



## **An analysis of research papers published in the *Journal of Marine Biological Association of India* during 1959 - 2008**

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### **Abstract**

In 50 years, 1961 research papers have been published in the *Journal of Marine Biological Association of India*. The number of pages per paper decreased from 10.4 during 1974 - 1978 to 5.6 during 2004 - 2008. On the other hand, the number of references quoted per paper increased from 9.2 during 1959 - 1963, to 17.2 during 2004 - 2008. The number of authors in a paper increased from 1.3 (1959 - 1963) to 2.8 (2004 - 2008). During 1959 - 1963, the women authors were only 1.3% which increased to 28.1% during 2004-2008. A total of 3789 authors affiliated to 356 institutions contributed papers. Of this, 162 are from international institutions and 194 are from India. Among the 194 institutions in India, which contributed research papers to JMBAI, 60 were from Tamil Nadu (including the Union Territory of Puducherry) followed by Kerala (36) and Maharashtra (32). Among 19 major subjects covered by the JMBAI, a large number of papers were published on biology such as food and feeding, life history, morphology, developmental biology etc (556 papers; 27.1%). The maximum research concentration was on the Infraclass Teleostii (560 papers; 33.8%), Class Crustacea (424 papers; 25.6%) and Class Bivalvia (119 papers; 7.2%).

**Keywords:** *Journal of Marine Biological Association of India*, research papers, analysis

### **Introduction**

Despite the fact that it is the largest biome on earth, covering 71% of the earth's surface and harboring 32 of the 33 known animal phyla, we know relatively little about the complexities of marine life. Compared to about 1.5 million terrestrial plants and animals, the scientists of Census of Marine Life have listed about 2,35,000 species of marine organisms. It is suspected that perhaps a million or more species remain to be discovered, if all small animals and protists are included. The marine life provide us with a rich source of food, medicine and income and support species that serve as animal feed, fertilizers, food additives and cosmetics. The oceans contain several billion plankton which account for most of the photosynthesis occurring in the earth, without which there may not be enough oxygen to support the world population and animal

life. Every year discoveries are made that demonstrate the importance of marine life, from the isolation of new anti-cancer drugs to the production of alternative energy sources. Over the past several decades, increasing human activities such as overfishing and pollution have rapidly destroyed or affected the marine life throughout the world.

The opportunities from the ocean and challenges to marine life have prompted the scientists world over to conduct research upon the biology of marine organisms in the last few centuries. A large number of research journals dedicated to marine biology are being published addressing a wide array of issues from taxonomy and DNA bar-coding to the complexities of dependence of marine life on oceanic processes. These publications have helped to a great extent to gain an insight into the fauna and flora of the world oceans.

Marine biological research in India started in the year 1850 with the establishment of Marine Biology Station in Kurusadai in the Gulf of Mannar by the then Government of Madras. However the impetus was provided only in the beginning of the 20<sup>th</sup> century after the establishment of Madras Survey of India, Madras Museum and various marine biological stations by the Government of Madras (Anon, 1959). These investigations gave an incentive to the Indian biologists to further their knowledge of the marine flora and fauna of the Indian waters. Since then, marked strides have been made in fundamental researches in marine biology and allied subjects especially at the Universities of Madras, Kerala, Cochin, Bombay, Andhra and Annamalai, Central Marine Fisheries Research Institute and Zoological Survey of India. Considering the rapid progress in applied as well as fundamental studies of marine life in the Indian waters, a network of marine biologists, the Marine Biological Association of India was established in 1958 with the objective to create and promote an active interest in studies related to marine flora and fauna. Since 1959, the Marine Biological Association of India is publishing the *Journal of the Marine Biological Association of India* (JMBAI). Being the primary research journal dedicated to marine biology, it is expected that an analysis of the research papers published in the JMBAI would indicate the (i) volume of research work published in marine biology, (ii) changes in the priority areas of research over the last 50 years, and (iii) institutions which contributed to marine biology research. To address this, an analysis was made on the papers published in the 50 volumes of JMBAI during 1959 – 2008.

### Material and methods

The JMBAI is a half yearly journal consisting of two issues every year. However, three issues were published in each of the volumes 16, 17 and 18. Thus 50 volumes consisted of 103 issues.

The following data were collected from each issue of the *Journal of Marine Biological Association of India*: the total number of research papers, pages, references which include authors, their affiliations and gender. For assessing the subject area covered, the subjects were listed into 81 categories and then

re-grouped into 19 based on the area of interest considered for publication, which is indicated in the journal. The research contributions were also categorized into different faunal and floral phyla based on the list of phyla provided in [www.absoluteastronomy.com](http://www.absoluteastronomy.com).

All the above mentioned information were collected by examining each paper published in the JMBAI in the last 50 years. The collected information for each issue were tabulated in MS Excel for further analysis. Since the journal is not included in Science Citation Index, a scientometric analysis for fisheries research as done by Jayashree and Arunachalam (2000) could not be carried out.

### Results and Discussion

In 50 years, the Journal had 8 editors, all belonging to the Central Marine Fisheries Research Institute (CMFRI). This is because the Marine Biological Association of India is continuously hosted and supported by the CMFRI.

**Papers:** A total of 1961 papers have been published, running into 15,708 pages (Table 1). The list of References cited in 1961 papers consists of 29,773 papers, reports, books and monographs (The total numbers of papers in the last 6 volumes (45 - 50) were 234 with 4052 references. Out of this 155 references were from the JMBAI. There is a decreasing trend in the length of the paper especially in the last 35 years. The number of pages per paper decreased from 10.4 during 1974 - 1978 to 5.6 during 2004 – 2008 (Fig.1). On the other hand the number of references quoted per paper increased from 9.2 during 1959 - 1963 to 17.2 during 2004 – 2008. In other words, with advancement of scientific contributions, the number of references has increased over the years. In the last 5 years, the list of references occupies nearly one page in a paper of average length of 5.6 pages. In comparison, the references occupied only about half a page in a paper with an average length of about 8 pages during 1959-1963.

**Authors:** A total of 3789 authors have contributed research papers to the JMBAI including repeat authorship. The number of authors in a paper has increased from 1.3 (1959 - 1963) to 2.8 (2004 -

Table 1. Details of research papers published in the JMBAI in 50 years

Year	Volume	Papers	Pages	Reference	Authors		Total
					Men	Women	
1959 - 1963	1 to 5	180	1424	1662	238	3	241
1964 - 1968	6 to 10	211	1597	2167	372	7	379
1969 - 1973	11 to 15	281	2638	4716	375	30	405
1974 - 1978	16 to 20	245	2551	4205	350	29	379
1979 - 1983	21 to 25	112	953	2000	222	14	236
1984 - 1988	26 to 30	185	1259	2644	325	32	357
1989 - 1993	31 to 35	210	1603	3260	417	42	459
1994 -1998	36 to 40	178	1242	2823	350	45	395
1999 - 2003	41 to 45	137	1198	2479	254	68	322
2004 - 2008	46 to 50	222	1243	3817	440	173	616
TOTAL		1961	15708	29773	3343	443	3789

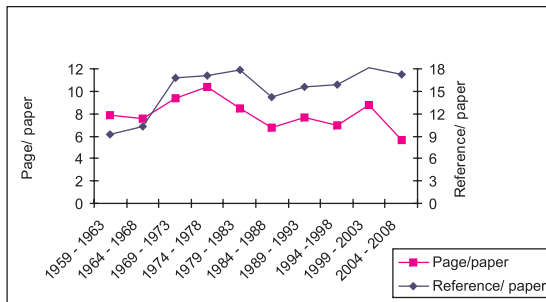


Fig. 1. Average number of pages and references per paper published in JMBAI

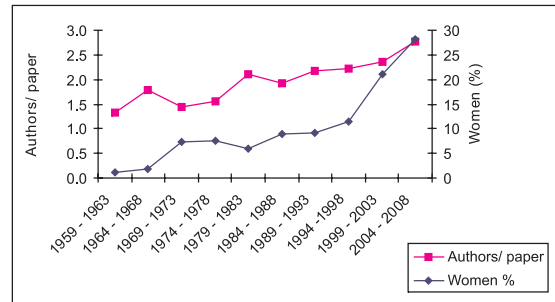


Fig. 2. Number of authors per paper and contribution of women authors to the papers published in JMBAI

2008) (Fig. 2). This shows the importance given to team research in the later years. Of the 3789 authors, 88% were men. However, gender bias is being rectified in the later years. During 1959 – 1963, the women authors were only 1.3% which increased to 28.1% during 2004-2008 (Fig. 2). The contribution of women authors substantially increased in the last 15 years, which shows the increasing number of women taking up research in marine biology as their career option.

Table 2. Number of papers from different continents published in JMBAI

Continent	1959 -1968	1969 - 1978	1979 - 1988	1989 - 1998	1999 - 2008	Total
North America	13	44	0	0	0	57
South America	0	4	1	5	3	13
Australia	1	8	0	2	0	11
Africa	0	10	3	10	1	24
Europe	12	40	2	5	0	59
Southeast Asia	0	5	2	2	2	11
East Asia	1	7	0	1	0	9
Western Asia	0	3	4	10	2	19
Southern Asia (except India)	0	9	1	12	5	27
Total	27	130	13	47	13	230

**Institutions:** The authors were affiliated to 356 institutions. Of this, 162 were from international institutions and 194 from India. Among the international institutions, the contributions in terms of number of institutions as well as papers were mainly from North America and Europe (Fig. 3 and Table 2). The institutions from the USA (40) and UK (23) contributed the maximum. The following striking observations were made on the papers published from abroad: (i) Though the number of institutions was

high at 162 the number of research papers were only 230. (ii) The number of contributions especially from North America and Europe drastically decreased over the years (Table 2).

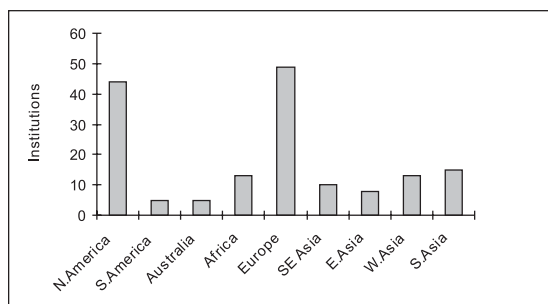


Fig. 3. Total number of contributing institutions to JMBAI during 1959 – 2008

Within India, as expected, the authors and institutions from maritime states contributed more than those from the inland states. Among the 194 institutions in India, which contributed research papers to JMBAI, 60 were from Tamil Nadu (including the Union Territory of Puducherry) followed by Kerala (36) and Maharashtra (32) (Fig. 4). Perhaps this is an indication that Tamil Nadu had allocated more funds than other states for establishing a large number of institutions to undertake marine biological research. However, these institutions except a few, are not dedicated to marine biological research alone but devoted to research on marine biology and allied subjects as one of their areas of interest. It was also found that, a total of 281 papers were published from Tamil Nadu. Compared to other

states, the contributions from Tamil Nadu increased over the years from 34 papers during 1959-1968 to 75 papers during 1999-2008 (Table 3). However the number of papers was substantially higher from Kerala (1153) than the other states. It should be mentioned here that the contributions of CMFRI, with 12 research centers distributed along the maritime states of India has headquarters at Cochin (Kerala) and were included under Kerala in this analysis. Barring the contributions by CMFRI, there were only 205 contributions from Kerala.

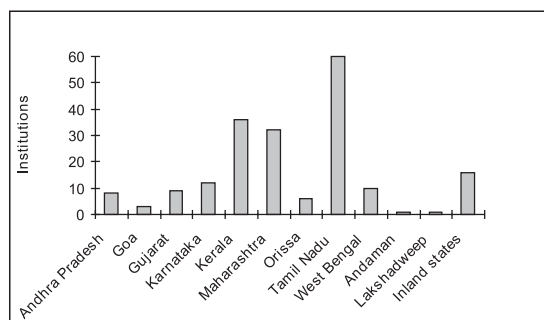


Fig. 4. Total number of contributing institutions from different states in India to JMBAI during 1959 - 2008

Table 4 provides the list of institutions, which contributed ten and more papers during the 50 years. CMFRI has contributed 948 papers (48.3% of the total number of papers) followed by Centre of Advanced Study in Marine Biology (Annamalai University), Cochin University of Science and Technology, Zoological Survey of India and Andhra

Table 3. Number of papers from different states in India published in JMBAI

State	1959 -1968	1969 - 1978	1979 - 1988	1989 - 1998	1999 - 2008	Total
Andhra Pradesh	15	15	10	13	16	69
Goa	1	23	2	20	10	56
Gujarat	4	18	1	5	2	30
Karnataka	0	3	5	13	15	36
Kerala	330	200	180	195	248	1153
Maharashtra	17	61	12	17	13	120
Orissa	0	3	1	5	5	14
Tamil Nadu*	34	29	63	80	75	281
West Bengal	25	50	21	18	5	119
Andaman	0	0	0	0	2	2
Lakshadweep	0	0	1	0	0	1
Inland States	2	10	3	5	6	26
Total	428	412	299	371	397	1907

\* Including Union Territory of Puducherry

Table 4. Institutions which contributed ten and more papers to JMBAI during 1959 – 2008

No:	Institution	No: of papers
1	Central Marine Fisheries Research Institute, Cochin	948
2	Centre of Advanced Study in Marine Biology, Parangipettai, Tamil Nadu	109
3	Cochin University for Science and Technology, Cochin	66
4	Zoological Survey of India, Kolkatta	66
5	Andhra University, Visakhapatnam	61
6	Kerala University, Thiruvananthapuram	54
7	National Institute of Oceanography, Goa	51
8	Madras University, Chennai	50
9	Central Inland Fisheries Research Institute, Barrackpore	27
10	Central Institute of Fisheries Technology, Cochin	20
11	Bhabha Atomic Research Centre, Maharashtra	20
12	College of Fisheries, Mangalore	17
13	Calcutta University, Kolkatta	17
14	Marathawada University, Aurangabad	13
15	Institute of Science, Mumbai	12
16	Institute of Tropical Meteorology, Pune	11
17	Suganthi Devadason Marine Research Institute, Tuticorin	11
18	Central Salt and Marine Chemicals Research Institute, Bhavnagar	10

University. Substantial contribution by CMFRI shows that the JMBAI is serving as a platform to project the results of the research projects undertaken by the CMFRI. Being the premier institution on marine fisheries research in India, the contributions by CMFRI to the JMBAI were mainly on fish biology and fisheries.

**Research subjects:** Among the 19 major subjects covered by the JMBAI, a large number of papers were published on biology such as food and feeding, life history, morphology, developmental biology etc (556 papers; 27.1%); distribution and abundance including exploratory surveys, occurrence and new record and migration etc (462 papers; 22.5%) and

Table 5. Number of Papers published in JMBAI in each subject area of marine biology

No:	Subject	1959-1968	1969-1978	1979-1988	1989-1998	1999-2008	Total
1	Aquaculture	3	2	9	10	4	28
2	Biodiversity	1	2	1	4	18	26
3	Biology	138	135	94	95	94	556
4	Chemical Oceanography	2	20	0	5	10	37
5	Climate Science	1	8	0	0	0	9
6	Conservation	13	7	5	3	3	31
7	Diseases	4	3	13	1	10	31
8	Distribution & Abundance	124	164	56	58	60	462
9	Ecology	10	28	27	16	13	94
10	Fisheries & Management	10	16	12	59	29	126
11	Geology & Sediments	1	7	0	0	0	8
12	Marine microbiology	2	3	3	0	4	12
13	Methodology	2	14	9	23	27	75
14	Physical Oceanography	23	31	13	12	8	87
15	Physiology & Biochemistry	23	36	39	58	42	198
16	Pollution	16	1	4	13	12	46
17	Population dynamics	8	2	17	31	16	74
18	Primary & Secondary Production	2	4	5	6	10	27
19	Systematics & Anatomy	8	38	16	7	10	79
20	Miscellaneous	11	16	5	8	4	44

physiology and biochemistry (198 papers; 9.7%) of marine organisms (Table 5). The number of papers on aquaculture, fisheries and management and biodiversity has increased over the years. It was found that some of the very important subject areas relevant to Marine Biological Research such as physical oceanography and conservation decreased over the years. Several other important areas such as primary and secondary production, marine microbiology, sedimentology and climate science

have not been addressed adequately. Papers on the relationship between physical, chemical and biological oceanography, and fisheries were very few and limited to the early issues of the Journal.

An analysis of the publications on marine organisms shows that a variety of fauna and flora has been studied. The analysis showed that 22 floral and faunal phyla were represented in the publications. The maximum concentration was on the Infraclass Teleostii (560 papers; 33.8%), Class Crustacea (424

Table 6. Number of papers published on different phyla in JMBAI during 1959 – 2008

No:	Phylum	1959-1968	1969-1978	1979-1988	1989-1998	1999-2008	Total
1	Bacillariophyta	1	4	6	2	4	17
2	Cyanophyta	1	1	1	0	0	3
3	Chlorophyta	3	3	1	1	1	9
4	Phaeophyta	2	6	2	1	0	11
5	Rhodophyta	0	5	1	1	0	7
6	Dinoflagellata	0	3	0	0	0	3
7	Bryozoa	1	1	1	0	1	4
8	Porifera	6	10	5	3	2	26
9	Cnidaria	13	23	5	17	8	66
10	Annelida	20	11	3	3	6	43
11	Ciliophora	0	1	0	0	0	1
12	Arthropoda						
	Class Arachnida	0	0	0	3	0	3
	Class Crustacea	122	103	61	66	72	424
	Class Insecta	0	2	1	3	0	6
	Class Malacostraca	2	12	3	1	3	21
	Class Maxillopoda	1	1	1	0	0	3
	Class Ostracoda	0	2	0	0	0	2
	Class Pycnogonida	0	1	0	0	1	2
13	Nematoda	1	0	1	1	2	5
14	Nemertea	0	1	0	0	0	1
15	Platyhelminthes	1	4	0	0	0	5
16	Chaetognatha	2	2	3	4	0	11
17	Radiolaria	0	1	0	0	0	1
18	Rotifera	0	0	1	0	7	8
19	Mollusca						
	Class Bivalvia	12	18	19	38	32	119
	Class Cephalopoda	1	3	1	4	2	11
	Class Gastropoda	10	4	4	7	6	31
20	Echinodermata	11	12	11	4	4	42
21	Hemichordata	0	0	0	2	0	2
22	Chordata						
	Cephalochordata	6	4	0	2	5	17
	Class Elasmobranchii	3	9	3	4	5	24
	Infraclass Teleostii	146	110	84	118	102	560
	Class Reptilia	2	7	4	2	2	17
	Class Aves	0	3	0	0	0	3
	Class Mammalia	12	8	7	5	1	33
23	Others						
	Phytoplankton	5	20	6	12	12	55
	Zooplankton	1	4	7	14	7	33
	Mollusca	0	5	2	0	0	7
	Bacteria	0	3	2	5	9	19

papers; 25.6%) and Class Bivalvia (119 papers; 7.2%) (Table 6). All these three classes consisted of commercially important species, which formed fisheries along the Indian coast. Several ecologically important and sensitive organisms belonging to the Phyla Dinoflagellata, Porifera, Ciliophora, Nemertea, Platyhelminthes, Radiolaria, Rotifera, Classes Ostiopoda, Reptilia and Aves have not been adequately represented.

The present analysis does not represent the whole research on marine biology carried out in India. A few other related journals in India such as the *Indian Journal of Fisheries*, *Indian Journal of Marine Sciences* and *Journal of Bombay Natural History Society* are also publishing research papers on marine biology and allied subjects. A large number of papers from India have also been published in several foreign journals. Unless an enquiry into the publications of all these journals is made, it is not

possible to arrive at conclusions on the marine biological research carried out in India. However the present analysis is indicative of the areas and organisms targeted for research on marine biology in India.

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