

## **ZOOLOGICAL RESEARCH BY INDIANS IN BRITISH INDIA: A SCIENTOMETRIC ANALYSIS**

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### **ABSTRACT**

*The study highlights the contribution of Indians in zoological research during 1901-1945. The study also discusses various features of Indian zoology research such as its growth in terms of research papers, nature of collaboration, authorship pattern, identification of core journals, and geographical distribution of publications. It also shows the correlation between India and World in case of zoology research during the period under study. The findings of the study revealed that solo research has been preferred by the researcher over that of collaborative research. The period between 1931 and 1940 become the most productive era in view of zoological science research in India.*

**Keyword:** *Zoological research, Authorship Pattern, Degree of Collaboration, author productivity, Relative Growth Rate, Doubling Time*

### **1. INTRODUCTION**

Modern Science was no doubt an implantation on India. Science during the initial phase is an extension of geographical exploration, and it includes the appraisal of natural resources. According to Shiv Viswanathan, the whole phase of development of science and technology in colonial India may be divided into three phases-The first phase, launched in the Mid-eighteenth century was described as the era of ‘great surveys’ conducted on a scientific basis, a wide-range of topographical, statistical, trigonometric, cartographic and other surveys had a long-term significance not only for the scientific mapping of India, but also for the development of scientific knowledge in Britain and Europe. The second phase led to the introduction of scientific and technical education in colonial India. Known for the famous Anglicist-Orientalist controversy in 1835, it had crucial significance for the formulation of goals and direction of the

policy for the development of science and technology in India. The third and final phase was marked by the colonial state's calculated attempts to forge institutional links between science, technology and the Indian economy. Primarily consisting of experiments in building scientific institutions, it had a potential role in the development of Indian society and rational thinking and attitudes among the people (**Viswanathan, 1985**).

Modern science started in India in the 18<sup>th</sup> century, largely through the individual efforts of European missionaries, traders, soldiers and colonial administrators. Only from the mid-nineteenth century did Indians start participating in practicing Western science. The nineteenth century saw rapid developments, and as Majumdar says:

*“The Nineteenth century was the great dividing line, and these hundred years changed the face of India far more than did the preceding thousand years”.* (**Majumdar, 1961**)

Zoological research in India dates back to the appointment of Edward Blyth as the curator of the Museum of the Asiatic Society in 1841. In 1867, The Indian Museum was founded. It became the main centre of zoological research in India. But prior to it, The Royal Asiatic Society, Calcutta was the main centre for this purpose. In 1916, the Zoological and Anthropological sections of Indian Museum were merged and turned into the Zoological Survey of India. In the same year, Zoological Society of India was also formed in Calcutta. Entomological Society of India was founded in 1938 in Delhi. It started bringing out Indian Journal of Entomology from 1939 (**Sen, 2005**). Pioneers such as Atkinson, Wood-Mason, Walsh, Sclater, Frank Finn, Alcock, James Anderson, S L Hora, B Prasad, and others made notable contribution in this field.

Very few evaluative studies were conducted on zoological research in India, such as **Begum and Rajendra (1990, 1996)**, Nandi and **Bandyopadhyay (2010)** discussed the different aspects of evaluative analysis of zoological research in India.

## **2. OBJECTIVES**

The basic objective of the study is to trace the contribution of Indian in zoological research from 1901 to 1945. The other objectives are to:

- i. Describe the pattern of growth of contribution in zoology by Indian researchers;
- ii. Study the chronological distribution of contribution;
- iii. Find out the authorship pattern;
- iv. Identify the core journals;
- v. Correlate Indian research scenario against World scenario in zoological research.

### 3. SCOPE OF THE STUDY

The study is confined to the articles/papers written in English by Indian published in the journals only. The period covered in this study ranges from 1901 to 1945. The geographical limit of the coverage is confined to British India which covers India, Pakistan, Bangladesh and Myanmar.

### 4. METHODOLOGY

Detail bibliographical data on publication of Indian were collected and put into Excel sheets for carried out necessary analysis in order to fulfill the prime objectives of this study. Hard copies of different primary and secondary sources were manually as well as electronically scanned for collecting articles on science in India, especially on zoological research in India. For study of Indian contribution we intended to include those papers only which were published in English language during the period under study.

### 5. ANALYSIS AND INTERPRETATION

The present study deals with the Indian's contribution in British India. We found that 3378 papers were written by Indian researchers during the period under study.

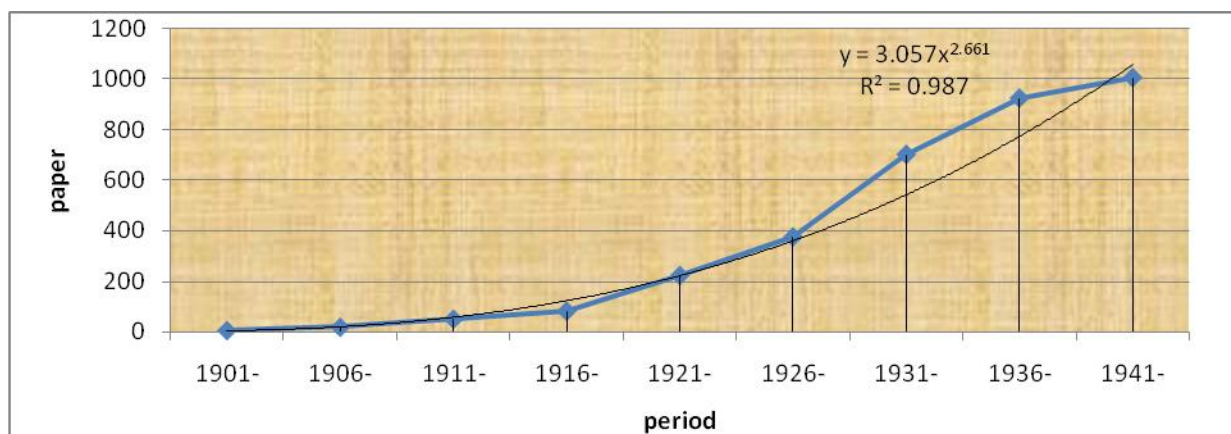
#### 5.1 Paper Publication Scenario

Period	1901-5	1906-10	1911-15	1916-20	1921-25	1926-30	1931-35	1936-40	1941-45
Paper	4	17	49	81	222	375	701	924	1005
Average publication	0.8	3.4	9.8	16.2	44.4	75	140.2	184.8	200.1

*Table 1: Distribution of papers*

Table1 provides quinquennial (every five years) accumulation of papers distribution. As usual for the first few years there was very little growth and after that the growth picked up a good pace. It is evident from the above table that the contribution of scientific papers during the first two decade of 20<sup>th</sup> century was not very remarkable, just 7.5 papers per year were published. Thereafter continuous growth was witnessed at the rate of 45 papers per year during 1921-25 and 75 papers per year during 1926-30. Growth during the next decade of 1931-40 crossed all the previous records as it was more than double (162.5 papers/year). However, last decade covering only three years form 1941-1945 superseded the growth rate of all the previous decades as almost 200 papers per years were published during this period. Thus, it can be inferred that the number of papers is continuously increasing at a good increasing average annual rate.

It is evident from the Fig.1 that the quinquennial accumulation of the papers published tends to cluster after the first two decades of the 20th century. While during the last twenty five years of the period under study shows that research activity begins to pick up rapidly in terms of the number of publication of papers. On a close scrutiny of the graph, we may say that the growth of papers in 1930s when compared to that in 1920s was pretty good, which almost then started going almost flat in 1940s.



*Figure 1: Quinquennial Distribution of paper*

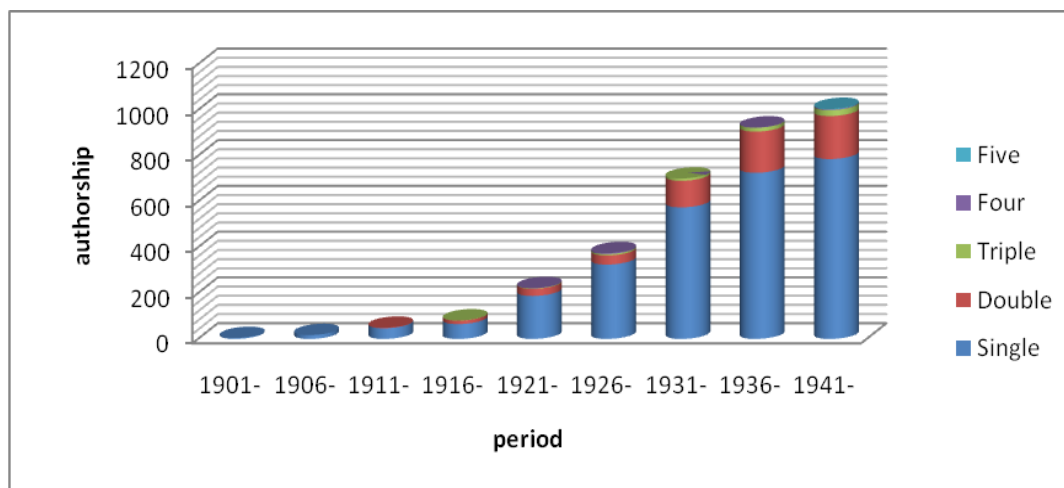
A simple trend line gives the following regression equation  $y=3.057x^{2.661}$  and  $R^2=0.987$ , that means, the curve fits well with power law with R-squared value so close to 1.

## 5.2 Authorship Pattern

Period	Single	Double	Triple	Four	Five
1901-	4				
1906-	17				
1911-	47	2			
1916-	65	15	1		
1921-	188	31	2	1	
1926-	325	40	6	4	
1931-	575	116	10	0	
1936-	726	180	17	1	
1941-	786	188	26	3	2

*Table 2: Distribution of authorship*

The above table shows the distribution of different authorship category throughout the period under study. It is also found that during the period of 1931-1945, the collaborative research shows a remarkable progress. About 84 percent contributions of total collaboration have occurred during this period.



**Figure 2:** *Quinquennial Distribution of authorship*

From the analysis, we see that solo research (81%) has the dominancy over collaborative research and this was the general trends of the scientific research not only in India but also in globe during that period.

### 5.2.1 Degree of Collaboration

Period	Single authored paper	Multi authored paper	Total	Degree of Collaboration
1901-	4	0	4	0
1906-	17	0	17	0
1911-	47	2	49	0.0408
1916-	65	16	81	0.197
1921-	188	34	222	0.153
1926-	325	50	375	0.133
1931-	575	126	701	0.179
1936-	726	198	924	0.214
1941-	786	219	1005	0.217

**Table 3:** *Degree of collaboration*

The extent or degree of collaboration has been quantified by applying Subramaniam's formula (1983), which states that the degree of collaboration is a ratio between the numbers of multi-authored papers (NM) to the number of multi authored papers (NM) plus the single authored (NS) ones.

$$C = \frac{NM}{NM+NS} \quad \text{where,}$$

NM = number of multi authored papers

NS = number of single authored papers

Here the overall degree of collaboration is 0.191. Therefore, the proliferation of solo research has become very much visible during this period.

### 5.2.2 Author Productivity

Period	Number of authors	Number of papers	Mean papers per author
1901-05	4	4	1
1906-10	17	17	1
1911-15	51	49	0.96
1916-20	98	81	0.82
1921-25	260	222	0.85
1926-30	439	375	0.85
1931-35	837	701	0.83
1936-40	1141	924	0.80
1941-45	1262	1005	0.79

**Table 4:** Author Productivity (1901-1945)

Table 4 provides five yearly cumulations of papers and the author's productivity. The data in the table indicates that between the end of 1920 and the end of 1930 there is more than a four hundred per cent increase in the number of authors and almost a three hundred percent increase between 1930 and 1940. During the first decade, the mean number of papers per author slight greater than that of the remaining period under study. The rates were 1, 0.96, 0.82, 0.85, 0.83, 0.80 and 0.79 respectively. Only mild de-growth were started from the beginning of 1931 and continued upto the end of 1945.

### 5.2.3 Prolific Researchers

When we analysed the total contribution level of the Indian researcher, we found that about 21% papers of total papers have been published by the ten most prolific researchers during this period. According to this study, total 3378 papers have been published among which 2733 single authored and 645 multi-authored papers. Table 5 provides the listing of ten prolific researchers. The most prolific researchers were Sunder Lal Hora with 7.96% contribution, followed by B. Prasad (2.51%), Hem Singh Pruthi (1.98%), M. A. Husain (1.74%), Himadri Kumar Mookerjee (1.36%) and so on.

Researcher's name	Publication	% of contribution
Sunder Lal Hora	269	7.96
B. Prasad	85	2.51
Hem Singh Pruthi	67	1.98
M. A. Husain	59	1.74
Himadri Kumar Mookerjee	46	1.36
Mithan Lal Roonwal	38	1.12
T. V. Ramakrishna Ayyar	38	1.12
H. Srinivasa Rao	35	1.03
Salim Ali	33	0.97
P. R. Awati	32	0.94
Biswanath	32	0.94

*Table 5: Prolific researchers*

### 5.3 Ranking of Journals

Being the carrier of original research work, journal articles serve as a basis for counting the publications output, in terms of scientific productivity of nations in a given field of study. Journal articles are, now a day, being used for qualitative performance evaluation of scientists and nations.

From the analysis of journal ranking it has been observed that Indian scientists prefer to publish their articles in Indian journals rather than foreign journals.

Rank	Name	No. of Paper	% of share
1	The Indian Veterinary Journal	900	26.64
2	Record of Indian Museum	388	11.48
3	Indian Journal of Veterinary Science and Animal Husbandry	317	9.38
4	Current Science	333	9.85
5	Journal of the Bombay Natural History Society	270	7.99
6	Proceedings of the Indian Academy of Science	191	5.65
7	Indian Journal of Entomology	115	3.40
8	Indian Farming	94	2.78
9	Journal of Bengal Asiatic Society	113	3.34
10	Indian Journal of Agricultural Science	42	1.24

*Table 6: Most productive journals*

A total number of 127 journals published 3378 articles covered in our study. 54 (42%) journals publish only one article, 14 journals (11.02%) publish only two articles and 8 journals (6.29%) publish 3 articles, rest of the journals publish more than three articles. The leading journals preferred by the scientists were Indian Veterinary Journal with 900 (26.64%) papers, Record of Indian Museum with 388 (11.48%) papers, Current Science with 333 (9.85%) papers, Indian Journal of Veterinary Science and Animal Husbandry with 317 (9.38%) papers, Journal of the Bombay Natural History Society with 270 (7.99%) papers and so on. (Table 6)

It has also found that the top 10 domestic journals published papers in zoology together contributed 2763 papers, which accounts for 81.79% share in the cumulative publications output of India during the period under study. Similarly, the top 10 most productive foreign journals published papers in zoology together contributed 166 papers, which accounts for 4.91% share in the cumulative publications output of India during the period under study.

#### **5.4 Geographical Distribution of Contributions**

Table 7 provides data of only ten high performing places from where at least 50 papers were published. These top ten places account for 69.38 % of total research output. Data in Table 7 reveals that Calcutta is on the top with highest contribution of 25.76 % papers; followed by Madras (12.05 %), Lahore (6.71%), Bangalore (5.14%), Mukteswar (5.11%) and so on.

<b>Place</b>	<b>% of contribution</b>
Calcutta	25.76
Madras	12.05
Lahore	6.71
Bangalore	5.14
Mukteswar	5.11
Bombay	4.24
Dehra Dun	3.25
Lucknow	2.98
Hyderabad	2.29
Allahabad	1.85

*Table 7: Geographical distribution*



### 5.5 Relative Growth Rate and Doubling Time

#### 5.51 Relative Growth Rate

The relative growth Rate (RGR) is the increase in number of articles/papers per unit of time. The mean Relative Growth Rate over specific period of interval can be calculated from the following equation:

$$RGR = \frac{\text{Log of } W_2 - \text{Log of } W_1}{T_2 - T_1}$$

Whereas,

RGR= mean relative growth rate over the specific period of interval

Log  $W_1$ = log of initial number of articles

Log  $W_2$ = log of final number of articles

$T_2 - T_1$ = the unit difference between the initial time and the final time

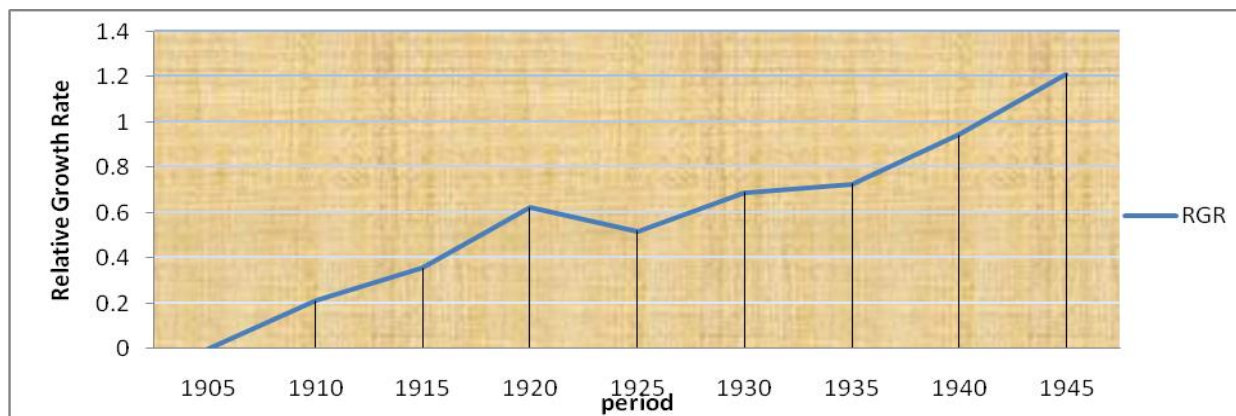
#### 5.52 Doubling Time (DT)

There exist a direct relationship between the relative growth rate and the doubling time. If the number of articles of a subject doubles during a given period then the difference between the logarithms of numbers at the beginning and end of this period must be logarithms of number 2. If natural logarithm is used this difference has a value of 0.693. So, the doubling time for the articles for each specific period of interval can be calculated by the formula:

$$\text{Doubling Time (DT)} = 0.693 / \text{RGR}$$

Period	1901-05	1906-10	1911-15	1916-20	1921-25	1926-30	1931-35	1936-40	1941-45
<b>RGR</b>	0	0.211309	0.356675	0.622831	0.518901	0.690477	0.726121	0.943198	1.212296
<b>DT</b>	0	3.279556	1.942946	1.112662	1.335515	1.003654	0.954386	0.734734	0.571642

**Table 8:** RGR and DT for zoological research output (1901-1945)



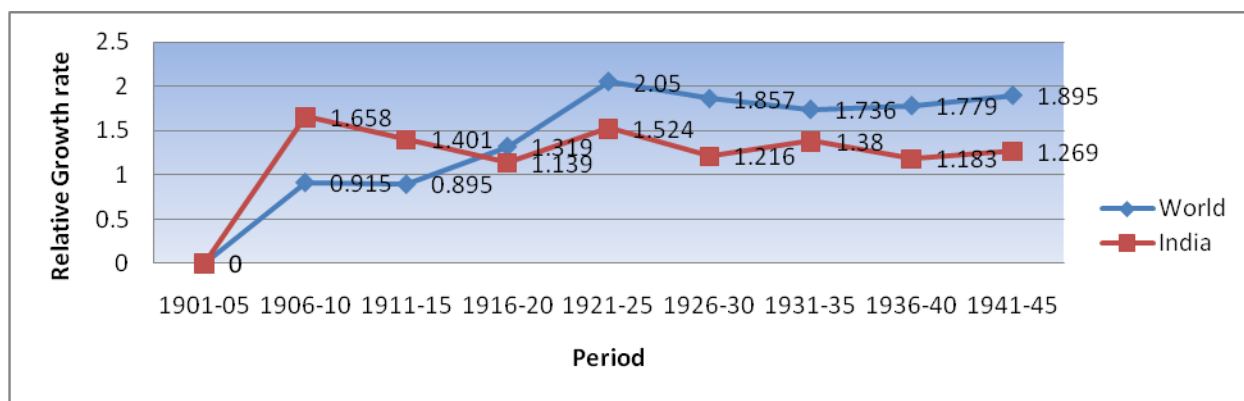
*Figure 3: Relative Growth Rate (1901-1945)*

This study has been done for the period 1901-1945 with the aim to understand the structure and dimensions of zoological literature. The analysis of the above table (Table 8) shows that relative

growth rate gradually increases from 0.211 in the first decade (1901-1910) to 1.212 in the last decade under study of period and correspondingly the doubling time decreases from 3.279 in the first decade to 0.571 in last decade under the study of period. (Fig.3)

The mean growth rate and doubling time is 0.586 and 1.215 respectively during this period.

### 5.6 Comparative study of growth of World zoological literature and Indian zoological literature



**Fig. 4:** Relative Growth Rate of Zoological literature (World and India) (1901-1945)

The above figure (Fig.4) shows the comparative data on relative growth rate of zoological literature between World and India during the first half of the twentieth century. The data for world zoological literature is based on the 'Zoological Record' of The Zoological Society of India. It has seen that Indian researchers have contributed only 0.82% of total output of the World during this period. In a close scrutiny, it has also found that the relative growth rate of paper publication by Indian researchers was higher than the World rate by the end of 1915. The World War might have a considerable effect on the output of zoological literature worldwide.

### 6. FINDINGS AND CONCLUSION

From the above analysis, we could note the following major findings, such as, the first few years there was very little growth and after that the growth picked up a good pace; almost 75 papers per years were published during 1901-1945. The overall degree of collaboration was 0.19, Therefore, the proliferation of solo research was become very much visible during this period; only 7.87% journals accounts for published 81.79% of total research output; the mean Relative Growth Rate and Doubling Time were 0.586 and 1.215 respectively during this period and Indian researchers were contributed only 0.82% of total output of the World during this period. Therefore, the contributions of Indians in zoology research were gradually increased by the end of the 1910s and continued upto the end of 1940s. This could be the result of more participation

in research work by the Indian researchers during this period. Another reason was the gradual increase in case of number of the birth of new journals as well as the establishment of new educational institutions and learned societies during this period.

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