Bradford's Zones Distribution of Journal Citations to the Fishery Science Literature: A Study with reference to Ph D Thesis submitted to Bangalore University Bangalore, Karnataka, 1972-2014

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Abstract

A Total of 5074 journal citations collected from 32 PhD thesis in Fishery Science were submitted to Bangalore University, Bangalore during 1972 – 2014. The citations were analyzed and discussed according to the following objectives: (1) To verify the types of sources referred by PhD students in Fishery Science, (2) To prepare rank list of core journals and (3) To identify Bradford's Zones distributions of journal citations
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Keywords

Citation Analysis; Ph D Thesis; Fishery Science; Rank list of core Journals;Bradford's Law Zones; Bangalore University

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I. Introduction

Journal is one of the best example of primary source because it covers first hand information. Journals are most cited by researchers. The Librarians were face many problems like budget, space and maintenance of journals. Citations analysis study helps them to purchase relevant journals for their library users and also for study of researchers who they were publish research articles in good journals. Citation analysis indicates evaluation of journals and helps to understand the active life of literature on various subjects. The analysis of citied papers is used as a measure the impact of individual article, journals, authors of publication and etc. It's basically technique which involves the process of counting, analysis and interpretation of citations given in research writings. It reflects in two major aspects i.e. firstly use of citation as a tool for librarians to evaluate the library collections and services and secondly use of citations as a tool to analyze research activities of researchers has chosen documents.

Basically there are three Basic Empirical Laws of Bibliometrics such as: (1) Bradford's Law of Scattering (distribution of journal citations), (2) Lotka's Law (denotes authorship Productivity of journal articles) and (3) Zipfs law (occurrence of frequency of words in ranking distribution). There are many previous works were done by various Library and Information Science professionals on Bradford's Law of scattering of periodicals on various subjects. A few of them were presented below:Sudhier (2010) applied Bradford Law to Physics Literature, Singh and Bebi (2014) discussed on Social Science Literature, Neelamma and Gavisiddappa (2016) analysed citations of Botany literature, Neelamma and Gavisiddappa (2016) presented on Crystallography, Jeyshankar and Nishavanthi (2017) examine Bradford's Law on Law Literature, Veerabasavaiah and Prakasha (2019) focus on Fishery Microbiology Literature.

The present study examined Bradford's Zones of distribution of journal citations in Fishery Science. There are 32 Fishery Science PhD theses and 5074 journal citations were selected for the study. The citations were analyzed and presented in Tables, figures and graphical form according to the following objectives of the study.

II. Objectives of the Study

1. To verify the types of sources referred by PhD Students in Fishery Science
2. To prepare rank list of core Journals
3. To identify Bradford's Zones distribution of journal citations.

III. Methodology

Citation Analysis is adopted for the present study. The required data collected from 32 PhD theses in Fishery Science. Each theses title pages and references pages were photocopied. Each references details were entered in to the Ms Excel Sheets.

IV. Analysis of Data

The analysis of data is presented in the following Table headings:

Table 1: Types of Sources referred by PhD Students in Fishery Science

Sl No	Types of Sources	No of Citations	%	Cumulative Citations	Cumulative %
1.	Journals	5074	73.41	5074	73.41
2.	Other than Journals	1801	26.05	6875	99.46
3.	Incomplete references	37	0.54	6912	100
	Total	6912	100		

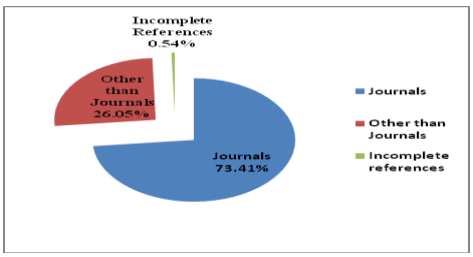


Fig .1. Types of Sources referred by PhD Students in Fishery Science

Table-1. Indicates that the types of sources cited by Fishery Science researchers. The result of the study reveals that journals were highest cited with 5047 (73.41%), followed by other than journal cited with (26.59%) of researchers.

Table-2. Rank list of Core Journals referred by Researchers.

SlNo	Rank	Name of Periodicals	Frequency of Citations	%	Cumulative Citations	Cumulative %
1	1	Gen and Comp Endocrinol	215	4.24	215	4.24
2	2	Aquaculture	177	3.49	392	7.73
3	3	J. Fish Biol	170	3.35	562	11.08
4	4	Can J. Fish Aquatic Sci	118	2.33	680	13.4
5	5	Hydrobiologia	115	2.27	795	15.67
6	6	Proc of Ind Acad of Sci Sec B	93	1.83	888	17.5
7	7	Ind J. Fisheries	78	1.54	966	19.04
8	8	J.Inland Fish Soc of Ind	73	1.44	1039	20.51
9	8	Poll Res	73	1.44	1112	21.92
10	9	J. Environ Biol	69	1.36	1181	23.28
11	10	Bull Environ Contam Toxicol	67	1.32	1248	24.6
12	11	Comp Bio and Physiology Part B	66	1.3	1314	25.9
13	12	J. Morphol	51	1.01	1365	26.9
14	13	Indian J. Exp Biol	50	0.99	1415	27.89
15	14	Ecotoxicol Environ Saf	48	0.95	1463	28.83
16	15	Acta Anatomica	47	0.93	1510	29.76
17	15	Can J. Zool	47	0.93	1557	30.69
18	15	Trans Am Fish Soc	47	0.93	1604	31.61

19	16	J. Endocrinol	46	0.91	1650	32.52
20	17	Z Zellforsch und Mikrosk Anat	45	0.89	1695	33.41
21	18	Aquatic Toxicology	40	0.79	1735	34.19
22	19	Environ Poll	39	0.77	1774	34.96
23	20	Nature	38	0.75	1812	35.71
24	20	Environment and Ecology	38	0.75	1850	36.46
25	21	Cur Sci	37	0.73	1887	37.19
26	22	Bull Jap Soc Sci Fish	36	0.71	1923	37.9
27	22	Cell Tissue Res	36	0.71	1959	38.61
28	23	Ind J Environ Ecoplan	35	0.69	1994	39.3
29	24	Am Zoo	33	0.65	2027	39.95
30	24	Wat Res	33	0.65	2060	40.6
31	25	J Exp Zool	28	0.55	2088	41.15
32	26	Z Mikrosk Anat Forsch	25	0.49	2113	41.64
33	26	Biol Bull	25	0.49	2138	42.14
34	26	J Ecotoxicol Environ Monit	25	0.49	2163	42.63
35	26	Prog Fish Cult	25	0.49	2188	43.12
36	27	Marine Biol	24	0.47	2212	43.59
37	27	Physio Zool	24	0.47	2236	44.07
38	27	J Exp Biol	24	0.47	2260	44.54
39	28	J Zool Soc Ind	23	0.45	2283	44.99
40	29	Com Physiol Ecol	22	0.43	2305	45.43
41	29	Copeia	22	0.43	2327	45.86
42	29	Ecology	22	0.43	2349	46.29
43	30	Arch Environ Contam Toxicol	21	0.41	2370	46.71
44	30	J Bombay Nat His Soc	21	0.41	2391	47.12
45	30	Quart J Microsc Sci	21	0.41	2412	47.54
46	31	Freshwater Biology	20	0.39	2432	47.93
47	32	Ind J Environ Health	19	0.37	2451	48.31
48	32	Matsya	19	0.37	2470	48.68
49	33	Anat Rec	18	0.35	2488	49.03
50	33	Environ Biol Fish	18	0.36	2506	49.39
51	33	Environ Health Perspect	18	0.36	2524	49.74
52	33	J Nutri	18	0.36	2542	50.1
53	33	Science	18	0.36	2560	50.45
54	33	Toxicol Letters	18	0.36	2578	50.81
55	34	Pol Arch Hydrobiol	17	0.34	2595	51.14
56	35	Fish Physiol Biochem	16	0.32	2611	51.46
57	35	J Ecobiol	16	0.32	2627	51.77
58	35	J Anim Ecol	16	0.32	2643	52.09
59	35	J Biol Chem	16	0.32	2659	52.4
60	36	Acta Zool	15	0.3	2674	52.7
61	36	Pest Biochem Physiol	15	0.3	2689	53
62	37	Environ Toxicol Chem	14	0.28	2703	53.27
63	37	Environ Res	14	0.28	2717	53.55
64	37	Quart Rev Biol	14	0.28	2731	53.82
65	38	Am J Physiol	13	0.26	2744	54.08
66	38	Appl Environ Microbiol	13	0.26	2757	54.34
67	38	Aquacult Res	13	0.26	2770	54.59
68	38	Bull Bot Soc Univ Saugar	13	0.26	2783	54.85
69	38	Ecol Environ Conser	13	0.26	2796	55.1
70	38	J Fish Dis	13	0.26	2809	55.36

71	38	J Zool	13	0.26	2822	55.62
72	38	Proc of the Soc for Expt Biol and Med	13	0.26	2835	55.87
73	39	Biol Reprod	12	0.24	2847	56.11
74	39	Bull Freshwater Fish Res Lab	12	0.24	2859	56.35
75	39	Chemosphere	12	0.24	2871	56.58
76	39	Fish Bull	12	0.24	2883	56.93
77	39	Int Rev Cytol	12	0.24	2895	57.06
78	39	J Anim Morphol Physiol	12	0.24	2907	57.29
79	39	J Comp Physiol A	12	0.24	2919	5235.1
80	39	J. Protozool	12	0.24	2931	57.77
81	39	SciCul	12	0.24	2943	58
82	39	Toxicol	12	0.24	2955	58.24
83	40	Endocrinology	11	0.22	2966	58.45
84	40	Fishery Technol	11	0.22	2977	58.67
85	40	Records of Indian Museum	11	0.22	2988	58.89
86	40	Proc of the Zool Soc of India	11	0.22	2999	59.11
87	40	Water, Air and Soil Poll	11	0.22	3010	59.32
88	41	Nat Environ Poll Tech	10	0.2	3020	59.52
89	41	Proc of the Royal Soc (B : Biological Sciences)	10	0.2	3030	59.72
90	41	Proc of the Zool Soc of London	10	0.2	3040	59.91
91	41	Zool Beit	10	0.2	3050	60.11
92	42	Act Zool (Stockholm)	9	0.18	3059	60.29
93	42	Bull Facul Fish Hokkaido Univ	9	0.18	3068	60.47
94	42	Fund Appl Limnol	9	0.18	3077	60.64
95	42	Ind J Mar Sci	9	0.18	3086	60.82
96	42	Int J of Acad of Ichthyol	9	0.18	3095	61
97	42	Israeli J Aquac (Bamidgeh)	9	0.18	3104	61.17
98	42	J Ichthyol	9	0.18	3113	61.35
99	42	J Parasitol	9	0.18	3122	61.53
100	42	J Threat Taxa	9	0.18	3131	61.71
101	42	J World Aquacult Soc	9	0.18	3140	61.88
102	42	Life Sciences	9	0.18	3149	62.06
103	42	Mutation Research	9	0.18	3158	62.24
104	42	Rev Fish Biol Fish	9	0.18	3167	62.42
105	42	Zool Anz	9	0.18	3176	62.59
106	42	Zoo'S Print Journal	9	0.18	3185	62.77
107	43	Aust J Mar Freshwater Res	8	0.16	3193	62.93
108	43	Biol Rev	8	0.16	3201	63.09
109	43	Bull Microscopial Application	8	0.16	3209	63.24
110	43	Bull Japan Soc Scientific Fish	8	0.16	3217	63.4
111	43	Comptes Rendus Chimie	8	0.16	3225	63.56
112	43	Comptes Rendus Des Séances de la Société de Biologie et De SesFiliales	8	0.16	3233	63.72
113	43	J Mar Biol Ass Ind	8	0.16	3241	63.87
114	43	Phil Trans Royal Soc (B) Biological Sciences	8	0.16	3249	64.03
115	43	Sci Total Environ	8	0.16	3257	64.19
116	43	Symp of the Zool Soc of London	8	0.16	3265	64.35
117	43	Trans of the Amer Micro Soc	8	0.16	3273	64.51
118	44	Comp Biochem Physiol Part (C)	7	0.14	3280	64.64
119	44	Experientia	7	0.14	3287	64.78
120	44	Fish Res Bull	7	0.14	3294	64.92

121	44	J Appl Bacteriology	7	0.14	3301	65.06
122	44	J Environ Health	7	0.14	3308	65.2
123	44	Limnology and Oceanography	7	0.14	3315	65.33
124	44	Mol Endocrinol	7	0.14	3322	65.47
125	44	Parasitology	7	0.14	3329	65.61
126	44	Proc of the Ind Sci Con	7	0.14	3336	65.75
127	44	Zeitschrift Für Wissenschaftliche Zoologie	7	0.14	3343	65.88
128	45	Acta Ichthyologica et Piscatoria	6	0.11	3349	66.003
129	45	Acta Veterinaria Brno	6	0.11	3355	66.121
130	45	Anat Anz	6	0.11	3361	66.24
131	45	Annales d Endocrinologie	6	0.11	3367	66.358
132	45	Aqua Fish Management	6	0.11	3373	66.476
133	45	Aquarium Sci Conserv	6	0.11	3379	66.594
134	45	Archiv Fur Protistenkunde	6	0.11	3385	66.713
135	45	Archives de Biologie (leige)	6	0.11	3391	66.831
136	45	Biol Bull of India	6	0.11	3397	66.949
137	45	Bull Fish Sci Hokkaido Univ	6	0.11	3403	67.067
138	45	Can J Microbiol	6	0.11	3409	67.186
139	45	Chinese J Chroma	6	0.11	3415	67.304
140	45	Comptes Rendus De IAcademie des Sciences Series D	6	0.11	3421	67.422
141	45	Ecoscan	6	0.11	3427	67.54
142	45	Endokrinologie	6	0.11	3433	67.659
143	45	Environ Monit Assess	6	0.11	3439	67.777
144	45	Food Control	6	0.11	3445	67.895
145	45	Helgolander Wissenchaftliche Meersuntersuchungen	6	0.11	3451	68.013
146	45	Journal du Conseil Permanent International Pour l'Exploration de la Mer	6	0.11	3457	68.132
147	45	J Appl Microbiol	6	0.11	3463	68.25
148	45	J Aqua Biol	6	0.11	3469	68.368
149	45	J Aqua Sci	6	0.11	3475	68.486
150	45	J Ecophy and Occ Health	6	0.11	3481	68.605
151	45	J Genetics	6	0.11	3487	68.723
152	45	J Lab and Clin Med	6	0.11	3493	68.841
153	45	J Protozool	6	0.11	3499	68.959
154	45	Mar Pol	6	0.11	3505	69.078
155	45	Mem of the Fac of Fish Sci ,Hokkaido Univ	6	0.11	3511	69.196
156	45	Oceologia	6	0.11	3517	69.314
157	45	Proc of the Nat Inst of Sci of Ind	6	0.11	3523	69.432
158	45	Tohoku J Agri Res	6	0.11	3529	69.551
159	45	Verhandlungen Des Internationalen Verein Limnologie	6	0.11	3535	69.669
160	45	Water SA	6	0.11	3541	69.787
161	45	Water Science and Technology	6	0.11	3547	69.905
162	45	Zool Pol	6	0.11	3553	70.024
163	45	Zool Sci	6	0.11	3559	70.142
164	45	Zoology	6	0.11	3565	70.26
165	46	Am J of Anat	5	0.099	3570	70.359
166	46	Am J of Path	5	0.099	3575	70.457
167	46	Animal Behaviour	5	0.099	3580	70.556
168	46	Arch Anat Microsc Morphol Exp	5	0.099	3585	70.654

169	46	Arch Pol Fish	5	0.099	3590	70.753
170	46	Aquacul Nut	5	0.099	3595	70.851
171	46	Behaviour	5	0.099	3600	70.95
172	46	Biochemical	5	0.099	3605	71.048
173	46	Braz J Biol	5	0.099	3610	71.147
174	46	Bull Bingham Ocean Coll	5	0.099	3615	71.246
175	46	Doklady Akademii Nauk SSSR	5	0.099	3620	71.344
176	46	Environ Ecol	5	0.099	3625	71.443
177	46	Environ Toxicol	5	0.099	3630	71.541
178	46	Geobios	5	0.099	3635	71.64
179	46	Int Ecol and Environ Sci	5	0.099	3640	71.738
180	46	J Appl Ichth	5	0.099	3645	71.837
181	46	J Exp Mar Biol and Ecol	5	0.099	3650	71.935
182	46	J Gen Microbiol	5	0.099	3655	72.034
183	46	J Physi	5	0.099	3660	72.132
184	46	Mar Poll Bull	5	0.099	3665	72.231
185	46	Mem of the Fac of Fish Kagoshima Univ	5	0.099	3670	72.33
186	46	Phykos: Journal of the Phycological Society India	5	0.099	3675	72.428
187	46	Raffles Bull Zool	5	0.099	3680	72.527
188	46	Sewage and Industrial Wastes	5	0.099	3685	72.625
189	46	Stain Technology	5	0.099	3690	72.724
190	46	The Science of Nature - Naturwissenschaften	5	0.099	3695	72.822
191	46	Toxicol Appl Pharmacol	5	0.099	3700	72.921
192 -234		43 Journals cited with 4 titles (43*4 = 172)	172	3.39	3872	76.311
235- 311		77 Journals cited with 3 titles (77*3 = 231)	231	4.553	4103	80.863
312-504		193 Journal cited with 2 titles (193*2 = 386)	386	7.607	4489	88.471
505-1089		585 cited with 1 titles (585*1 = 585)	585	11.529	5074	100
		Total	5074	100		

Table-2. denote rank list of core journals referred by researchers. There are 1089 journals were cited by researchers. Only 5 times cited journals can be considered for ranking. Among the ranked list of journals "**General and Comparative Endocrinology"** highest cited with 215 (4.24%) citations, followed by "**Aquaculture"** with 177 (3.49%), "**Journal of Fish Biology"** cited with 170 (3.35%), "**Can J. Fish Aquatic Sci**" with 108 (2.33%), " **Hydrobiologia**" with 115 (2.27%) citations and respectively.

Bradford's Zones Distribution of Journal Citations

Bradford's Law of scattering of journals can describe the journals citations in a field can be divided in to three zones. Each zone has 1/3rd of journal citations i.e. (1) A core of a few journals, (2) A second Zone with more journals and (3) A third zone with bulk of Journals

According to Bradford the law can be calculated as $1:n:n^2$. The study can be calculated below in Table-3.

Table- 3. Bradford's Zones Distribution of Journal Citations

Zone	No of Journals	No of citations	%	Bradford multiplier k
1	19	1650	32.52	
2	107	1686	33.23	5.63
3	963	1738	34.25	9.00
	1089	5074	100.00	14.63

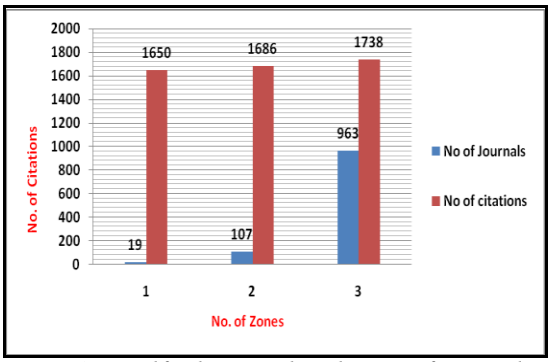


Fig-2. Bradford's Law distribution of Journal Citations

Table-3. It is observed that **19** core journals covered **1650** citations, the second zone contains **107** journals covered with **1686** citations and the third zone contains **963** journals covered with **1738** citations. According to Bradford's Law is $1:n:n^2$ is calculated as **19:107:963** and Bradford's Multiplier mean is **7.31**. It is found that does not fit for the law.

V. Findings and Conclusion

The findings of the study shows that the journals are most highly cited with 5074 (73.14%) by researchers. The top 3 journals are General and Comparative Endocrinology , Aquaculture and Journal of Fish Biology are highly cited by researchers, Further the distribution of citations in Bradford zones, there are 19 journals with 1650 (32.52%)citations , 107 Journals with 1686 (33.23%)and 963 Journals with 1738 (34.25%) citations were distributes in $1/3^{rd}$ of citations in each Zone.

It can be concluded that Bradford's Law helps to select the core journals in research field. This study will be helpful to the libraries to procure best literature in a given areas. This study also helpful to the researchers who are working in Zoology in Fishery Science.

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