

*Full Length Research Paper*

## Citation analysis of doctoral theses in Zoology submitted to Kuvempu University, India: A case study

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The purpose of this paper is to determine the materials cited in Doctoral theses of the Zoology, submitted to the Kuvempu University, India during the year 2002 to 2006 with the aim of improving the existing collection development of the library. Data were extracted from title page and references given at the end of each chapter. The cited documents are recorded on 5"x3" slips and the same is tabulated in Microsoft Excel, and extracted data were analysed using statistics. The study reveals that journals are the most preferred sources of information used by the researchers in the field of Zoology accounting for 74.47% of total citations followed by books and monographs 18.02% citations although, citations from conference proceedings, theses, reports, patents and news papers are also found. It is also observed those researchers are taken advantage of internet resources. The Journal of Mutation Research has ranked the first with 94 citations accounting for 5.71% of the total journal citations. Further, Bradford's Law of Scattering was applied. It is observed that major citation from journal literature. In addition, more cited materials were contributed by Multi authors and Degree of collaboration is 0.71.

**Key words:** Zoology, doctoral theses, citation study, authorship pattern, journals ranking, Bradford's Law.

### INTRODUCTION

Zoology is the aspect of science that deals with the study of the animals' evolution, habitat and behavior. It is also concerned with every level of biological organization from the gene to the ecosystem, and with the structure, physiology, behavior, genetics, development, distribution, and evolution of animals in all taxonomic groups. In a broad sense, zoology also deals with the inter-relationships between humans and other animals. There is ample scope for students to obtain a broad education in zoology. It is a wide field offering many career opportunities for research, especially because there still is a great deal to learn about it. In this subject field research is increasing day by day. There is huge amount

of information resources are available in the field of Zoology. This has led to the explosion of information. Hence, selecting the appropriate periodicals can be a challenging job. As such it is necessary to find a solution to tackle with the growth of literature and changing needs of the users. To take a right decision in this regard citation analysis study is important in any subject field (Importance of Zoology, 2012).

Citation analysis is an effective tool to identify the core references in a subject by counting the citations appended at the end of each scientific article. It is basically a technique, which involves the process of collection, counting, analysis and interpretation of

citations given in research writing and thereby helping in identification of significant sources of information. White (1985) is of the opinion that, citation analysis plays a promontory role for easy identification of earlier research. It is one of the thrust units of research in the field of library and information science. In this line, the present study therefore looks at the research productivity of doctoral theses in the Department of Zoology of Kuvempu University, Karnataka. The results of the study would be useful to the librarians and information scientists for planning, managing the information resources and services in the field of Zoology.

### Review of related studies

A large number of bibliometrics and citation analysis studies on doctoral theses have been conducted on various subject fields in India and abroad. The present study focuses on the Citation Analysis of Doctoral Theses in Zoology submitted to Kuvempu University, Karnataka. Though researcher got large number of literature on research topic, researcher selected some core works to review.

A number of researchers have used citation analysis to look at the various subjects of doctoral theses to determine their information needs. Such as Maheswarappa and Prakash (1982) carried out a study on literature use pattern by the researcher's in the field of botany, a citation study of doctoral theses. The study examined 2,726 citations and they were analysed on the basis of principal of bibliographic forms, obsolescence and Bradford's law was applied to the botanical literature. Vimala and Pulla (1996) carried out a study on trend in authorship pattern and collaborative research in zoology. Study indicated that although multiple authorship is dominant, solo research also exists. The proportion of single authored papers has shown a declining trend during the period 1901 to 1995. It is observed that the proportion of single authorship is likely to be insignificant after the year 2030. The degree of collaboration in research is 0.75 in zoology as a whole.

Another similar study had undertaken by Shafi and Wahida (2005) on Citation Analysis of Ph.D Theses submitted to Kashmir University during 1980 to 2000 in Natural Sciences. This study covered one hundred doctoral dissertations submitted to Kashmir University during the period 1980-2000 in the field of Natural sciences. Among them 17 theses were from zoology. Total of 11,862 citations were analysed for identifying bibliographic form, citation potential, journal ranking and obsolescence rate.

Nabe et al. (2008) Dissertation citations in Organismal Biology at Southern Illinois University at Carbondale: Implications for collection development. They reported on a citation analysis of Ph.D. dissertations in plant biology and zoology at Southern Illinois University Carbondale,

study aims to test the common assumption that scientists favour current research to such an extent that journal back files can be de-emphasized in academic library collections. Results demonstrate otherwise. The study is reproducible for any institution, and can help to evaluate 1) the value of electronic journal back files and 2) the need to maintain print back files.

Nandi and Bandopadhyay (2010) conducted case study on Zoological Research Contributions of the University of Burdwan in West Bengal: An analytical study. Research productivity in Zoology, authorship pattern and nature of collaboration among the zoology scholars are studied. Result reveals that authorship trend is towards multi authored papers and the degree of collaboration is 0.51. Similar study conducted by the same author Nandi and Bandopadhyay (2012), in which an attempt has been made to study the comparative research performance of Botany and Zoology department of the University of Burdwan during 1960 to 2000. There were 160 theses and 189 research articles in the field of Botany and 236 theses and 251 research articles in Zoology were found. The degree of collaboration in botany and zoology is 0.70 and 0.51 respectively.

### About Department of Zoology

The Post Graduate Department of Zoology of Kuvempu University, Karnataka was started in 1993. The Department is well equipped with instruments, facilities and infrastructure. Major thrust areas of the research in the Department include Genetics, Bio diversity, Wetland limnology, Toxicology, Fisheries, Sericulture and Physiology. It offers M.Sc., M.Phil., and Ph.D., courses.

### Objectives

The following are the main objectives of the study:

1. To trace out the average number of references per thesis.
2. To know the form wise distribution of sources.
3. To know the authorship pattern.
4. To know the Chronological distribution of citations.
5. To determine the Subject wise distribution citations.
6. To study the distribution of documents, according to their country of origin.
7. To prepare a rank list of journals in order of their frequency of citation.
8. To apply Bradford's Law to the journal citations.

### METHODOLOGY

For the present study necessary data has been collected from 12 doctoral theses accepted by the Department of Zoology Kuvempu University, Karnataka from 2002 to 2006. The bibliographical

**Table 1.** Year wise submission of thesis.

S/No.	Year	Number of thesis	Percentage
1	2002	1	8.33
2	2003	1	8.33
3	2004	3	25
4	2005	4	33.34
5	2006	3	25
Total		12	100

**Table 2.** Average number of citations per thesis.

S/No.	Year	Total no. of theses	Total no. of citations	Average citations per dissertations
1	2002	1	184	184
2	2003	1	219	219
3	2004	3	482	160.66
4	2005	4	734	183.05
5	2006	3	590	196.66
Total		12	2209	184.08

references cited at the end of the doctoral theses are taken as the source of data for the study. Further, Ulrich's periodical directory for knowing the country and the subject of the cited journals was referred. The cited documents are recorded on 5"x3" slips and the same is tabulated in Microsoft Excel, and the data are extracted to meet the objectives of the study.

## RESULTS AND DISCUSSION

Analysis of data is the penultimate step in research process. It is the link between raw data and significant results leading to conclusions. This process of analysis has to be result oriented. In other words, it must aim at setting objectives. After the analysis, a total of 12 theses were analyzed. A total of 2209 citations were made.

### Year wise submission of theses

The data pertaining to the year wise distribution of theses submitted to the Department of Zoology is presented in Table 1. It is evident from the study that maximum number of theses (33.34%) was submitted in the year 2005, followed by 2004 and 2006 (25.00% each). Data shows increasing trend in research output.

### Average number of citations per thesis

Table 2 present the data regarding the average number of citations per thesis. It is observed from the study that on an average, 184.08 citations were cited per thesis by the Zoology research scholars. Further it is observed from Table 2 that the highest number of citations per

thesis is 219 in the year 2003.

### Distribution of citations according to bibliographic forms

Table 3 and Figure 1 show the distribution of different forms of citations in the field of Zoology. It is observed from Table 3 that journal contributes the highest number of citations accounting for 74.47% of the total citations. This indicates that journals are the most profusely cited source of information by the Zoology researchers. Books are the second most cited source accounting for 18.02% of the total citations. In other words journals and books together constitute 92.49% of the total number of citations cited by the research scholars.

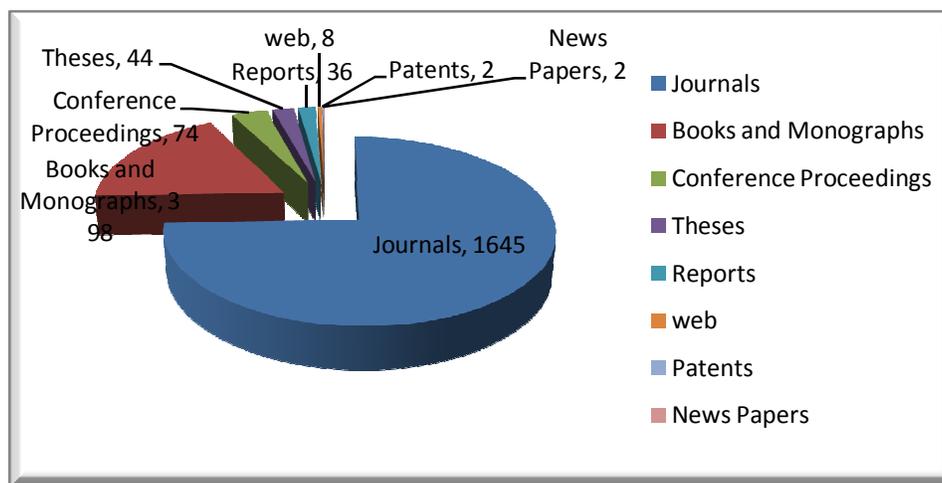
The next preferred source of information for Zoology research scholars is the seminar/conference proceedings accounting for 3.36% followed by theses and dissertations (1.99%) and reports (1.62%). Another new source of information for the present society is web resources which also found place in the bibliographic forms.

### Authorship pattern of journal citations

Table 4 clearly shows that authorship pattern of journal citations indicates that out of a total number of 1645 citations, 588 (35.75%) are by two authors. The results of the study fall in the line of study conducted by Koteppa and Biradar (2013). Among the two authorship, foreign authors' contribution constitutes 20.97%, while a Indian authors contributed 14.77%.

**Table 3.** Distribution of citations according to bibliographic forms.

S/No.	Bibliographic form	Citation	Cumulative citations	Percentage	Cumulative percentage
1	Journals	1645	1645	74.47	74.47
2	Books and Monographs	398	2043	18.02	92.49
3	Conference Proceedings	74	2117	3.36	95.85
4	Theses & Dissertations	44	2161	1.99	97.84
5	Reports	36	2197	1.62	99.46
6	Web Resources	8	2205	0.36	99.82
7	Patents	2	2207	0.09	99.91
8	News Papers	2	2209	0.09	100
	Total	2209		100	

**Figure 1.** Distribution of citations according to bibliographic forms.**Table 4.** Authorship pattern of journal citations.

No. of authors	Total citations	Percentage	Foreign authors	Percentage	Indian authors	Percentage
One	462	28.08	332	20.18	130	7.90
Two	588	35.75	345	20.97	243	14.77
Three	282	17.14	170	10.33	112	6.81
Four	133	8.08	92	5.59	41	2.49
Five	81	4.92	67	4.07	14	0.85
Six	41	2.49	26	1.58	15	0.92
Seven	28	1.72	19	1.17	9	0.55
Eight and above	30	1.82	18	1.09	12	0.73
Total	1645	100.00	1080	64.98	565	35.02

Overall contribution indicates that foreign author's percentage is 64.98% while Indian author's percentage is 35.02%.

Collaborative research is the common phenomenon in the field of science and technology in general and Zoology in particular. According to Price (1963), investigation have pointed out that there has been a

consistent trend towards increased collaboration. The collaborative research is a well recognized feature of modern science, and there has been a consistent trend towards increased collaboration in all branches of science during the present century. An attempt has been made to know whether the trend towards increased collaboration is in Zoology or not.

**Table 5.** Chronological distribution of journal citations.

Period	Number of citations	Cumulative citations	Percentage of citations	Percentage of cumulative citations
1800-1849	01	01	0.06	0.06
1850-1899	03	04	0.18	0.24
1900-1909	03	07	0.18	0.42
1910-1919	05	12	0.30	0.72
1920-1929	08	20	0.48	1.20
1930-1939	12	32	0.72	1.92
1940-1949	17	49	1.03	2.95
1950-1959	54	103	3.28	6.23
1960-1969	82	185	4.98	11.21
1970-1979	185	370	11.26	22.47
1980-1989	391	761	23.78	46.25
1990-1999	580	1341	35.27	81.52
2000-2006	304	1645	18.48	100.00
Total	1645		100.00	

By analyzing Table 4 it is observed that majority of the cited documents were by two and more authors that means the collaborative research is prevailing in Zoology subject. Further Table 4 shows that 28.08% of all the citations are in favor of single authors and remaining 71.92% of citations in favour of team research.

Degree of collaboration among authors is calculated by the following formula given by Subramanyam (1983).

$$C = \frac{NM}{NM + NS}$$

Where, C=degree of collaboration; NM=No. of multi authored papers; NS=No. of single authored papers;

$$C = \frac{1183}{(1183 + 462)} = \frac{1183}{1645}$$

In the present study, the degree of collaboration, C= 0.71.

### Chronological distribution of journal citations

Table 5 reveals the chronological distribution of journal citations. The maximum number of citations (35.27%) is cited during the year 1990 to 1999, followed by the period 1980 to 1989 accounting for 391 (23.78%) citations. The other period groupings are in decreasing trend. This clearly shows that the Zoology researchers are in need of recent information for their research work. Very small percent of references are cited which are published about a century ago.

### Subject wise distribution of citations

Subject wise distribution of citation is one of the important

issues of citation analysis. It will help to know the distribution of citations among the sub branches and allied subjects of zoology besides to know the research trend in Zoology.

Table 6 clearly shows that Entomology (18.78%), Ecology (12.76%), Plant Insect Interaction (8.63%), Aquatic biology (6.80%) and Biodiversity (6.56%) contributes 53.53% of the total citations. The remaining subject together contributes 46.47% of the total citations. This clearly indicates that the research trend in zoology is towards Entomology, Ecology, Plant Insect Interaction, Aquatic biology and Biodiversity.

### Geographical vs. Bibliographic form wise distribution of cited documents

It is noticed from the cited documents that the research scholars in Zoology have referred the literature published from 20 countries (Table 7). Of all the countries, USA dominates with accounting 38.88% citations; the second highest utilized sources originated from India (24.26%), UK occupies the third place with a total of 16.34% citations followed by Netherlands, Canada and Germany which occupy the fourth, fifth and sixth places with 5.70, 2.13, 2.22% citations respectively. Only 10.47% of the citations are from remaining 14 countries.

### Core Journals

The output of scientific literature has been increasing exponentially and new journals in specialized branches of science keep appearing. In order to cover the communication flow of periodicals publications either multiplies the number of volumes per year or split into different titles covering narrower subject areas. But research

**Table 6.** Subject wise distribution of citations.

S/No.	Subject	No. of citations	Cumulative citations	Percentage	Cumulative percentage
1	Entomology	309	309	18.78	18.78
2	Ecology	210	519	12.76	31.54
3	Plant Insect Interaction	142	661	8.63	40.17
4	Aquatic biology	112	773	6.80	46.97
5	Biodiversity	108	881	6.56	53.53
6	Insect diversity	88	969	5.35	58.88
7	Ornithology	86	1055	5.23	64.11
8	Food Habitat	74	1129	4.50	68.61
9	Animal Behaviour	72	1201	4.37	72.98
10	Animal Genetics	68	1269	4.13	77.11
11	Resistance Mechanism	56	1325	3.40	80.51
12	Pest Control	54	1379	3.28	83.79
13	Water Management	48	1427	2.92	86.71
14	Water Quality	42	1469	2.55	89.26
15	Agronomy of Coffee	36	1505	2.19	91.45
16	Behaviour Study	31	1536	1.88	93.33
17	Adoption Biology	29	1565	1.76	95.09
18	Coffee Cultivation	23	1588	1.40	96.49
19	Insect	18	1606	1.09	97.58
20	Chemical Control	12	1618	0.73	98.31
21	Control Management	9	1627	0.57	98.88
22	Fish Diversity	8	1635	0.48	99.36
23	Diversity	6	1641	0.39	99.75
24	Animal Physiology	4	1645	0.25	100.00
	Total	1645		100.00	

libraries must be highly selective in their acquisition programmes due to their limited funds. Citation analysis helps to identify the most cited journals which can be considered as core journals. The ranked list prepared as a result of the analysis of citations should reflect the priority given by the readers to the journals. Such ranked lists are very often used as guidelines in the acquisition of periodical in the library. Table 8 represents a rank list of most frequently cited journals in Zoology.

From Table 8 it is understand that the journal with the highest number of citations occupies the top rank and thus obviously the most important journal in the field of Zoology while the least important titles are placed at the bottom of the table.

There are 304 journals arranged in order of their ranks. From Table 8 it can be ascertained that the Mutation Research published from Netherlands occupies the first rank as the most preferred journal having been cited 94 times. Journal of Exp. Zool. (USA) occupies the second rank with 62 citations, followed by Journal of economic entomology (USA) with 58 citations, Journal of Fish Biology (U.K.) with 55 citations, the first ten journals in the rank list together accounts for 33.58% of the total citations. Table 8 also shows that the first 50 journals out

of 304 total ranked journal covers 66.63 of citations, while the remaining 254 journals together account for 33.37% of citations.

### Production of journals in Zoology

In order to measure the productivity of journals, the total of 1645 citations were divided into four equal categories of citations each. The number of cited journals for each group is given in Table 9.

It is observed from Table 9 that the first groups of citations are from the first 7 journals of the ranked list, thus signifying their high rate of productivity. The average productivity of each journal in the first group/category was 60.14 articles, where it has considerably gone down to 1.79 articles in the fourth category. This marked difference easily confirms the decreasing productivity of individual journals in the rank list.

### Bradford's Law

Bradford's Law serves as a general guideline to librarians

**Table 7.** Geographical distribution of citations.

S/No.	Country	Citations								Total	Percentage
		Journals	Books	Proceedings	Theses	Reports	URLs	Patents	NewsPapers		
1	USA	659	160	21	2	9	0	1	0	859	38.88
2	India	320	118	38	38	20	0	0	2	536	24.26
3	UK	271	84	1	2	2	0	1	0	361	16.34
4	Netherlands	116	9	1	0	0	0	0	0	126	5.7
5	Canada	42	2	1	1	1	0	0	0	47	2.13
6	Germany	41	6	2	0	0	0	1	0	49	2.22
7	Japan	38	4	1	0	1	0	0	0	44	1.99
8	France	24	1	0	0	0	0	0	0	25	1.13
9	China	21	2	1	0	0	0	0	0	24	1.08
10	Australia	18	0	1	0	0	0	0	0	19	0.88
11	Italy	14	2	2	0	1	0	0	0	19	0.88
12	Russia	14	0	0	0	0	0	0	0	14	0.63
13	Brazil Philippines	13	0	1	0	0	0	0	0	14	0.63
14	Switzerland	9	0	0	0	0	0	0	0	9	0.4
15	Denmark	8	2	2	0	1	0	0	0	13	0.59
16	S.Africa	6	0	1	0	0	0	0	0	7	0.32
17	Korea	5	1	1	0	1	0	0	0	8	0.37
18	Egypt	5	0	0	0	0	0	0	0	5	0.22
19	Poland	5	0	0	0	0	0	0	0	5	0.22
20	Un identified	3		0	1	0	0	0	0	4	0.18
21		13		0	0	0	8	0	0	21	0.95
	Total	1645	398	74	44	36	8	2	2	2209	100

**Table 8.** Rank list of journals in zoology.

S/No.	Rank No.	Journal title	Number of citations	Cumulative citations	Percentage	Cumulative percentage	Country
1.	1	Mutation Research	94	94	5.71	5.71	Netherlands
2.	2	Journal of exp. zool.	62	156	3.77	9.48	USA
3.	3	Journal of economic entomology	58	214	3.52	13.00	USA
4.	4	Journal fish biology	55	269	3.34	16.34	UK
5.	5	Environment ecology	51	320	3.10	19.44	USA
6.	5	Indian journal of fisheries	51	371	3.10	22.54	India
7.	6	Aquaculture	50	421	3.03	25.57	UK
8.	7	Journal of Bombay natural history society	46	467	2.79	28.36	India
9.	8	American Nutrition	44	511	2.67	31.03	USA
10.	9	Trans. American fish soc.	42	553	2.55	33.58	USA
11.	10	Journal of Biological control	39	592	2.37	35.95	USA
12.	10	Nature	39	631	2.37	38.32	UK
13.	11	Journal coffee research	38	669	2.31	40.63	India
14.	12	Entomon	37	706	2.24	42.87	India
15.	13	Journal of environmental biology	34	740	2.06	44.93	India
16.	14	Evolution	32	772	1.94	46.87	USA
17.	15	Canadian journal zoology.	26	798	1.58	48.45	USA
18.	16	Geredity	18	816	1.09	49.54	USA
19.	17	Fishery technology	16	832	0.97	50.51	India
20.	17	Animal behavior	16	848	0.97	51.48	UK
21.	18	Ecology	14	862	0.85	52.33	UK

Table 8. Contd.

22.	18	Newsletter for birdwatchers	14	876	0.85	53.18	India
23.	19	Environ toxicology & chem.	13	889	0.79	53.97	USA
24.	20	Journal fish res. Bd. Canada	12	901	0.72	54.69	Canada
25.	20	Science	12	913	0.72	55.41	USA
26.	20	Applied entomology zoology	12	925	0.72	56.13	Japan
27.	21	Conservation biology	10	935	0.60	56.73	USA
28.	21	Drosophila. Information service	10	945	0.60	57.33	USA
29.	21	General & comparative endocrinology	10	955	0.60	57.93	USA
30.	21	Indian journal entomology	10	965	0.60	58.53	India
31.	21	Journal of aquatic animal health	10	975	0.60	59.13	USA
32.	22	Current Science	9	984	0.54	59.67	India
33.	22	Annual review of entomology	9	993	0.54	60.21	USA
34.	22	Molecular ecology	9	1002	0.54	60.75	UK
35.	22	Environ. Health prospect	9	1011	0.54	61.29	USA
36.	23	Molecular general genetics	8	1019	0.48	61.77	Germany
37.	24	Journal animal ecology	7	1026	0.42	62.19	UK
38.	24	Advance in biosensors	7	1033	0.42	62.61	USA
39.	24	Proc. Indian acad. Science	7	1040	0.42	63.03	India
40.	25	Journal of insect physiology	6	1046	0.36	63.39	UK
41.	25	Matsya	6	1052	0.36	63.75	India
42.	25	Canadian entomology	6	1058	0.36	64.11	Canada
43.	25	Environ. Boil fishes	6	1064	0.36	64.47	Netherlands
44.	25	Experiential	6	1070	0.36	64.83	Switzerland
45.	26	FAO fisheries technical paper Rome	5	1075	0.30	65.13	Italy
46.	26	Journal of agric. Food chemistry	5	1080	0.30	65.43	USA
47.	26	Geobios	5	1085	0.30	65.73	India
48.	26	Int. rev. ges. Hydrobiology	5	1090	0.30	66.03	Germany
49.	26	Pestic. Biochemc & physiology.	5	1095	0.30	66.33	USA
50.	26	Ecol. Applications.	5	1100	0.30	66.63	USA
51.	26	Journal inland fish soc India	5	1105	0.30	66.93	India
52.	26	Journal wildl. Management	5	1110	0.30	67.23	USA
53.	26	Journal bacteriology	5	1115	0.30	67.53	USA
54.	26	Mysore journal of agric. Science.	5	1120	0.30	67.83	India
55.	26	Arch. Environ contamination toxicology.	5	1125	0.30	68.13	USA
56.	26	Canadian journal biochem. Physiology.	5	1130	0.30	68.43	Canada
57.	26	Genetics in aquaculture	5	1135	0.30	68.73	USA
58.	26	Indian journal of agricultural science	5	1140	0.30	69.03	India
59.	26	Am. Fish. Soc. Beth. Med.	5	1145	0.30	69.33	USA
60.	26	Rec. zool. Surv. India	5	1150	0.30	69.63	India
61.	26	Applied environmental microbiology	5	1155	0.30	69.93	USA
62.	26	Crop protection	5	1160	0.30	70.23	UK
63.	26	Journal of insect behaviour	5	1165	0.30	70.53	USA
64.	26	Journal bioscience	5	1170	0.30	70.83	France
65.	26	Journal fish science china	5	1175	0.30	71.13	China
66.	26	Indian journal ecology	5	1180	0.30	71.43	India
67.	26	Indian journal comp. animal physiology.	5	1185	0.30	71.73	India
68.	26	Journal fresh water biology	5	1190	0.30	72.03	USA
69.	26	Journal of aquatic food product technology	5	1195	0.30	72.33	USA
70.	26	Journal of applied ecology	5	1200	0.30	72.63	UK
71.	26	North American journal fish. Manag.	5	1205	0.30	72.93	USA
72.	26	Uttar Pradesh journal zool.	5	1210	0.30	73.23	India

Table 8. Contd.

73.	26	Acta entomologica sinica	5	1215	0.30	73.53	China
74.	26	Annot. Zoolo. Japan	5	1220	0.30	73.83	Japan
75.	26	Australian journal zoology	5	1225	0.30	74.13	Australia
76.	26	Ann. Rev. physiology	5	1230	0.30	74.43	USA
77.	26	Aqua fish. Management	5	1235	0.30	74.73	UK
78.	26	Biotechnology advances	5	1240	0.30	75.03	USA
79.	26	Journal chem. Ecology	5	1245	0.30	75.33	USA
80.	26	Journal advance zool.	5	1250	0.30	75.63	India
81.	26	Journal zoology London	5	1255	0.30	75.93	UK
82.	26	Journal of animal science	5	1260	0.30	76.23	USA
83.	26	Oriental insects	5	1265	0.30	76.53	USA
84.	26	Photochemistry	5	1270	0.30	76.83	UK
85.	26	Proc. Zool. Soc. London	5	1275	0.30	77.13	UK
86.	26	Entomologists newsletter	5	1280	0.30	77.43	Brazil
87.	26	Acta ichthyologica et piscatorial	5	1285	0.30	77.73	Poland
88.	26	Ecology of freshwater fish	5	1290	0.30	78.03	Denmark
89.	26	Int. journal acad. ichthyol	5	1295	0.30	78.33	Russia
90.	26	ICLARM	5	1300	0.30	78.63	Philippines
91.	26	Physiology zoology	5	1305	0.30	78.93	USA
92.	26	Insect environment	5	1310	0.30	79.23	UK
93.	26	Environmental entomology	5	1315	0.30	79.53	USA
94.	26	Mutagenesis	5	1320	0.30	79.83	UK
95.	26	Genetics	5	1325	0.30	80.13	USA
96.	27	15 Journals with 4 citation each	60	1385	3.79	83.92	
97.	28	25 Journals with 3 citation each	75	1460	4.69	88.61	
98.	29	16 Journals with 2 citation each	32	1492	1.99	90.60	
99.	30	153 Journals with 1 citation each	153	1645	9.40	100.00	
		304	1645		100.00		

Table 9. Production of journals in Zoology.

S/No.	Percentage of citations	Number of citations	Number of journals covered	Percentage of journals	Average production of journals
1	0-25	421	7	2.30	60.14
2	26-50	411	12	3.95	34.25
3	51-75	408	59	19.41	6.91
4	76-100	405	226	74.34	1.79
	Total	1645	304	100.00	5.41

in determining the number of core journals in any given field. It states that journals in a single field can be divided into three parts, each containing the same number of articles (Bibliometric Laws, 2012):

- A core of journals on the subject, relatively few in number that produces approximately one-third of all the articles.
- A second zone, containing the same number of articles as the first, but a greater number of journals.
- A third zone, containing the same number of articles as

the second, but a still greater number of journals. The mathematical relationship of the number of journals in the core to the first zone is a constant 'n' and the second zone of relationship is  $n^2$ . Bradford expressed this relationship as  $1:n:n^2$ .

It is observed from the Table 10 that there are 10 journals in the nucleus and they are the most productive journals devoted to Zoology sharing 3.29% of total cited journals. The next zone is represented by 41 journals which share 13.48% of total journals, and the last zone is represented

**Table 10.** Bradford's zones for Zoology.

S/No.	Number of		Cumulative number of	
	Citations	Journals	Citations	Journals
1	553	10 (3.29)	553	10
2	552	41 (13.48)	1105	51
3	540	253(83.23)	1645	304

**Table 11.** Distribution of cited journals by decreasing frequencies of citations.

No. of journals	Cumulative no. of journals	Log of cumulative journals	No. of citations	Total citations	Cumulative citations	% of cumulative citations	% of cumulative journals
	1	0	94	94	94	5.71	0.32
1	2	0.3	62	62	156	9.49	0.65
1	3	0.47	58	58	214	13.01	0.98
2	4	0.6	55	55	269	16.35	1.31
1	6	0.77	51	102	371	22.55	1.97
1	7	0.84	50	50	421	25.59	2.3
1	8	0.9	46	46	467	28.39	2.63
1	9	0.95	44	44	511	31.06	2.96
2	10	1	42	42	553	33.61	3.29
2	12	1.07	39	78	631	38.36	3.94
1	13	1.11	38	38	669	40.67	4.27
1	14	1.14	37	37	706	42.91	4.6
1	15	1.17	34	34	740	44.98	4.93
1	16	1.2	32	32	772	46.93	5.26
1	17	1.23	26	26	798	48.51	5.59
2	18	1.25	18	18	816	49.6	5.92
2	20	1.3	16	32	848	51.55	6.57
1	22	1.34	14	28	876	53.25	7.23
3	23	1.36	13	13	889	54.02	7.56
5	26	1.41	12	36	925	56.24	8.55
4	31	1.49	10	50	975	59.27	10.19
1	35	1.54	9	36	1011	61.46	11.51
3	36	1.55	8	8	1019	61.94	11.84
5	39	1.59	7	21	1040	63.22	12.82
51	44	1.64	6	30	1070	65.04	14.47
15	95	1.97	5	255	1325	80.54	31.25
25	110	2.04	4	60	1385	84.19	36.18
16	135	2.13	3	75	1460	88.75	44.4
153	151	2.17	2	32	1492	90.7	49.67
	304	2.48	1	153	1645	100	100
304				1645			

by 253 journals which share 83.23% of total cited journals. Each zone has approximately one-third of the total citations. Table 11 and Figure 2 also reveals the same results and hence the journal data fits well with Bradford's Law of distribution. Hence the journals distribution as per the Bradford's Law reveals the ratio 10:41:253.

#### **Distribution of cited journals by decreasing frequencies of citations**

The graphical interpretation of the Bradford's law of scattering has been applied to the literature of Zoology. Table 11 represents journals arranged in decreasing frequency of citations. To testify the applicability of

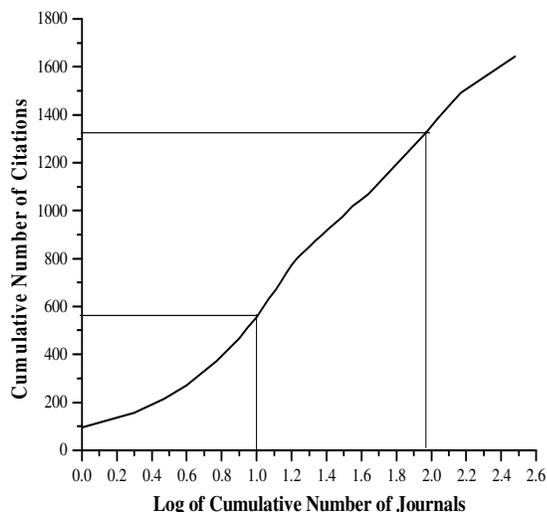


Figure 2. Bradford's law.

Bradford's Law of scattering, a graph is plotted by taking the cumulative number of citations on "y" axis and log of cumulative number of journals on "x" axis. It is observed that the resulting bibliography starts rising in an exponential nature and then follows the linear curve indicating the observance of Bradford's Law of scattering, 1800 citations starts dropping as shown in Figure 2.

## DISCUSSION AND CONCLUSION

Citations play a vital role in identification and retrieval of earlier works. Librarians are expected to know enough about key subjects in order to assist patrons with their research needs. The results indicate that Zoology research in the period between 2002 and 2006 has grown at levels lower than the explosive global growth. Scholars are very interested in reviewing periodicals and the libraries have stressed the need to develop those collections aggressively. In this work, a thorough bibliometric analysis of the zoology literature was conducted using well established bibliometric techniques. The findings in the study are based on the data obtained from the Kuvempu University Library.

2209 citations from 12 doctoral dissertations were analyzed. The following findings are drawn:

- i. Nearly 75% of the citations recorded are from journal articles: 1645 (74.47%) followed by books (18.02%)
- ii. Study also shows the Authorship pattern of journal citations indicates that out of 1645 citations, 1183 (71.92%) are contributed by two authors. The degree of collaboration is found to be 0.71.
- iii. 18.78% of articles are cited on Entomology subject
- iv. Mutation Research (Netherlands) is the most cited journal with 94 citations, followed by Journal of Exp. Zoology (USA) with 62 citations.

v. 80.13% of citations are from 95 journals out of 304 cited journals.

vi. It is strongly suggested to acquire journals viz. Mutation Research, Journal of Exp. Zool., Journal of Economic Entomology.

This study is also useful in identifying journals worthy of closer examination by librarians that are expected to be familiar with local needs as this study has generously pointed out the core journals in Zoology. Ultimately, it is also assumed that an improved periodical collection for zoology will better support the research needs of future Zoology doctoral students.

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