Full Length Research Paper

The pattern of using information by research scholars in zoology: A bibliometric study

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Accepted 31 March, 2011

Citations of 24 doctoral dissertations in Applied Zoology submitted to Kuvempu University since its inception were analysed to study the information use pattern of research scholars. The study also analysed the principal bibliographic forms, the journal used and their distribution according to country of origin and chronological scattering. The application of Bradford’s Law of scattering to the literature of botany reveals an exponential trend when plotted on the graph. The study shows that the distribution pattern of citations by type of documentary sources shows that periodicals are highly cited (75.52%). Books are considered as the second major source, which accounts for 17.25%. In other words, periodicals and books together constitute 92.77% while other forms of sources are negligible. Team research prevails in the field of Biotechnology. The degree of collaboration is found to be 0.66. The study shows that United States occupied top position with 1,679 citations (32.69%), followed by India (1,303; 25.37%) and then the United Kingdom (842; 16.39%). It is evident from the result of the study that the journal, Journal Mutation Research (212; 5.46%) occupies first in the rank list of journals, followed by the Journal of Bombay Natural History Society 74 (1.90%) and Aquaculture 70 (1.80%); Journal Fish Biology 67 (1.72%) scores the highest number of citations among the most cited periodicals.

Key words: Bibliometric analysis, applied zoology, bibliography, authorship pattern, core journals, mutation research, aquaculture.

INTRODUCTION

Library is a dynamic instrument of education, an agency for the transfer of knowledge. It builds the bridge between knowledge and the seekers of information. We are living in information era. In this era of science, research is carried out in different disciplines. Information and its resources are the life blood of any organization or a nation, and thus an essential element in the research developmental process. Information has been considered an important resource, as it plays a vital role in all spheres of man’s activities. Information is an essential raw material for all human endeavors in a complex modern society. It is recognized as a prerequisite of scientific, socio-economic and cultural development of any nation for this is inevitable to provide the right information to right user at the right time in the right form.

The first need of a scientist, technologist and technician is that they must be aware of what is currently going on in their respective field of work. So bibliometric study has now become a well established part of information research; and quantitative approach to the description of documents and examination of services is gaining ground both in research and practice (Mubeen 1994).

In recent years, bibliometric techniques have been used widely to identify the characteristics of journals, literature of many different subject areas; but most often, researchers have concentrated on the use of these techniques on the research from various branches of science (Pillai 2007). Applied zoology is the branch of biology that focuses on the structure, function, behavior and evolution of animals.

Humans have been fascinated by the other members of the animal kingdom throughout history. In early Europe,
they gathered up and catalogued descriptions of strange animals from distant lands or deep seas, such as are recorded in the *Physiologus* and in the works of Albertus Magnus. His work was based largely on the writings of Aristotle. Magnus’ *De animalibus libri XXVI* is not the only volume of his commentaries on Natural History, but it remains one of the most extensive studies of zoological observation published before modern times. The disciplinary study of zoology also found root in Arabia and China. Afro-Arab scholar Al-Jahizz (781 to 868) wrote the *Book of Animals*, a predecessor to *The Origin of Species*. Two great Chinese authors in this field were Su Song (1020 to 1101) and Shen Kuo (1031 to 1095) of the Song Dynasty period, yet there were many others.

**Objectives**

They are as follows:

1. To determine the year wise distribution of thesis submitted in applied zoology.
2. To trace out the average number of references per thesis.
3. To determine the characteristics of sources of information used by the applied zoology scientists, taking their PhD theses as samples.
4. To find out the nature of authorship pattern and degree of collaboration.
5. To determine the chronological distribution of citations used by applied zoology researchers.
6. To find out the subject wise break-up.
7. To study the distribution of documents, according to their country of origin.
8. To prepare a rank list of journals in order of their frequency of citation which may help librarians document list and research workers in the selection and acquisition of most useful documents.
9. Rank with country wise distribution of cited journals.
10. To apply Bradford’s Law to the journal citations.

**METHODOLOGY**

Literature, cited in the Ph.D. thesis in applied zoology, is the basic source of information to access the information used by the researchers. Accordingly, the bibliographical reference cited at the end of the Ph.D. thesis is taken as the source data for the present study. The Ph.D. thesis submitted to Kuvempu University, Jnana Sahyadri in the subject of Applied Zoology will be studied. The data needed for the application of bibliometric analysis were collected from the in-house database prepared from the theses submitted to the University Library. All the data pertaining to this study were recorded on 5" × 3" slips, and the same slips were sorted according to the objectives of the study, with the necessary tables prepared.

**Scope and limitation of the study**

The present study is conducted with the aim of tracing the growth of the PhD output of Applied Zoology Departments of Kuvempu University. The Doctoral Dissertations submitted to the Applied Zoology Departments of Kuvempu University were considered as the data base for the present study.

**Analysis**

The analysis is a process of summarizing or transforming raw data into useful information. Citation studies attempt to study the characteristics of subject literatures. The investigations of such kind of studies are found to be useful to manage the information resources and services in libraries and information centers.

To achieve the objectives of the present study these data covered only the applied zoology subjects. A total number of 5135 citations are collected from 24 theses in the field of applied zoology and have been presented and analyzed to facilitate interpretation and conclusions in the following sections.

**Year wise distribution of submission of thesis**

At first glance, Table 1 and Figure 1 reveals that between years 2002 to 2009, the output of the Ph.D. level research works from this university has been showing an increasing trend. It is clearly evident from the study that a maximum number of 8 (33.36%) theses were submitted in the year 2008, followed by 4 (16.66%) in the year 2005, 3 (12.50%) each in the years 2004, 2006 and 2007, respectively. 1 (4.16%) of each theses were submitted in the years 2002, 2003 and 2009, respectively.

**Average number of citations per thesis**

Table 2 gives the average number of citations per dissertation submitted by the researcher of applied zoology. It is clearly observed from the study that on an average 213.95 citations per thesis were used by the applied zoology researchers. Further, it is observed from the table that the highest average numbers of citations per thesis, that is 301, were found in the year 2009 and the lowest average number of citations, that is, 184 was found in the year 2002.

**Distribution of citations according to bibliographic forms**

Table 3 and Figure 2 shows the distribution of citations among different documentary forms such as journals, books and monographs, conference proceedings, thesis, reports, websites, patents, news papers, etc. used by researchers. It is observed from the table that the journals have the highest number of citations accounting for (75.52%) percent of the total citations. It shows that the researchers in the field of applied zoology are mainly concentrating on journals for collecting information. It is the most preferred source of information used by them. Books are the second highest group (17.25%). Periodicals and books together contribute the highest number of citations than the other form of documents such as conference proceedings, thesis etc. In other words, books and periodicals together constitute 92.77% of all the citations cited by the research scholars (Kannappanavar and Vijayakumar, 2001).

The next source of information for researchers is the conference proceedings accounting for 3.42%. The next sources of information for research scholars are thesis and dissertations. These amounts to 1.73% of all citations followed by reports, web, patents, newspapers, which together constitute 2.08% of all citations. The relatively high percentage of citations of journals and low percentage of citations to newspaper and unpublished monographs, etc. indicates that journals are the most preferred channel.
Table 1. Year wise distribution of submission of thesis.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of thesis</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>1</td>
<td>4.16</td>
</tr>
<tr>
<td>2003</td>
<td>1</td>
<td>4.16</td>
</tr>
<tr>
<td>2004</td>
<td>3</td>
<td>12.50</td>
</tr>
<tr>
<td>2005</td>
<td>4</td>
<td>16.66</td>
</tr>
<tr>
<td>2006</td>
<td>3</td>
<td>12.50</td>
</tr>
<tr>
<td>2007</td>
<td>3</td>
<td>12.50</td>
</tr>
<tr>
<td>2008</td>
<td>8</td>
<td>33.36</td>
</tr>
<tr>
<td>2009</td>
<td>1</td>
<td>4.16</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Figure 1. Year wise distribution of submission of thesis.

Table 2. Average number of citations per thesis.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total no. of dissertations</th>
<th>Total no. of citations</th>
<th>Average citations per dissertation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>1</td>
<td>184</td>
<td>184.00</td>
</tr>
<tr>
<td>2003</td>
<td>1</td>
<td>219</td>
<td>219.00</td>
</tr>
<tr>
<td>2004</td>
<td>3</td>
<td>482</td>
<td>160.66</td>
</tr>
<tr>
<td>2005</td>
<td>4</td>
<td>734</td>
<td>183.05</td>
</tr>
<tr>
<td>2006</td>
<td>3</td>
<td>590</td>
<td>196.66</td>
</tr>
<tr>
<td>2007</td>
<td>3</td>
<td>851</td>
<td>283.66</td>
</tr>
<tr>
<td>2008</td>
<td>8</td>
<td>1774</td>
<td>221.75</td>
</tr>
<tr>
<td>2009</td>
<td>1</td>
<td>301</td>
<td>301.00</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>5135</td>
<td>213.95</td>
</tr>
</tbody>
</table>

Table 3. Distribution of citations according to bibliographic forms.

<table>
<thead>
<tr>
<th>Bibliographic form</th>
<th>Citation</th>
<th>Cumulative citation</th>
<th>Percentage (%)</th>
<th>Cumulative percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal</td>
<td>3878</td>
<td>3878</td>
<td>75.52</td>
<td>75.52</td>
</tr>
<tr>
<td>Book and Monograph</td>
<td>884</td>
<td>4762</td>
<td>17.25</td>
<td>92.77</td>
</tr>
<tr>
<td>Conference Proceeding</td>
<td>176</td>
<td>4938</td>
<td>3.42</td>
<td>96.19</td>
</tr>
<tr>
<td>Thesis</td>
<td>89</td>
<td>5027</td>
<td>1.73</td>
<td>97.92</td>
</tr>
<tr>
<td>Report</td>
<td>92</td>
<td>5119</td>
<td>1.79</td>
<td>99.71</td>
</tr>
<tr>
<td>Web</td>
<td>10</td>
<td>5129</td>
<td>0.19</td>
<td>99.90</td>
</tr>
<tr>
<td>Patent</td>
<td>04</td>
<td>5133</td>
<td>0.07</td>
<td>99.97</td>
</tr>
<tr>
<td>Newspaper</td>
<td>02</td>
<td>5135</td>
<td>0.03</td>
<td>100.00</td>
</tr>
<tr>
<td>Total</td>
<td>5135</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
of information. From the table we can observe that journal and books are the most important source of information when compared to other source of information.

**Authorship pattern in applied zoology**

Table 4 clearly indicates that out of 5135 citations, the maximum citations are written by single authors with 1727 (33.63%); two authors, 1648 (32.02%); third place is occupied by three authors with 814 (15.85%); fourth place, by four authors with 396 (7.71%); fifth place, by five authors with 225 (4.38%); sixth place, by six authors with 82 (1.59%); and seventh place is occupied by seven authors, and the remaining 68 (1.32%) citations are contributed by eight and the above authors; anonymous, corporate, URLs authors together constitute 113 citations.

Collaborative research is the common phenomenon in the field of science and technology in general and applied zoology, in particular. According to Derek Desollo price, and meadows investigations 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. There is an attempt made to know whether the trend towards increased collaboration is in applied zoology or not.

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 applied zoology subject. Furthermore, the table shows that 33.63% of all the citations are in favor of single authors and remaining 66.37% of citations in favor of team research. Degree of collaboration among authors is measured by the following formula, given by K. Subramanyam:

\[
C = \frac{NM}{NM + NS}
\]

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

\[
C = \frac{3408}{3408 + 1727} = \frac{3408}{5135}
\]

In present study the degree of collaborative:

\[
C = 0.66.
\]
Table 5. Authorship pattern of journal citations.

<table>
<thead>
<tr>
<th>No. of author</th>
<th>Total citation</th>
<th>Percentage (%)</th>
<th>Foreign author</th>
<th>Percentage (%)</th>
<th>Indian author</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1097</td>
<td>28.28</td>
<td>829</td>
<td>21.39</td>
<td>268</td>
<td>6.91</td>
</tr>
<tr>
<td>2</td>
<td>1372</td>
<td>35.37</td>
<td>836</td>
<td>21.59</td>
<td>536</td>
<td>13.82</td>
</tr>
<tr>
<td>3</td>
<td>697</td>
<td>17.97</td>
<td>467</td>
<td>12.04</td>
<td>230</td>
<td>5.93</td>
</tr>
<tr>
<td>4</td>
<td>340</td>
<td>8.76</td>
<td>244</td>
<td>6.29</td>
<td>96</td>
<td>2.47</td>
</tr>
<tr>
<td>5</td>
<td>190</td>
<td>4.89</td>
<td>155</td>
<td>3.99</td>
<td>35</td>
<td>0.90</td>
</tr>
<tr>
<td>6</td>
<td>73</td>
<td>1.88</td>
<td>65</td>
<td>1.67</td>
<td>8</td>
<td>0.20</td>
</tr>
<tr>
<td>7</td>
<td>59</td>
<td>1.57</td>
<td>52</td>
<td>1.34</td>
<td>7</td>
<td>0.18</td>
</tr>
<tr>
<td>&gt;8</td>
<td>50</td>
<td>1.28</td>
<td>45</td>
<td>1.16</td>
<td>5</td>
<td>0.12</td>
</tr>
<tr>
<td>Total</td>
<td>3878</td>
<td>100.00</td>
<td>2693</td>
<td>69.47</td>
<td>1185</td>
<td>30.53</td>
</tr>
</tbody>
</table>

Table 6. Chronological distribution total citations.

<table>
<thead>
<tr>
<th>Period</th>
<th>No. of citation</th>
<th>Cumulative citation</th>
<th>% of citation</th>
<th>% cumulative citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1800-1849</td>
<td>05</td>
<td>05</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>1850-1899</td>
<td>16</td>
<td>21</td>
<td>0.31</td>
<td>0.40</td>
</tr>
<tr>
<td>1900-1909</td>
<td>14</td>
<td>35</td>
<td>0.27</td>
<td>0.68</td>
</tr>
<tr>
<td>1910-1919</td>
<td>27</td>
<td>62</td>
<td>0.52</td>
<td>1.20</td>
</tr>
<tr>
<td>1920-1929</td>
<td>36</td>
<td>98</td>
<td>0.70</td>
<td>1.90</td>
</tr>
<tr>
<td>1930-1939</td>
<td>37</td>
<td>135</td>
<td>0.72</td>
<td>2.62</td>
</tr>
<tr>
<td>1940-1949</td>
<td>65</td>
<td>200</td>
<td>1.26</td>
<td>3.89</td>
</tr>
<tr>
<td>1950-1959</td>
<td>155</td>
<td>355</td>
<td>3.01</td>
<td>6.91</td>
</tr>
<tr>
<td>1960-1969</td>
<td>377</td>
<td>732</td>
<td>7.34</td>
<td>14.25</td>
</tr>
<tr>
<td>1980-1989</td>
<td>1135</td>
<td>2575</td>
<td>22.16</td>
<td>50.14</td>
</tr>
<tr>
<td>1990-1999</td>
<td>1662</td>
<td>4237</td>
<td>32.36</td>
<td>82.51</td>
</tr>
<tr>
<td>2000-2009</td>
<td>898</td>
<td>5135</td>
<td>17.48</td>
<td>100.00</td>
</tr>
<tr>
<td>Total</td>
<td>5135</td>
<td>100.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Authorship pattern of journal citations

Table 5 clearly shows the authorship pattern of the journal citations. It is observed from the table that out of 3,878 citations, 1,372 (35.37%) are in favour of two authors, of which 21.59% are of foreign authors and remaining, Indian authors. It is observed from the table that overall, 69.47% of citations are in favour of foreign authors and 30.53% of the citations are in favour of Indian authors. This clearly shows that the zoology researchers are in need of recent literature more as compared to Indian literature (Kannappanavar and Vijayakumar, 1999).

Chronological distribution of total citations

Table 6 and Figure 3 reveal the number of citations scattered during a particular year. It is easy for identification of subject interest or development in a year. Table 6 provides data regarding use of references by applied zoology researchers in preparation of their dissertations.

In Table 6 the citations are divided into 13 groups, each comprising a time span of 50 years from 1800 up to 1899; followed by the time span of 10 years from 1900 up to 2009. Each group’s citation is very high during 1990 to 1999 (32.36%) and low during 1800 to 1849 (0.09%). This clearly shows that the zoology researchers are in need of recent literature for their study and research.

Table 7 indicates the chronological distribution of journal citations. The maximum number of citations 1248 (32.18%) are covered during the period of 1990 to 1999, followed by the period 1980 to 1989, accounting for 859 (22.15%). This shows that the research scholars are in need of the literature published in 1980, 1990 and 2000. That means nascent literature is very much useful for the research scholars in zoology and allied subject.

Subject wise distribution of citations in applied zoology

In this present era, it is very difficult to find out particular required information due to the existence of multidisciplinary subjects. Thus to overcome this problem, subject wise distribution is helpful for finding out right information at the right time. Table 8 shows the subject wise distribution of total number of citations in the field of applied zoology.

Table 8 clearly shows that Entomology (13.38%), Animal Physiology (7.99%), Animal Genetics (7.86%), Ecology (6.13%), Fish Diversity (5.93%), Ornithology (5.15%), and Plant Insect Interaction (4.89%) contribute 51.33% of the total citation; the remaining subjects altogether contribute 48.67% of the total citations. This clearly shows that the above mentioned subjects are more important to Zoologists.
amount for subscription of periodicals. But how many readers utilize these periodicals is a question of concern. There is usually a small group of readers who use the periodical collections.

**Rank list of journals in applied zoology**

Table 10 provides an overall rank list of journals in the field of applied zoology prepared on the basis of the number of grand total of citations of individual journals counted in the source documents. Rank list connotes a list of core journals arranged in the descending order of the number of citations. From the table, it is shown that the journal with the highest number of citations occupies the highest rank and thus obviously the most important journal in the field of applied zoology, while the least important titles are placed at the bottom of the table.

The table has been arranged in eight columns. The first column indicates the running serial number of the entries. The second column provides the actual rank of the journal in order of its importance, which is based on the grand total of citations in the source documents. Naturally, the serial numbers and the number of ranking order will change as two or more journals may occupy the same rank and hence the same rank number, but their serial number will differ from one another as each journal has its own separate serial number. Column three indicates the titles of the ranked journals Column four indicates the number of times the journal has been cited in the source documents. The fifth column
Table 8. Subject wise distribution of citations in applied zoology.

<table>
<thead>
<tr>
<th>Subject</th>
<th>No. of citation</th>
<th>Cumulative citation</th>
<th>Percentage (%)</th>
<th>Cumulative (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entomology</td>
<td>519</td>
<td>519</td>
<td>13.38</td>
<td>13.38</td>
</tr>
<tr>
<td>Animal physiology</td>
<td>310</td>
<td>829</td>
<td>7.99</td>
<td>21.37</td>
</tr>
<tr>
<td>Animal genetics</td>
<td>305</td>
<td>1134</td>
<td>7.86</td>
<td>29.23</td>
</tr>
<tr>
<td>Ecology</td>
<td>238</td>
<td>1372</td>
<td>6.13</td>
<td>35.13</td>
</tr>
<tr>
<td>Fish diversity</td>
<td>230</td>
<td>1602</td>
<td>5.93</td>
<td>41.29</td>
</tr>
<tr>
<td>Ornithology</td>
<td>200</td>
<td>1802</td>
<td>5.15</td>
<td>46.44</td>
</tr>
<tr>
<td>Plant insect interaction</td>
<td>190</td>
<td>1992</td>
<td>4.89</td>
<td>51.33</td>
</tr>
<tr>
<td>Toxicology</td>
<td>140</td>
<td>2132</td>
<td>3.61</td>
<td>54.94</td>
</tr>
<tr>
<td>Aquatic biology</td>
<td>132</td>
<td>2264</td>
<td>3.40</td>
<td>58.34</td>
</tr>
<tr>
<td>Cytogenetics</td>
<td>127</td>
<td>2391</td>
<td>3.27</td>
<td>61.61</td>
</tr>
<tr>
<td>Pisciculture</td>
<td>120</td>
<td>2511</td>
<td>3.09</td>
<td>64.70</td>
</tr>
<tr>
<td>Pesticide effect</td>
<td>110</td>
<td>2621</td>
<td>2.83</td>
<td>67.53</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>87</td>
<td>2708</td>
<td>2.24</td>
<td>69.77</td>
</tr>
<tr>
<td>Butterfly ecology</td>
<td>80</td>
<td>2788</td>
<td>2.06</td>
<td>71.83</td>
</tr>
<tr>
<td>Evaluation</td>
<td>80</td>
<td>2868</td>
<td>2.06</td>
<td>73.89</td>
</tr>
<tr>
<td>Insect diversity</td>
<td>80</td>
<td>2948</td>
<td>2.06</td>
<td>75.95</td>
</tr>
<tr>
<td>Sericulture</td>
<td>80</td>
<td>3028</td>
<td>2.06</td>
<td>78.01</td>
</tr>
<tr>
<td>Reproductive biology</td>
<td>65</td>
<td>3093</td>
<td>1.67</td>
<td>79.68</td>
</tr>
<tr>
<td>Genetic engineering</td>
<td>60</td>
<td>3153</td>
<td>1.54</td>
<td>81.22</td>
</tr>
<tr>
<td>Resistance mechanism</td>
<td>60</td>
<td>3213</td>
<td>1.54</td>
<td>82.76</td>
</tr>
<tr>
<td>Animal behaviour</td>
<td>55</td>
<td>3268</td>
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provides the cumulative citations. Percentage of each journals citation is presented in column six. Column seven provides the cumulative percentage. Column eight provides the country of origin.

There are 988 journals arranged in order of their ranks. From the Table 10, it can be ascertained that the Mutation Research published from Netherlands occupies the first rank as the most preferred journal having been cited 212 times. Journal of Bombay Natural History Society (India) occupies the second rank getting 74 citations, followed by Aquaculture (U.K.) with 70 citations, Journal of Fish Biology (U.K.) with 67 citations, Journal of Food Science (USA) with 53 citations, Proc. Indian Academy Science (India) with 50 citations, Nature (U.K.) with 48 citations, Environment Ecology (U.S.A.) with 44 citations, Current Science (India) with 44 citations, Indian Journal of Fisheries (India) with the 41 citations, Journal of...
Table 9. Geographical distribution of citations.

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Economic Entomology (USA) with 38 citation, Animal Behavior (U.K.) with 35 citations, Entomon (India) with 34 citations. The first ten journals in the ranking list together account for 19.11% of the total citations. The table also shows that the first 50 journals out of the total of 988 ranked journal cover 41.12% of citations, while the remaining 938 journals together account for 58.88% of citations (Biradar 2006).

Thus, it is noted that a few journal yielded more citations and more journals yielded a few citations. A single concentration in a few journals is evident. Therefore 'Core' or productive journals can be identified on the basis of the ranked lists.

### Ranked countries of journals

The journals are analysed according to their country of origin and the result of the ranked countries are shown in Table 11. It has been observed that U.S.A. is the leading country with 26.51% of the total journals cited. India has a contribution of about 15.68% and the U.K., 14.06%. It can be inferred from the analysis that U.S.A., India, and U.K. are the prominent countries in applied zoology.

### Production of journals in applied zoology

In order to measure the productivity of journals, the total of 3878 citations were divided into four equal categories of citations each. The number of cited journals for each group is given in Table 12. It is observed from Table 12 that the first groups of citations are to the first 18 journals on the rank list, thus signifying their high rate of productivity. The average productivity of each journal in the first group/category was 54.11 articles, where it has considerably gone down to 1.22 articles in the fourth category. This marked difference easily confirms the decreasing productivity of individual journals in the rank list.

### Bradford’s zones for applied zoology

It is observed from Table 13 that there are 31 journals in the
Table 10. Rank list of journals in applied zoology.

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nucleus and they are the most productive journals devoted to applied zoology, sharing 3.14% of total cited journals. The next zone is represented by 148 journals which share 14.97% of total journal, and the last zone is represented by 809 journals which share 81.89% of total cited journals. Each zone has approximately one-third of the total citations. Table 14 and Figure 4 also reveal the same results and hence the journal data fit well with Bradford’s Law of distribution. Hence the journals distribution as per the Bradford’s Law reveals the ratio of 31:148:809.

Bradford formulated a simple mathematical model to describe reference scattering. Cole statistically explained that “by plotting the cumulative fraction of total reference against the logarithm of the cumulative fraction total of titles, an approximately linear curve is obtained and the slope of this curve gives a reference scattering which may be characteristics of the study”.

Distribution of cited journals by decreasing frequencies of citations

The graphical and verbal interpretation of the Bradford’s Law of Scattering has been applied to the literature of applied zoology. Table 14 represents journals arranged in decreasing frequency of citations. To testify the applicability of Bradford’s Law of Scattering, a graph is plotted by taking the cumulative number of citations on the “y” axis and the log of cumulative number of journals on the “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. Here, it is observed that an experimental curve (continuous line) is closely in association with the theoretical line (dotted line) up to about 4,000 citations and then starts dropping as shown in Figure 4.

FINDINGS OF THE STUDY

1. Average Citations: the average number of citations per thesis is 213.95 by the Applied Zoology researchers.

2. Distribution of citation format: Periodicals are highly cited (75.52%). Books are considered as second major source, which accounts for 17.25%. In other words periodicals and books together constitute 92.77% next to other forms of sources which are negligible.

3. Authorship pattern: Single author contribution is more (33.63%) as compared to others. Team research prevails in the field of Biotechnology. The degree of collaboration is found to be 0.66.

4. Study also shows that authorship pattern of journal citations indicates that out of total number of 3878 citations, 1372 (35.37%) are contributed by two authors.

5. Chronological distribution: 17.48% of citations refer to current literature i.e. for 2000-2009 and 32.36% citations referred to 1990-1999, 22.16% citations to 1980 to 1989, 13.78% citations to 1970-1979. These sequences got the largest number of citations that is 85.78%.

6. Further it is observed from the study that the maximum number of citations 1248 (32.18%) are covered during the period of 1990-1999, of total citations, followed by the period 1980-1989 accounting for 859 (22.15%).

7. Subject Wise Distribution: Entomology (13.38%), Animal Physiology (7.99%), Animal Genetics (7.86%), Ecology (6.13%), Fish Diversity (5.93%), Ornithology (5.15%), and Plant Insect Interaction (4.89%) contribute the 51.33% of the total citation; the remaining subjects together contribute 48.67% of the total citations.

8. Geographical distribution: United States predominates in country wise distribution of citations (1679; 32.69%), followed by India (1303; 25.37%) and United Kingdom (842; 16.39%). It may be observed that these three countries have been well developed in the field of Applied Zoology.

9. Core Journals: It is evident from the result of the study Mutation Research (212; 5.46%) occupies the first rank in the ranked list of journals followed by Journal of Bombay Natural History Society (74; 1.90%), and Aquaculture (70; 1.80%); Journal Fish Biology (67; 1.72%) scores the highest number of citations among the most cited periodicals.

10. U.S.A., India and U.K are ranked as the first, second and third country in dissemination of information in the field of Applied Zoology.

11. Productivity of cited journals: the first 25% of the citation are covered by the first 18 journals with an average productivity of 54.11 citations per journal. The average productivity has gone down considerable to 1.22 articles in the fourth group. This shows the concentration of more number of

Table 10. Contd.

| 39 | Trends in Ecol. Evol. | 5 | 2797 | 0.13 | 71.52 | UK |
| 39 | Zool Surv. of India | 5 | 2802 | 0.13 | 71.65 | India |
| 40 | 25 Journal with 4 citations each | 100 | 2902 | 2.58 | 74.23 | |
| 41 | 41 Journal with 3 citations each | 123 | 3025 | 3.17 | 77.40 | |
| 42 | 154 Journal with 2 citations each | 308 | 3333 | 7.95 | 85.35 | |
| 43 | 545 Journal with 1 citations each | 545 | 3878 | 14.65 | 100.00 | |
| Total | | 3878 | | | | |
Table 11. Ranked countries of journals.

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Table 12. Production of journals in applied zoology.

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Table 13. Bradford’s zones for applied zoology.

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for the need based collection developed in the field of applied zoology.

SUGGESTIONS

The present study is based on the citations cited in Ph.D thesis in Applied Zoology submitted to Kuvempu University. Similar type of investigations may be carried out covering the thesis in Applied Zoology from other universities also, so as to generalize the findings of the study and gain an in-depth knowledge of the characteristics of the literature used by the researchers in the field.

As far as citations from other forms of documents are concerned, conference proceedings, reports, thesis are least used because of the inadequacy of information on these documents. Further they are not easily available
Table 14. Distribution of cited journals by decreasing frequencies of citations.

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citation in a few journals.

12. This study confirms that the journal use pattern of Applied Zoology researchers fits well with the Bradford's Law of Scattering.

13. The findings of the study have great implication and accessibility due to many restrictions. It is suggested that concerned authorities should make an attempt to overcome these restrictions by compiling proper cataloging, bibliography, abstracting and indexing services.
The acquisition policy of the university libraries should be examined in the light of the growing demands of the research scholars. The University Grants Commission (UGC) should also extend helping hand to the university libraries in getting access of more and more number of e-Journals under its UGC-infonet programme, and other forms of reading materials.

Orientation programme should be arranged for the research scholars from time to time in order to enable them to explore the resources of the university library and keep them abreast of the available resources in the libraries.

Conclusion

Citation studies do provide some guide lines for librarians and information scientists in the decision making process in their acquisition policy. The exponential growth of knowledge, ever escalating costs of documents and limited allocations of budget are some of the factors that are leading librarians and information managers to adopt statistical and mathematical techniques for decision making process.

No doubt, these findings are much helpful to librarians while taking decisions regarding collection development, removing out dated documents and also maintaining the need based collection in the library.

The study also has serious implication on calling for the construction of citation indexes that will be web based at different levels especially institutional level being narrowed down to departmental level to ease citation practices of students, faculties and research scholars. These citation indexes will also facilitate citation analysis study which entails a manual and painful process or count. This will save the rigorous and time-wasting exertions as encountered in this study during the process of data collection. The index will help to correct the anomalies of the ISI's databases that cite more of USA and UK journals thus contributing to the low impact factor of our national and local journals. At least, this will boost our national and local citations towards achieving international visibility and influence.

REFERENCES