G. K. Kulkarni and B N Pande is 0.0004252; G. K. Kulkarni and S S Mokase is 0.0005347, and Salton index of G. K. Kulkarni and M U Patil is 0.03099; G. K. Kulkarni and B N Pande is 0.02525 and G. K. Kulkarni and S S Mokase is 0.0230234. By giving one credit to each author, the total authorship comes to 420 (Table No.3). The collaboration coefficient is 0.8424, the highest collaboration co-efficient (1.00) was observed during the years 1978-1982, 1984-1988, 1990-1994, 1996-1997, 2000-2001 and 2004. It can be further noted that G.K.Kulkarni had collaborated with his teachers viz. R. Nagbhushanam, colleagues, like M.M.Hanumante, M U Patil, B.N.Pande and S.S.Mokase, researchers as well as he has international collaborators like M. Fingerman, etc.

Table -4 Author Productivity in Research Group& Lotka's Law

Papers	No. of authors	Total authorship	Prominent collaborators	Expected authors
1	17	17		17
2	9	18		4.25
3	6	18		1.88
4	3	12		1.06
5	1	5	R V Bedre	0.68
6	1	6	S D Kondekar	0.47
7	3	21	A. K. Khan, V D Kulkarni, V V vaidya	0.34
8	1	8	R. Sarojini	0.26
9	1	9	C S K Anand	0.21
12	1	12	P P Joshi.	0.19
13	1	13	P K Joshi	0.10
13	1	13	A.Bhaskarrao	0.10
14	1	14	M. M. Hanumante,	0.09
16	1	16	M. Fingerman	0.07
67	1	67	R. Nagbhushanam	0.0042
170	1	170		0.00062
	49	407		

Total authorship to the credit of the group of G K Kulkarni is 420. 81% of the authorship belongs to 12 persons (24.49%) out of 49 persons involved in his research group. Thus partially it follows 80/20 rule i.e. 20% authors published 80% papers. It can be further noted that the data verbally fits into Lotka's inverse square Law.

Fig.No.1 Authorship growth in publications of G K Kulkarni



Attempt was made to find out publication per year, Publications per author, No. of Publications by single authored, two authored, three authored etc. It can be observed from the table number -5 that, out of total 170 publications; single authored, two authored and three authored publications were 87.27%. While four, five, six and seven authored publications were 12.73%. It can further noted that in the cluster of two and three authored publications, G K Kulkarni is found more active in comparison to four & Five etc. authored publications.

Table -5 Authorship credit to collaborators during 1977-2009

Sr.No	Researcher	FPY	LPY	one	Two	Three	Four	Five	Six	Seven	Total
1	Total Authorship	1977	2009	26	148	147	48	20	24	7	420
2	Percentage Authorship			6.19	35.23	35	11.42	4.76	5.71	1.66	100
3	Number of Authors			1	21	26	20	15	11	7	101
4	Authorship per papers			26	7.04	5.66	2.4	1.33	2.18	1	4.16
5	FPY (First Paper Year)			1983	1977	1976	1979	1985	1987	1997	1997
6	LPY (Last Paper Year)			1989	2008	2008	2007	2007	1997	2009	
7	Period in years			33	33	32	28	22	21	1	33
8	No. of publications			26	74	49	12	4	4	1	170
9	Publications per year			0.79	2.24	1.53	0.43	0.18	0.19	1	5.15
10	Publication per author			26	3.52	1.88	0.6	0.27	0.36	0.14	1.68

Total Publication outlets

Form wise productivity, Channels of communication wise productivity, Document wise productivity, and publication outlets are used synonymously. Publication outlets means, a form (books, journals, or other source of information) in which the articles, papers, or any publications are published.

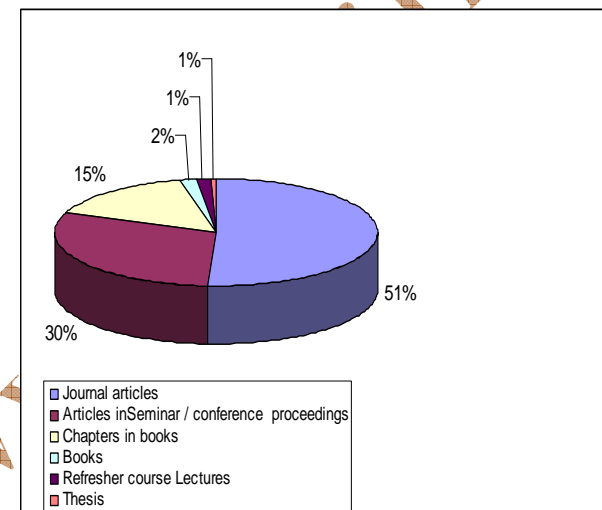
Attempt was made to analyze the data by Publication outlets used by G K Kulkarni, to publish total 170 publications, which is presented in Figure -2

Communication Channels

Dr. G. K. Kulkarni had published 170 documents from the year 1976-2009. These publications were grouped under various forms and are presented in Figure 2. It can be observed from Figure 2 that 81.21% items are published in the form of research articles and shows that it is the most vital media of communication. This indicates that he is continuously engaged in research. The next four popular forms are chapters in book 15.15%, Books 1.81%, Refresher course Lectures 1.21% and thesis 0.60%.

The Figure -2 & table-6 reveal that of the total 170 publications in total 94 channels are used, the highest percentage i.e. 51% of publications were journal articles, followed by 30% publications were published in conference proceedings, seminars, symposia, etc. While very few i.e. 4% publications were published as books or chapters in the books, refresher course lectures and thesis.

Fig. 2: Total Publication outlets



The topmost 13 channels had 51% publication. Thus publication concentration for total channels is 20.21; publication density for total channels is 1.76. The numbers of publication in various outlets are: International

Journals (17), International Seminar , Symposium& conference proceedings etc. (02); Indian journals (19), National Seminar , Symposium , conference proceedings (48).

Table-6
Total Publication outlets

Sr.No.	Channels of Communication	year	publications	%	Cumulative
1	Hydrobiologia	1977	21	12.35	21
2	Biology	1978	6	3.52	27
3	Bioinfolet	2005	5	2.94	32
4	Proc. Natn. Sympo. Ecotoxicol.	1987	5	2.94	37
5	Boinformatics	2007	4	2.35	41
6	Comp. Biochem. Physiol.	1986	4	2.35	47
7	Indian Jr. Invert. Zool. & Aqua. Biol.	1989	4	2.35	51
8	Indian Jr. Mar. Sci.	1979	4	2.35	55
9	Aquaculture	2007	3	1.76	57
10	Aquaculture	1979	3	1.76	60
11	Environment Toxicology	2008	3	1.76	63
12	Flora and Fauna	2006	3	1.76	66
13	Journal Animal Morphol. Physiol.	1977	4	2.35	70
14	Jr. Acqua Biol.	1996	3	1.76	73
15	Proc. Indian Scc. Of Invert. Reprod.	1983	3	1.76	76
16	Proc. Natn. Sympo. On Physiol. Crust.	1987	3	1.76	78
17	Rev. brasil Biology	1979	3	1.76	81
18	Adv. Pharamacol. Toxicol.	2007	2	1.17	83
19	Bioresearch	1978	2	1.17	85
20	Cell and Molecular Biology	2009	2	1.17	87
21	Ecology and Environment	2005	2	1.17	89

22	Fisheries and Fish Toxicology	2007	2	1.17	91
23	Him.Jr. of Environ. Zool.	2007	2	1.17	93
24	Proc. Indian Nat. Sci. Acad.	1988	2	1.17	95
25	Proc. of Natn, Symp. Eco-Environ. Impact & Organsm Response	1994	2	1.17	97
26	Proc.II nd Natn. Sympo. Ecotoxicol.	1988	2	1.17	99
27	Refresher course materials	2005	2	1.17	101
1-27	Total	2006	101	59.41	
28-94	Single paper channels	1977-2009	69	40.58	170
1-94	All publications	1976-2009	170	100	

Journal publication outlets

Journals are the channels which provide the recent or current information regarding the related topics. Journal wise productivity means, to find out from the total journals which are considered for study, in which journal G K Kulkarni has produced more articles.

Articles in journals are the most used vehicles in contemporary science and reflect a high degree of integration and evaluation done by scientific community. However, the fact that journal articles receive so much attention from the scientific community does not mean they are the only one, sometimes, even the most important source of information (Kademani, et.al. 1994).

In the present study 53.94% papers were published in journals hence an attempt was made to analyze the journals in which G K Kulkarni has published, which are presented in Table -7. In all he has published 85 papers in 36 journals. Maximum 19 papers were published in 'Hydrobiologia' having impact factor 1.2 during 1977-1984. He has published 6 papers in Biology having impact factor 1.49. He has published some articles in high impact factor journals, like Trends in life science (8.3), Advances in Bioscience Ocean

(4.08), 'Pigment Cell Research' (3.18), Invert reproduction development (2.66), Cell Tissue Research (2.61),

Comp. Biochem. Physiol. (2.345), Pollution Research (1.98), Aquaculture (1.74), & Malacologia (1.49).

Table -7
Journal Publication Outlets

Sr.No.	Name of Journals	Lang uage	Cou ntry	Public ations	Perce ntages	Impact factor	ISSN
1	Hydrobiologia	Eng.	NLD	21	24.7	1.2	0018-8158
2	Biology	Eng.	IND	6	7.06	1.49	1367-5931
3	Bioinfollet	Eng.	IND	5	5.88		0019-6339
4	Comp. biochem. Physiol.	Eng.	USA	4	4.71	2.345	1744-117X
5	Indian journal of Marine Science	Eng.	IND	4	4.71	0.21	0379-5136
6	Indian Jr. of Invert. Zool & Aquaculture Biology	Eng.	IND	4	4.71		0046-8991
7	Aquaculture	Eng.	NED	3	3.53	1.74	0044-8486
8	Flora and fauna	Eng.	IND	3	3.53	1.23	0813-6726
9	Journal of Animal Morphology physiology	Eng.	IND	3	3.53	1.08	0021-8804
10	Jr. of Aqua biology	Eng.	IND	3	3.53	0.99	0285-4376
11	Review of Brazil Biology	Eng.	BRA	3	3.53		1516-8913
12	Adv.in Pharmacology Toxicology	Eng.	IND	2	2.35		0965-0512
13	Bioresearch	Eng.	USA	2	2.35		1596-7409
14	Hima. Jr. of Env, Zool.	Eng.	IND	2	2.35		0429-9329
15	Biology Bulletin	Eng.	USA	1	1.18	0.93	0317-0926
16	Bulletin of ESI	Eng.	IND	1	1.18		1323-8957
17	Cell Tissue Research	Eng.	USA	1	1.18	2.61	0302-766X

18	Comparative Physiology & Ecology	Eng.	UK	1	1.18	1.87	
19	Gen.Pharmacology	Eng.	USA	1	1.18	0	0206-3623
20	Indian journal of Experimental Biology	Eng.	IND	1	1.18	0.55	0019-5189
21	Indian Jr. of Environmental & Ecoplan	Eng.	IND	1	1.18		0250-4758
22	Indian jr. of Physiology & Allied science	Eng.	IND	1	1.18	0.36	
23	Invert reproduction development	Eng.	USA	1	1.18	2.66	0003-1569
24	Jr. of crust. Biology	Eng.	USA	1	1.18	0.61	0028-0836
25	Jr. of scientific and Industrial research	Eng.	IND	1	1.18	0.24	0022-4456
26	Jr. of Comp. toxicology Physiology	Eng.	USA	1	1.18	0.87	1532-0456
27	Malacologia	Eng.	USA	1	1.18	1.49	1007-1202
28	Natural Science	Eng.	IND	1	1.18		0076-2987
29	Pigment Cell Research	Eng.	USA	1	1.18	3.18	0893-5785
30	Pollution Research	Eng.	IND	1	1.18	1.98	0944-1344
31	Rec. Advances in Bioscience Ocean	Eng.	USA	1	1.18	4.08	
32	Rivista di Biology	Eng.	BRA	1	1.18	0.41	0035-6050
33	Science & culture	Eng.	IND	1	1.18		0865-4824
34	Trends in life Science (India)	Eng.	IND	1	1.18	8.3	
35	Zoology Jb Physiology	Eng.	FRA	1	1.18	2.660	1540-7063
36	Zoo's Print Jr.	Eng.	IND	1	1.18	0.973	0971-9378
Total					85	100	

The data presented in table -7 have been further analyzed under the following parameters, viz.

Publication density, Publication concentration, Bradford's Law of scattering, Geographical distribution and Impact factor.

It can be observed from the table -7 that, G K Kulkarni has used in all 36 journals, to publish his 85 articles, with publication density 2.36. The table - 7 further reveals that, 50% of the papers i.e. 42.5 papers accounted by 07 journals. The publication concentration is 19.44.

Bradford's Law of Scattering

Bradford's law states that "If scientific journals are arranged in decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to subject and several zones of groups containing the same number of articles as the nucleus, then the zone will be as $a : 5a : (5a)^2$

In the present set of data number of journals has been arranged in order of decreasing productivity of articles (Table -8). They were divided in a nucleus of 3 equal zones. Numbers of articles in each zone were more or less equal, which is shown in Table -8.

Table 8

Bradford's Law of Scattering

Zone	No. of article	No. of journal
I	30	3
II	29	9
III	26	24
Total	85	36

The attempt was made to test applicability of Bradford's Law of scattering, as shown in table- 8. The total numbers of journal articles were divided into 3 equal zones, i.e. 28.33 articles in each zone. It was observed that, numbers of articles in each zone are same but number of journals in each zone are 03:9:24. Even though data does not fit Bradford's Law of scattering mathematically but verbally it fits into it. The 03 journals coming under first zone are core journals. It can be further stated that 80% articles were contributed in 52.78% journals.

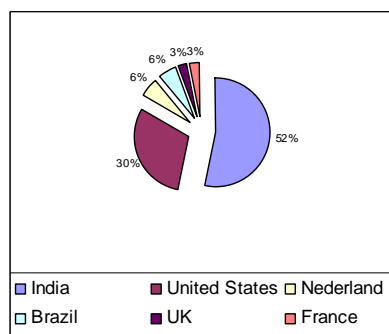
The total 85 journal publications of G K Kulkarni were analyzed to see which area or countries are preferred by him to publish his publications. This is shown in Table -9

Table -9: Geographical distribution

Name of the country	No. of papers published	Percentage
India	19	52.78
United States	11	30.56
Netherland	2	5.56
Brazil	2	5.56
UK	1	2.78
France	1	2.78
Total	36	100

It can be noted from table -9 and figure -3 that 47.22% journals preferred by G K Kulkarni were published in foreign countries i.e. international journals while 52.78% publications have been published in India. However, from amongst countries, India ranks first, followed by USA, Netherland, etc. Country wise publishers of the journals in which G K Kulkarni has published his papers revealed their belongingness as: India (19), USA (11), Netherland (2), Brazil (02), UK (01) and France (1).

Fig. 3: Geographical distribution



Impact factor

The articles which were published in journals are analyzed to find out the impact factor of all 36 journals which are related to the study undertaken from the Journal Citation Report (JCR), Web of Knowledge (Thomson Reuters, 2008) Scientific Business of file and home pages of each of the journals. The impact factor which were available in various sources, are categorized in to the ranges, which is shown in Table No.10.

Table -10: Impact factor

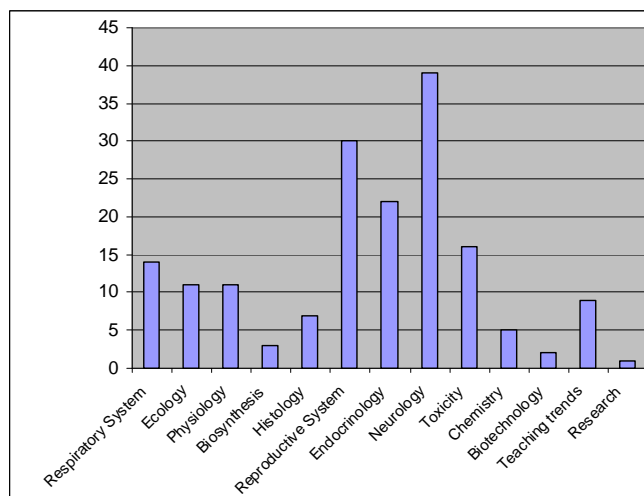
Range	Impact factor	percentage
0.00 to 0.99	10	27.78
1.00 to 1.99	8	22.22
2.00 to 2.99	4	11.11
3.00 to 3.99	1	2.778
4.00 to 5.99	1	2.778
more than 5	1	2.778
N.A.	11	30.56
	36	100

It can be observed from the table -10 that, inspite of making efforts , could not get impact factor of 11 (30.56 %) journals, 18 (50%) journals had impact factor less than 2; 4 (11.11%) journals had impact factor in between 2-3. One journal each had impact factor more than 3. Maximum impact factor of the journal was 8.3. Those journals are Pigment Cell research, Advances in Bioscience Ocean & Trends in life Science.

Domainwise Productivity

Of the 170 publications, he has published 61(35.8%) papers in Endocrinology and Neurology, 30(17.6%) papers in Physiology of Reproductive System, 14(8.24%) papers in Physiology of respiratory system, 22 (12.94%) papers in Ecology & Physiology, 33(19.41%) papers in Biosynthesis, Toxicity, Chemistry, Biotechnology etc., while 10(5.88%) papers were on general subjects like research in marine invertebrate Zoology & teaching trends in Zoology, etc. It can be noted that, he has high productivity in Neurology, Physiology of reproductive system, Endocrinology; medium productivity in Toxicity, physiology of respiratory system, Ecology& Physiology and Low productivity in Biosynthesis, Histology, Chemistry Biotechnology and general papers.(Fig.4).

Fig.No.4: Domain wise Productivity



After calculating h index for each topic, h-b index and value of the gradient m was calculated by using the method suggested by Hirsch (2005) which is shown in table No.11.

Table No. 11: Domain wise productivity & Citations received

Sr. No.	Keywords	Articles	%	Citations	%	h	FPY	LP Y	h-b	m
1	Physiology of Respiratory System	14	8.24	25	8.28	10.5	1977	2009	2.5	0.32
2	Ecology	20	11.8	36	11.9	11	1977	2009	4	0.34
3	Biosynthesis	4	2.35	2	0.66	2	1976	2007	1	.09
4	Histology	7	4.12	0	0	0	1978	2008	0	0
5	Reproductive system	30	17.6	133	44	23.4	1978	2007	0.4	1
6	Endocrinology	22	12.9	3	0.99	2	1978	2008	20	6
7	Neurology	40	23.5	56	18.5	12	1979	208	23	9
8	Toxicity	16	9.41	17	5.63	15	1981	2007	1	0.6
9	Chemistry (including immunocyto chemistry, histochemistry, biochemistry, electrophoratic separation, etc.)	5	2.94	27	8.94	27	1980	2008	23	1

10	Biotechnology	2	1.1 8	0	0	0	200 7	200 7	0	0
11	Teaching trends & Research	10	5.8 8	0	0	0	200 6	200 9	0	0
	Total	170	10 0	302	10 0					

It can be noted from the table No. 11 that in case of G. K. Kulkarni chemistry including Immunocytochemistry, Histochemistry, Biochemistry, Electrophoratic separation, etc. is the hot topic followed by Neurology having large value of h-b and m.

Table No.12: Indexes

Items	value
G Index (Egghe,2006) (square of top g articles i.e. g=11)	227
H- Index (Hirsch,2005) of hot topic Immunocytochemistry, etc.	27
h-b index (Banks,2006) of hot topic Immunocytochemistry, etc.	23
Gradient m (Banks,2006) of hot topic immunocytochemistry, etc.	1

As the value for H for the hot topic is 27, it indicates that even in hot topic like Immunocytochemistry, etc. he belongs to **full professorship** as well as it means a **fellowship in the united State National Academy of Sciences** (Peterson,2005)The value of G-Index indicates the impact of G.K. Kulkarni on scientific community. The large values of h-b and m for the topic immunocytochemistry, etc. indicate the impact of the topic as well as the author G. K. Kulkarni.

Conclusion

Publication productivity of Prof. G K Kulkarni was found to be consistent throughout his scientific career under study. Such examples are very rare to find. Percentage of collaborative work of the scientist was found to be very high as he had as many as collaborators within a short span of 31 years only. He is specialized in the domain of physiology and within physiology in the topics Neurology, Reproductive system, Endocrinology and Ecology, Immunocytochemistry etc. He can be considered as a 'role model' for younger researchers to follow.

Knowledge is valuable for its own sake and research has cultural value. Desire of being creative is built in our genes. Who knows this effort may be switched on genes for creativity in some of those who happen to read this article

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