

## SOME TRENDS IN INDIAN OCEANOGRAPHIC RESEARCH PUBLICATIONS (1963- 1992)<sup>+</sup>

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The bibliometric analysis of 2475 Indian oceanographic research contributions and 38886 references cited by them was undertaken. The data was compiled using CDS/ISIS software. The analysis was carried out by developing CDS/ISIS Pascal programmes for oceanography as a single multidisciplinary subject as well as for each discipline in oceanography. Subject-wise distribution, forms of contributions and references cited, authorship pattern, non-textual characteristics were the parameters used for analysis. A shift in the number of contributions among the disciplines of oceanography, the forms of documents as the communication channel and even the items cited is noticed over a period of three decades. The increase in the number of scientists did not proportionately yield the number of contributions. Single authored contributions tend to decrease as in other disciplines. The number of Tables and Figures in contributions are yet to stabilise. The results could be applied in the development of information systems.

**KEYWORDS/DESCRIPTORS:** Bibliometrics; Contributions; Citations; Intellectual forms; Authorship pattern; Number of pages; Figures; Tables; Oceanographic research

### 1 INTRODUCTION

Scientific development in a discipline is normally traced using published literature. The literature produced by the scientists of a specific institute, country or subject helps in understanding the information transfer process in that institute, country or subject. Whereas the literature cited by them helps in planning and designing of information systems. The forms of documents, year-wise, subject-wise analysis of the contributions, the authorship patterns, the non-textual characteristics such as number of tables, figures in the contributions and even the length of the

contributions or number of references cited are some of the parameters.

The preference of an intellectual form by the users of a certain discipline for publishing their contributions helps in deciding the policies regarding the indicators to be used in evaluating the productivity of the scientists. Whereas the choice of documents referred to in their contributions helps in justifying the proportion of funds allocation for acquisition of documents of a particular intellectual form in the library. Among the research community, the most common and accepted intellectual form is an article in a serial.

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The serials are supposed to be the *most primary and authentic* channel of communication for scientific information due to their characteristics such as the nascence, referring system, wider distribution, etc. A study on the research publications of an Indian marine fisheries research laboratory [2] shows that over 80% of their contributions are in the serials. The proceedings of conferences, seminars, workshops, etc., are noticed to be the second choice (16.5%) of the scientists of the institute. Contrary to this most common picture are the contributions of the Philippines based International Centre for Living Aquatic Resources Management (ICLARM) [5]. The number of contributions of ICLARM in the form of report and semi-technical literature amount to over 57%. Contributions in the proceedings of the conferences and chapters in books are the second choice of the scientists of ICLARM (29%). The contributions to serial literature are only 13.5% and thus the last choice. ICLARM has indeed a policy of very wide circulation of their report literature. In engineering sciences also the authors have been noticed to be largely publishing their findings in the non-serial literature. In some subjects, even the technology conference proceedings are known to have a better 'impact' than any serial in that field [16].

Disciplines grow, albeit differentially, along with the institutions. Year-wise distribution of the contributions of an institution should normally give the map of gradual increase in the number of publications especially when the institution is younger. One of the reasons attributed to the gradual increase is in the expansion of the institution. Once the institute reaches a stage of maturity, new recruitment retards, the average age of the staff cross boundaries of productive years, publication count shows signs of a status quo if not a down fall. This is due to the fact that the most productive age of the scientists is of 35 to 39 years [4]. Other factors are attributed to change in publication policies, change in research areas, occupation of the staff in the activities other than research, etc.

The architect of an intellectual and artistic work is recognised as an 'author'. Ranganathan [12] has described author as 'a person creating the work, that is the thought and expression constituting it' and 'joint-authors' means 'two or more authors, sharing responsibility for the thought and expression constituting the work, the portion of which each is separately responsible not being specified or separable'. Price [11] reported first the trend of multiple authorship after studying the data from Chemical Abstracts for the period 1910 to 1960. The proportion of two-authored papers had reached about 40% of the total output, three-authored papers made up about 15% and four-authored papers 5 to 10%. The proportion of three-authored papers showed rapid growth compared to two- authored papers and likewise the four-authored papers increased faster than three-authors. Authorship patterns in Indian publications have been studied extensively [6,7,8,9] using Indian Science Abstracts for the years 1965 to 1983 for the whole S&T field as well as separately for physical, applied and biological sciences. The results of these studies indicate that there is a considerable decline in the single-author publications ranging from highest 18 to 7% in Chemical sciences to lowest 68 to 41% in engineering. Proportionately, the multiple authorship increased from 82 to 92% in chemical sciences and from 32 to 78% in the engineering. The physical, biological, geological sciences followed similar trend in decreasing percentage after chemical sciences. In the science and technology as a whole, the multiple-author publications increased from 61 to 80% during 1965 to 1983. Of the multiple-author publications, two-authored publications were mostly in the range of 40 to 55% in all disciplines. The rise in the complexity of science is one of the reasons of the growth in multiple-authorship contributions [13]. While author collaboration tendency grew all over, an exceptional pattern was observed in the contributions from Central Marine Fisheries Research Institute in India at Kochi [2] during 1979 to 1984. The single-authored papers written during this recent period were nearly 49%. Two-authored contributions

were 27% and the rest were over two authored. Therefore it can be said that multiple-authorship trend varies from one discipline to another and depends on several factors.

The number of illustrations (Figures and Tables) in the scientific research articles make them more 'readable'. Pierce [10] is of the view that over a period of time, as the discipline matures, the number of the research articles in core periodicals become increasingly similar in their bibliometric characteristics. Variation in levels of use of footnotes, charts, tables and graphs decrease over time suggesting that authors, editors and referees come to view these practices as disciplinary standards for research presentation. Snizek, et al [15] observed the citation rates of DNA cluster papers are significantly influenced by both, the number of references and figures found in the body of those papers.

The length of papers is also one of the rarely used bibliometric indicator. This helps in finding out the average size (in terms of length) of the publications in a particular discipline. This parameter is particularly useful in deciding the minimum photocopying charges per set of pages. This kind of analysis is also useful to the editorial staff in deciding the length of the manuscript being received. Dizon and Sadorra [1] used the number of pages for assigning weights to the contributions of ICLARM while measuring the scientific productivity of the authors.

The average number of references at the end of the paper is accepted as a kind of crude measure of the 'scholarliness' of a citing item [3]. Senapati [14] analyzed papers according to the year, language, length of articles, and number of illustrations, citations, etc., appearing between 1988 and 1992 in studies in conservation. The average number of references was 13.88, the average length of papers was 8.47 pages and the average number of illustrations was 6.23.

This paper analyses: i) 2475 research contributions in the field of a multidisciplinary subject -

Oceanography - published by the authors from a single representative institute in India - National Institute of Oceanography (NIO), Goa, during 1963 to 1992; and ii) 38886 items cited by them. It studies the information transfer process and provides suggestions for the better information system based on the parameters mentioned above. The bibliographic data along with required bibliometric parameters was entered in the database using CDS/ISIS and the data was analysed using the software 'Bibliometrisis' - developed for the purpose [17].

## 2 METHODOLOGY

It was felt appropriate to track trends for the whole period as well as for three equal sets of year within the period. The analysis was also carried out for a multidisciplinary subject as a whole as well as for all individual disciplines within 'oceanography' separately. The disciplines were grouped in: Biology, Ecology and Living Resources (BS), Physical Sciences (PS), Chemical Sciences (CS), Earth Sciences (ES), Materials Sciences (MS), Engineering and Instrumentation (EI). Items not falling in any of these disciplines were grouped under Miscellaneous (Misc.) category.

After the subject wise division of the contributions, the form-wise analysis was carried out. As such the articles published in the serials, conference proceedings, books and 'published reports' only by NIO scientists were considered to study the preference of the channels of communication by the Indian scientists engaged in oceanographic research. These were examined in terms of their distribution over a period of time. The cited documents were also identified for their intellectual form (serials, books, reports, conference proceedings, theses and other miscellaneous forms).

The year-wise distribution of the Indian oceanographic contributions was tabulated in two forms of literature: serial and non-serial. They were then compared with the staff strength as well as

judged on other events within the institute likely to be responsible for abnormal peaks or downfall. An attempt was also made to identify impact of contributions to the non-serial literature on the serial literature, if any.

Authorship patterns in the publications of the Indian oceanographers was checked. Tables with sets for ten years each were drawn indicating how many of them are single-authored and multi-authored contributions.

Average number of Tables and Figures were calculated to find out any fluctuations among them over a period of time. The length of the contributions in terms of the number of pages was also measured. The contributions were also grouped for the number of references cited by them. Variations in the average number of these items were examined.

### 3 RESULTS

#### 3.1 Subject-Wise Analysis of Contributions

An analysis of the contributions (Figure 1) based on basic subject indicates that 41% of the total

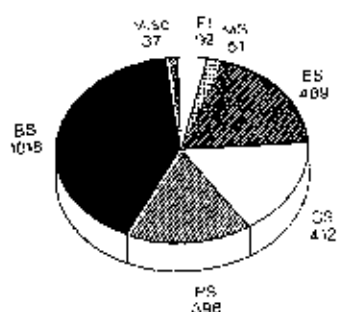


Fig. 1  
Subjectwise distribution: Total contributions

contributions are from BS. The ES, CS and PS follow in the decreasing order with 19, 17 and 16 percent respectively for the period considered (1963-1992). The subjects EI and MS were noticed to be contributing very small number (4

and 2%). Staff strength is observed to be an influential factor in the total number of contributions in the field. Oceanography was initially biased towards the studies on BS. The significance of CS and PS was recognised later. The increase in staff strength in non-BS fields yielded increase in the number of publications during subsequent part of the period. Decade-wise analysis in the next paragraph confirms this trend.

An analysis of data for three decades (Figure 2) indicates that the contributions from BS are

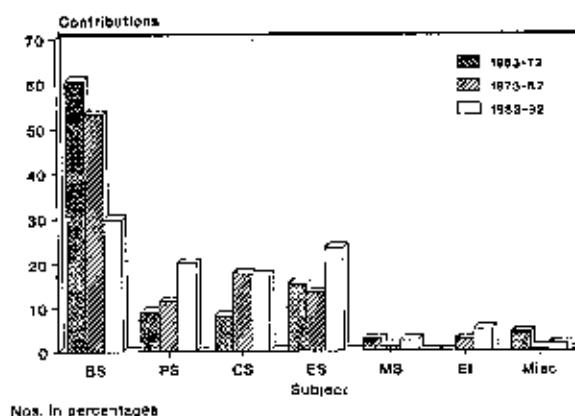


Fig 2  
Subjectwise distribution: Decadewise analysis

decreasing in number as well as in percentage. A considerable increase in percentage in the fields PS and CS is noticed in the first two decades. PS continued to progress in the third decade but CS retarded by a few percent. ES showed a decrease in percentage as like BS but then went ahead of PS and CS in the third decade. This is due to a considerable interest and induction of staff in this field. MS and EI were noticed to be contributing in very small number with a moderate growth.

#### 3.2 Formwise distributions

##### 3.2.1 Form-wise distribution of contributions

The form-wise distribution of contributions for the subject oceanography as a whole is summa-

ized in Figure 3. More than three fourth of the communications in oceanography are in serials. Over 86% contributions of the Indian scientists

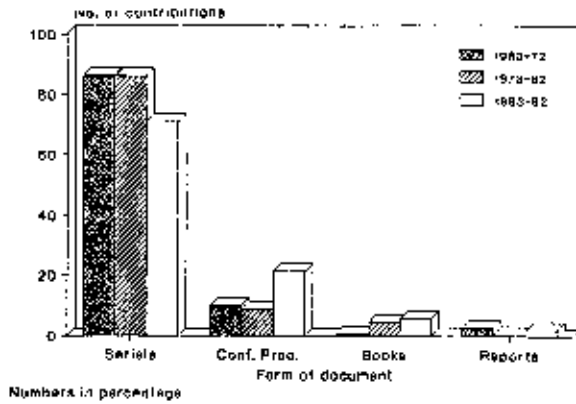


Fig. 3  
Formwise distribution of contributions

in oceanography as a single discipline were published in the serials during the first two decades. While the number of contributions in serials for the last decade did show an increase, the percentage of contributions reduced by 15% over earlier sets. This is due to large number of contributions in the conference proceedings during the last set of ten years. The number of contributions in the conference proceedings in the third decade increased to nearly three times to the earlier sets of ten years. Reports were least during the second decade. However, in the last set it again showed a hike. Contributions related to the Antarctic expedition mainly raised this number.

It is interesting to note a similar trend in the contributions to the serials in the BS (Table 1) though the actual number of contributions to the serials reduced during last set of ten years. The tendency of publishing in conference proceedings during the three sets of periods proceedings during the three sets of periods show multifold increase over previous period set in PS and MS. Therefore the number of contributions to the serials though in increasing order, show decrease in percentage over previous period sets in these subjects. A sharp increase in the contributions to the conference proceedings in last decade in PS is due to contributions to one of the conference proceedings during 1992 in physical oceanography. The trend in the CS also

showed an increase in the number of articles to the serials over a period. However, the fast increasing contributions to conference proceedings declined the percentage of contributions to serials. Dedicated conferences, therefore, encourage more contributions but tilt the focus away from serials.

An interesting trend is observed in the FI. The authors have preferred to publish more in the conference proceedings than in the serials during the last decade. Especially the contributions to conference proceedings in last decade outnumbered the contributions to the serials. This tallies with the general trend in the engineering sciences and technology.

As such the trend of publishing in conference proceedings has shown an overall increase in all disciplines. This is probably due to increasing number of opportunities to the scientists to participate in the different types of gatherings like conferences. Since the analysis of year-wise distribution of contributions has shown no significant influence of contributions to non-serial forms on the contributions to serials, this need not be taken as a serious matter but needs to be closely watched for subsequent years. Publishing in serials has its own merits and while contributing more to conference proceedings the trend should not unknowingly take reverse order.

### 3.2.2. Formwise distribution of references cited

The serials are usually considered to be the most preferred form of scientific communication and they are always cited highest. Form-wise distribution of references cited gives directions for the investments on the type of documents to be procured in the libraries. The results could also be interpreted in another way. The number of references cited to a particular document type indicates the present strength of the library.

The references cited for all disciplines together in oceanography (Figure 4) shows that the highest percentage (66%) of the citations are to the serials. Books find a second position

**Table I**  
**Formwise distribution of contributions**  
 (Numbers in brackets indicate percentage. Distribution of Misc. category not included)

Forms	Subject	Years				Total			
		1963 to 1972		1973 to 1982			1983 to 1992		
Serials	BS	106	(82.81)	413	(84.29)	286	(71.50)	805	(79.08)
Conf.Proc	BS	15	(11.72)	41	(8.37)	74	(18.50)	130	(12.77)
Books	BS	1	(0.78)	34	(6.94)	29	(7.25)	64	(6.29)
Reports	BS	6	(4.69)	2	(0.41)	11	(2.75)	19	(1.87)
Totals:		128		490		400		1018	
Serials	PS	18	(94.74)	89	(84.76)	183	(67.28)	290	(73.23)
Conf.Proc	PS	1	(5.26)	10	(9.52)	81	(29.78)	92	(23.23)
Books	PS	0	(0.00)	5	(4.76)	6	(2.21)	11	(2.78)
Reports	PS	0	(0.00)	1	(0.95)	2	(0.74)	3	(0.76)
Totals:		19		105		272		396	
Serials	CS	16	(94.12)	150	(92.02)	183	(78.88)	349	(84.71)
Conf.Proc	CS	1	(5.88)	10	(6.13)	27	(11.64)	38	(9.22)
Books	CS	0	(0.00)	1	(0.61)	17	(7.33)	18	(4.37)
Reports	CS	0	(0.00)	2	(1.23)	5	(2.16)	7	(1.70)
Totals:		17		163		232		412	
Serials	ES	28	(87.50)	108	(88.52)	240	(76.19)	376	(80.17)
Conf.Proc	ES	4	(12.50)	12	(9.84)	52	(16.51)	68	(14.50)
Books	ES	0	(0.00)	1	(0.82)	17	(5.40)	18	(3.84)
Reports	ES	0	(0.00)	1	(0.82)	6	(1.90)	7	(1.49)
Totals:		32		122		315		469	
Serials	MS	6	(100.00)	9	(90.00)	27	(77.14)	42	(82.35)
Conf.Proc	MS	0	(0.00)	1	(10.00)	6	(17.14)	7	(13.73)
Books	MS	0	(0.00)	0	(0.00)	2	(5.71)	2	(3.92)
Reports	MS	0	(0.00)	0	(0.00)	0	(0.00)	0	(0.00)
Totals:		6		10		35		51	
Serials	EI	0	(0.00)	19	(76.00)	26	(38.81)	45	(48.91)
Conf.Proc	EI	0	(0.00)	5	(20.00)	37	(55.22)	42	(45.65)
Books	EI	0	(0.00)	1	(4.00)	2	(2.99)	3	(3.26)
Reports	EI	0	(0.00)	0	(0.00)	2	(2.99)	2	(2.17)
Totals:		0		25		67		92	

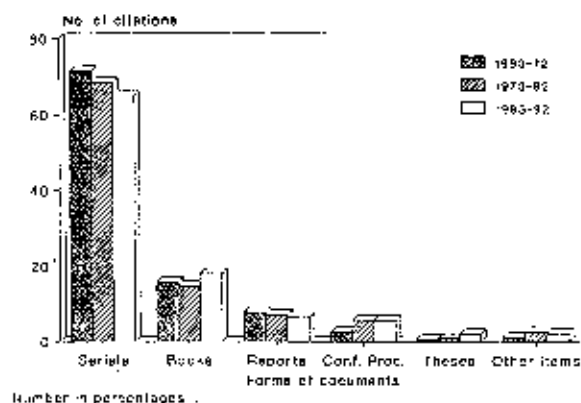


Fig. 4

## Formwise distribution of citations

(16.71%). The conference proceedings and technical reports are cited with very little difference in percentage (nearly 6 and 7%). As such, the technical reports are considered as unpublished literature and therefore should not have found a place higher than the articles in conference proceedings - a published item. A significant number of citations to the theses are also noticed. This is also another form of unpublished or 'gray literature'.

The break-up of the other forms for all years together is given in Table 2. Largest number of

Table 2

## Break-up of citations belonging to 'other forms'

Code	Form type	Citations	
		No.	%
c	Standards	14	1.68
d	Drawings	7	0.84
e	In press or personal communication	161	19.35
g	Maps & atlases	425	51.08
p	Patents	2	0.24
o	Review items	2	0.24
y	Summary only documents	213	25.60
z	Bibliographies	8	0.97
<b>Total</b>		<b>832</b>	<b>100.00</b>

references cited among other forms is for the maps and atlases. Most of the oceanographic studies are for the specific geographic locations, the highest percentage of citations to this kind of form of literature is expected. The next in the priority follows abstracts submitted for confe-

rences, seminars, etc. Significant number of citations is to the items like 'in press' or 'personal communication'. These items, in fact, are not available to the readers and hence redundant. Citations pertaining to personal communications only act as indicators of informal communication among scientists.

Form-wise distribution of references cited for each discipline in oceanography is presented in the Table 3. An unusual picture emerges from the analysis of forms of citations. The percentage of the citations to the serial items is noticed to be in decreasing in many specific subjects like BS, PS, ES and MS (including oceanography as a whole). This is particularly more in the last set of ten years period. A possible reason for this could be attributed to the restricted accessibility to the serials literature. Due to financial constraints and devaluation of an Indian currency, the library of the institute could not afford to maintain subscriptions to the serials it was otherwise subscribing earlier. The number of subscriptions has been considerably reduced after 1986.

In EI citations to the monographic literature are around 60% - higher than the citations to the serials - a trend in consistence with the other engineering and technology disciplines.

## 3.3 Year-Wise Distribution of Contributions

The number of contributions per year is primarily divided into the serial articles and other items for all the publications in oceanography as a whole (Figure 5) as well as for each subject separately (Table 4).

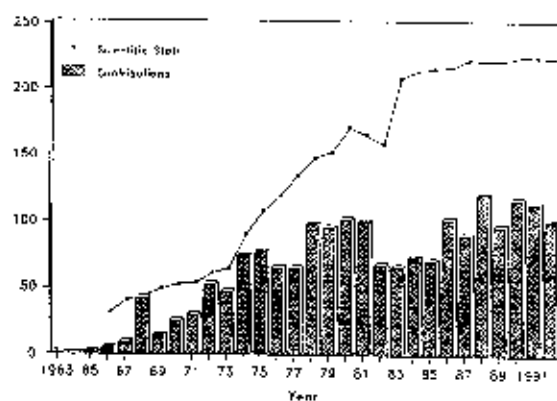


Fig. 5

## Yearwise distribution of contributions

**Table 3**  
**Formwise distribution of citations**  
 (Numbers in brackets indicate percentage. Distribution of Misc. category not included)

Forms	Subject	Years						Total	
		1963 to 1972		1973 to 1982		1983 to 1992			
Serials	BS	1633	(75.01)	5269	(70.14)	4697	(65.45)	11599	(68.78)
Books	BS	263	(12.08)	977	(13.01)	1303	(18.16)	2543	(15.08)
Reports	BS	187	(8.59)	529	(7.04)	426	(5.94)	1142	(6.77)
Conf.Proc	BS	57	(2.62)	462	(6.15)	497	(6.93)	1016	(6.02)
Theses	BS	14	(0.64)	77	(1.03)	140	(1.95)	231	(1.37)
Others	BS	23	(1.06)	198	(2.64)	113	(1.57)	334	(1.98)
<b>Total</b>		<b>2177</b>		<b>7512</b>		<b>7176</b>		<b>16865</b>	
Serials	PS	72	(58.54)	733	(65.10)	2104	(59.81)	2909	(61.02)
Books	PS	30	(24.39)	175	(15.54)	589	(16.74)	794	(16.66)
Reports	PS	14	(11.38)	97	(8.61)	306	(8.70)	417	(8.75)
Conf.Proc	PS	1	(0.81)	65	(5.77)	251	(7.13)	317	(6.65)
Theses	PS	1	(0.81)	21	(1.87)	108	(3.07)	130	(2.73)
Others	PS	5	(4.07)	35	(3.11)	160	(4.55)	200	(4.20)
<b>Total</b>		<b>123</b>		<b>1126</b>		<b>3518</b>		<b>4767</b>	
Serials	CS	167	(70.46)	1511	(70.15)	2892	(71.85)	4570	(71.23)
Books	CS	39	(16.46)	381	(17.69)	664	(16.50)	1084	(16.90)
Reports	CS	13	(5.49)	129	(5.99)	229	(5.69)	371	(5.78)
Conf.Proc	CS	12	(5.06)	83	(3.85)	87	(2.16)	182	(2.84)
Theses	CS	3	(1.27)	18	(0.84)	77	(1.91)	98	(1.53)
Others	CS	3	(1.27)	32	(1.49)	76	(1.89)	111	(1.73)
<b>Total</b>		<b>237</b>		<b>2154</b>		<b>4025</b>		<b>6416</b>	
Serials	ES	292	(66.36)	1523	(65.48)	4118	(65.15)	5933	(65.29)
Books	ES	89	(20.23)	388	(16.68)	1207	(19.10)	1684	(18.53)
Reports	ES	34	(7.73)	184	(7.91)	402	(6.36)	620	(6.82)
Conf.Proc	ES	14	(3.18)	131	(5.63)	316	(5.00)	461	(5.07)
Theses	ES	5	(1.14)	13	(0.56)	137	(2.17)	155	(1.71)
Others	ES	6	(1.36)	87	(3.74)	141	(2.23)	234	(2.58)
<b>Total</b>		<b>440</b>		<b>2326</b>		<b>6321</b>		<b>9087</b>	
Serials	MS	72	(84.71)	70	(71.43)	322	(60.07)	464	(64.53)
Books	MS	7	(8.24)	9	(9.18)	114	(21.27)	130	(18.08)
Reports	MS	2	(2.35)	6	(6.12)	17	(3.17)	25	(3.48)
Conf.Proc	MS	1	(1.18)	7	(7.14)	62	(11.57)	70	(9.74)
Theses	MS	2	(2.35)	4	(4.08)	16	(2.99)	22	(3.06)
Others	MS	1	(1.18)	2	(2.04)	5	(0.93)	8	(1.11)
<b>Total</b>		<b>85</b>		<b>98</b>		<b>536</b>		<b>719</b>	



Table 3 Contd...

Forms	Subject	Years			Total
		1963 to 1972	1973 to 1982	1983 to 1992	
Serials	EI	0 (00.00)	56 (35.90)	169 (40.72)	225 (39.40)
Books	EI	0 (00.00)	33 (21.15)	102 (24.58)	135 (23.64)
Reports	EI	0 (00.00)	18 (11.54)	49 (11.81)	67 (11.73)
Conf.Proc	EI	0 (00.00)	44 (28.21)	80 (19.28)	124 (21.72)
Theses	EI	0 (00.00)	1 (0.64)	8 (1.93)	9 (1.58)
Others	EI	0 (00.00)	4 (2.56)	7 (1.69)	11 (1.93)
Total		0	156	415	571

No steady growth in the number of serial publications for the total period of 30 years is noticed. The reasons for peaks and downfalls were identified. The first jump of 42 serial articles in 1968 is attributed to the number of articles contributed to the Symposium on Indian Ocean. One of the serials had published the proceedings of this symposium as its special volume. International Indian Ocean Expedition (IIOE) data was mostly used for these contributions. A steady growth otherwise is noticed until 1981 except a small surge in the years 1974 and 1975. The surge may be due to an impact of several reasons during that period: change in leadership, participation in the international programmes, availability of research vessel and participation in Monsoon Experiment 1973 (MONEX'73) cruises, change in the publication policy of a house bulletin to contribute research articles, etc. In general, the overall productivity in the form of contributions was more with comparatively less scientific staff until 1977 (Figure 5). As such, the large number of publications in BS during this period contribute to the rise in the total count (Table 4). The discipline BS had the largest population of researchers at that time. Rise during 1978 to 1981 is attributed to the large number of publications on the topical issues (special numbers of serials on Andaman and Lakshadweep Seas for cruises in that area) and participation in Antarctic

expedition and other international programmes. Increase in the number of publications during this period in PS are due to the MONEX'79 cruises.

There is a slump in the number of publications during 1982 to 1985. Gradual decrease in the number of staff during earlier years (1981 and 1982) could be one of the major reasons (Figure 5). This can also be attributed to the change in leadership, and shift in the research policy of the institute and the interests of the scientists. New programmes were introduced in physical oceanography in 1981. Beginning of Antarctic expeditions during this period had added a new dimension to the research activities of scientists. A large number of staff was busy in providing logistics support for this expedition. Two large events were organised in the institute (Bhatnagar tournaments, National Academy of Sciences of Allahabad Seminar) in which the majority of the scientific staff was likely to be pre-occupied in the activities not relating to the research at this time. The beginning of this period had also seen a major change in the assessment and promotion policies of the S&T staff. This should also have influenced the S&T output. During the same period a decrease in the number of publications in the BS is noticed (Table 4). One of the major reasons for the decline in the number of publications in BS could be attributed to the aging factor. A large number of staff joined during IIOE belonged to BS. These scientists had crossed the age of 40 years by that time.

**Table 4**  
**Yearwise distribution of contributions per discipline: Distribution of Misc. category not included.**  
 (a= serial contributions, b= non-serial contributions, c= a+b)

Year	BS			PS			CS			ES			MS			EI		
	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
1966	3	1	4	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
1967	5	0	5	1	1	2	0	1	1	0	0	0	0	0	0	0	0	0
1968	21	3	24	6	0	6	9	0	9	6	0	6	0	0	0	0	0	0
1969	9	0	9	1	0	1	1	0	1	2	0	2	1	0	1	0	0	0
1970	17	5	22	1	0	1	4	0	4	2	0	2	1	0	1	0	0	0
1971	20	0	20	1	0	1	0	0	0	4	0	4	2	0	2	0	0	0
1972	31	13	44	4	0	4	2	0	2	14	4	18	2	0	2	0	0	0
1973	33	32	65	3	4	7	3	0	3	5	4	9	3	0	3	0	0	0
1974	48	1	49	5	1	6	8	3	11	9	2	11	0	0	0	4	0	4
1975	46	2	48	10	1	11	11	1	12	7	0	7	1	0	1	2	0	2
1976	24	0	24	13	1	14	13	1	14	11	0	11	1	0	1	4	0	4
1977	35	29	64	5	1	6	12	0	12	6	0	6	2	0	2	4	0	4
1978	57	2	59	5	0	5	18	1	19	15	1	16	0	0	0	2	2	4
1979	44	4	48	11	0	11	23	1	24	14	2	16	0	0	0	3	0	3
1980	49	1	50	15	1	16	20	2	22	18	2	20	0	0	0	0	1	1
1981	46	1	47	14	5	19	27	4	31	12	0	12	0	0	0	1	3	4
1982	31	5	36	8	2	10	15	0	15	11	3	14	2	1	3	1	0	1
1983	25	7	32	5	6	11	27	6	33	7	7	14	1	0	1	1	3	4
1984	26	2	28	11	1	12	22	0	22	13	1	14	0	0	0	1	0	1
1985	25	19	44	15	4	19	12	4	16	14	4	18	1	0	1	4	1	5
1986	36	8	44	22	13	35	17	2	19	15	0	15	5	2	7	7	11	18
1987	26	14	40	17	10	27	19	9	28	25	10	35	0	1	1	2	5	7
1988	36	10	46	23	3	26	22	2	24	34	9	43	1	2	3	2	3	5
1989	20	6	26	24	5	29	16	5	21	31	8	39	4	1	5	3	3	6
1990	26	9	35	25	2	27	17	3	20	37	6	43	6	1	7	3	1	4
1991	32	6	38	22	5	27	20	6	26	33	12	45	5	1	6	1	6	?
1992	34	33	67	19	40	59	11	12	23	31	18	49	4	0	4	2	8	10
<b>Total:</b>	<b>805</b>	<b>213</b>	<b>1018</b>	<b>290</b>	<b>106</b>	<b>396</b>	<b>349</b>	<b>63</b>	<b>412</b>	<b>376</b>	<b>93</b>	<b>469</b>	<b>42</b>	<b>9</b>	<b>51</b>	<b>45</b>	<b>47</b>	<b>92</b>

A large count is noticed in the case of MS and EI after 1982 (Table 4). A separate division was formed for MS followed by subsequent development and large recruitment of researchers in EI discipline during that period. The increase in the number of publications in ES after 1987 co-

incided with granting of permission for publishing results based on the data collected during the surveys for polymetallic nodules.

The Table 4 also gives the number of non-serial items published during the respective years. Most

of these items are either contributions to conference proceedings, reports and/or felicitation volumes. It is interesting to note that these publications did not reduce or show any effect on the number of articles in serials for respective years. This indicates that the scientists have primary interest in publishing their data in serials.

In short, it could be said that the smaller groups tend to yield higher productivity. The research policies of the institute and the age of scientists also largely influence the publication count. Non-serial publications do not make any significant effect on the number of contributions to the serials. Research programmes with a definite aim and smaller duration yield large count on publications.

### 3.4 Authorship Pattern

Authorship pattern among Indian Oceanographers showed a general agreement with the world trend of decreasing number of contributions by single authors. In the first decade of study, the single-authored contributions were over 45%. This percentage decreased gradually to 25 in the third decade (Figure 6). Three (or

the percentage during second decade of investigation. Two- and three-authored publications constitute around 58% of the total contributions. Almost similar trends are noticed in all branches of oceanography (Table 5). In the field of CS and ES the third decade showed as many as ten authored papers. Other branches had up to six or seven authored papers. The lowest percentage of single-authored papers and highest percentage of multi-authored papers is noticed in PS and MS. The average number of authors per paper in each subject are in the range of 2 to 3 authors.

### 3.5 Non-Textual Characteristics

Tables, figures and annexures (usually termed as non-textual material) occupy a sizeable portion of the Indian oceanographic contributions. These items support the main part (text) of the contribution. As such, the average size of the paper (number of pages) and number of citations are also other non-textual characteristics. Observations on these parameters are described below:

#### 3.5.1 Average Content Types

Trends in the number of Tables, Figures and Annexures in Indian oceanographic contributions indicate marginal presence of annexures or appendices in all decades and subjects. However, the tables and figures have appeared almost consistently in all papers. In comparison, the number of tables are fewer than figures. But the average number of this non-textual material is not yet stabilised. The number of tables (Table 6) has shown an increasing trend during the three decades though the rate of growth is decreasing in all subjects, indicating possible stabilisation during the next decade. The least number of tables are in EI. Whereas a larger proportion is noticed in CS and BS but never exceeded an average of two per contribution.

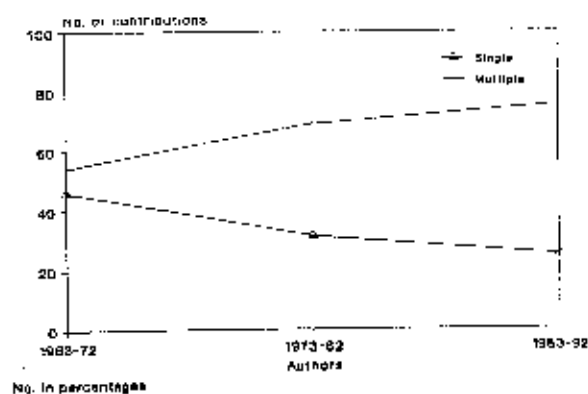


Fig. 6  
Single v/s multi-authored publications

more) authored papers increased over a period of time. Two-authored papers showed a slump in

**Table 5**  
**Authorship Pattern (Numbers in brackets indicate percentage)**

Subject & Period	No. of papers by n authors										Total	Anth/ pap
	1	2	3	4	5	6	7	8	9	10		
<b>Biol., Ecol. &amp; Living Resour.</b>												
1963 to 1972	72 (56.25)	39 (30.47)	12 (9.38)	4 (3.13)	1 (0.78)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	128	1.62
1973 to 1982	185 (37.76)	141 (28.78)	106 (21.63)	41 (8.37)	14 (2.86)	3 (0.61)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	490	2.12
1983 to 1992	132 (33.08)	127 (31.83)	91 (22.81)	34 (8.52)	6 (1.50)	5 (1.25)	4 (1.00)	0 (0.00)	0 (0.00)	0 (0.00)	399	2.21
1963 to 1992	389 (38.25)	307 (30.19)	209 (20.55)	79 (7.77)	21 (2.06)	8 (0.79)	4 (0.39)	0 (0.00)	0 (0.00)	0 (0.00)	1011	2.09
<b>Physical Sci.</b>												
1963 to 1972	5 (26.32)	9 (47.37)	5 (26.32)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	19	2.00
1973 to 1982	10 (9.52)	37 (35.24)	42 (40.00)	13 (12.38)	3 (2.86)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	105	2.64
1983 to 1992	39 (14.29)	102 (37.36)	87 (31.87)	32 (11.72)	5 (1.83)	5 (1.83)	3 (1.10)	0 (0.00)	0 (0.00)	0 (0.00)	273	2.59
1963 to 1992	54 (13.60)	148 (37.28)	134 (33.75)	45 (11.34)	8 (2.02)	5 (1.26)	3 (0.76)	0 (0.00)	0 (0.00)	0 (0.00)	397	2.58
<b>Chemical Sci.</b>												
1963 to 1972	2 (11.76)	11 (64.71)	2 (11.76)	2 (11.76)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	17	2.24
1973 to 1982	25 (15.34)	53 (32.52)	49 (30.06)	21 (12.88)	8 (4.91)	4 (2.45)	3 (1.84)	0 (0.00)	0 (0.00)	0 (0.00)	136	2.72
1983 to 1992	36 (15.52)	89 (38.36)	58 (25.00)	28 (12.07)	13 (5.60)	0 (0.00)	2 (0.86)	2 (0.86)	1 (0.43)	3 (1.29)	232	2.73
1963 to 1992	63 (15.29)	153 (37.14)	109 (26.46)	51 (12.38)	21 (5.10)	4 (0.97)	5 (1.21)	2 (0.49)	1 (0.24)	3 (0.73)	412	2.72
<b>Earth Sci.</b>												
1963 to 1972	11 (31.38)	14 (43.75)	7 (21.88)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0	32
1973 to 1982	43 (35.25)	31 (25.41)	27 (22.13)	17 (13.93)	3 (2.46)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.82)	0 (0.00)	122	2.28
1983 to 1992	92 (29.21)	109 (34.60)	69 (21.90)	26 (8.25)	9 (2.86)	3 (0.95)	2 (0.63)	3 (0.95)	1 (0.32)	1 (0.32)	315	2.35
1963 to 1992	146 (31.13)	154 (32.84)	103 (21.96)	43 (9.17)	12 (2.56)	3 (0.64)	2 (0.43)	3 (0.64)	2 (0.43)	1 (0.21)	469	2.30

Table 5 Contd...

Subject & Period	No. of papers by n authors										Total	Auth/pap
	1	2	3	4	5	6	7	8	9	10		
<b>Materials Sci.</b>												
1963 to 1972	1 (16.67)	4 (66.67)	1 (16.67)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	6	2.00
1973 to 1982	4 (40.00)	4 (40.00)	0 (0.00)	2 (20.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	10	2.00
1983 to 1992	1 (2.86)	18 (51.43)	12 (34.29)	0 (0.00)	1 (2.86)	3 (8.57)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	35	2.74
1963 to 1992	6 (11.76)	26 (50.98)	13 (25.19)	2 (3.92)	1 (1.96)	3 (5.88)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	51	2.51
<b>Engineering &amp; Instrumentation</b>												
1963 to 1972	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0	0.00
1973 to 1982	15 (60.00)	8 (32.00)	0 (0.00)	1 (4.00)	0 (0.00)	1 (4.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	25	1.64
1983 to 1992	24 (35.82)	22 (32.84)	14 (20.90)	6 (8.96)	1 (1.49)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	67	2.07
1963 to 1992	39 (42.39)	30 (32.61)	14 (15.22)	7 (7.61)	1 (1.09)	1 (1.09)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	92	1.96

Table 6  
Average number of tables

Period	BS	PS	CS	ES	MS	EI	MISC	OCEANOGR
1963 to 1972	1.66	0.47	0.29	1.09	1.00	0.00	0.22	1.28
1973 to 1982	1.68	1.00	1.65	1.03	1.40	0.40	0.40	1.46
1983 to 1992	1.77	1.27	1.86	1.31	1.26	0.97	1.43	1.52

Presentation of data in the form of figures is preferred over tables by the Indian oceanographers. The higher number of figures were noticed in the first decade in BS, CS, ES and MS (Fig. 7). Two of the 17 contributions in CS have more than 15 figures each. The average,

therefore, in CS is exceedingly lofty. Higher number of figures in other sciences could be attributed to large proportion of taxonomic studies on living as well as non-living organisms during that period. The contributions on taxonomic aspects are always with exceedingly

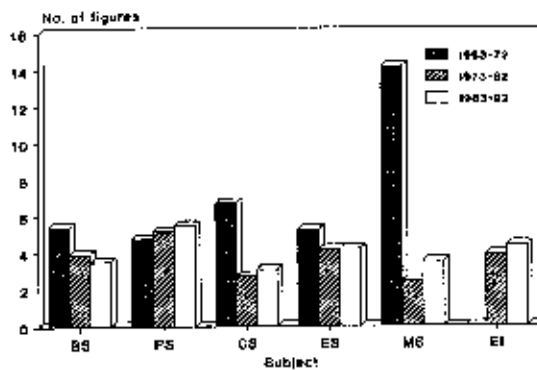


Fig. 7  
Average figures per contribution

large number of figures. The drop noticed in the number of figures in second decade could be attributed to a straight deviation from the taxonomic to ecological studies. The number in most cases show a rising trend from second to third decade. Highest number of figures is noticed in PS (over five) but never below two in other sciences. The average for last decade of study in oceanography as a multidisciplinary subject is four figures.

### 3.5.2 Length of the Contributions

Over 95% of the contributions were in the range of 1 to 20 pages for all subjects as well as

Table 7  
Length of contributions (Numbers in brackets indicate percentage)

Length in Pages	Number of contributions during the period			Total
	1963 to 1972	1973 to 1982	1983 to 1992	
<b>Oceanography</b>				
1 to 2	23 (10.90)	75 (8.15)	93 (6.92)	191 (7.72)
3 to 4	31 (14.69)	284 (30.87)	285 (21.21)	600 (24.24)
5 to 6	49 (23.22)	221 (24.02)	290 (21.58)	560 (22.63)
7 to 8	26 (12.32)	135 (14.67)	194 (14.43)	355 (14.34)
9 to 10	21 (9.95)	83 (9.02)	179 (13.32)	283 (11.43)
11 to 20	42 (19.91)	108 (11.74)	256 (19.04)	406 (16.41)
>21	19 (9.00)	14 (1.52)	46 (3.42)	79 (3.19)
<b>Biol., Ecol. &amp; Living Resour</b>				
1 to 2	13 (10.16)	40 (8.16)	36 (9.02)	89 (8.75)
3 to 4	19 (14.84)	148 (30.20)	95 (23.81)	262 (25.76)
5 to 6	32 (25.00)	120 (24.49)	81 (20.30)	233 (22.91)
7 to 8	14 (10.94)	66 (13.47)	59 (14.79)	139 (13.67)
9 to 10	13 (10.16)	52 (10.61)	57 (14.29)	122 (12.00)
10 to 20	24 (18.76)	55 (11.22)	62 (15.55)	141 (13.86)
>21	13 (10.16)	9 (1.84)	9 (2.26)	31 (3.05)
<b>Physical Sci.</b>				
1 to 2	3 (15.79)	2 (1.90)	4 (1.47)	9 (2.27)
3 to 4	3 (15.79)	22 (20.95)	54 (19.78)	79 (19.90)
5 to 6	4 (21.05)	24 (22.86)	65 (23.81)	93 (23.43)
7 to 8	3 (15.79)	24 (22.86)	35 (12.82)	62 (15.62)
9 to 10	0 (0.00)	14 (13.33)	40 (14.65)	54 (13.60)
11 to 20	3 (15.78)	18 (17.14)	66 (24.17)	87 (21.92)
>21	3 (15.79)	1 (0.95)	9 (3.30)	13 (3.27)

Table 7 Contd. . . .

Length in Pages	Number of contributions during the period			
	1963 to 1972	1973 to 1982	1983 to 1992	Total
<b>Chemical Sci.</b>				
1 to 2	1 (5.88)	20 (12.27)	26 (11.21)	47 (11.41)
3 to 4	3 (17.65)	49 (42.33)	55 (23.71)	127 (30.83)
5 to 6	2 (11.76)	35 (21.47)	56 (24.14)	93 (22.57)
7 to 8	0 (0.00)	17 (10.43)	25 (10.78)	42 (10.19)
9 to 10	5 (29.41)	8 (4.91)	26 (11.21)	39 (9.47)
11 to 20	5 (29.40)	14 (8.59)	33 (14.23)	52 (12.62)
>21	1 (5.88)	0 (0.00)	11 (4.74)	12 (2.91)
<b>Earth Sci.</b>				
1 to 2	4 (12.50)	3 (2.46)	20 (6.35)	27 (5.76)
3 to 4	4 (12.50)	35 (28.69)	40 (12.70)	79 (16.84)
5 to 6	6 (18.75)	34 (27.87)	68 (21.59)	108 (23.03)
7 to 8	8 (25.00)	22 (18.03)	60 (19.05)	90 (19.19)
9 to 10	3 (9.38)	6 (4.92)	38 (12.06)	47 (10.02)
11 to 20	6 (18.76)	18 (14.76)	74 (23.49)	98 (20.90)
>21	1 (3.13)	4 (3.28)	14 (4.44)	19 (4.05)
<b>Materials Sci.</b>				
1 to 2	1 (16.67)	0 (0.00)	1 (2.86)	2 (3.92)
3 to 4	1 (16.67)	3 (30.00)	17 (48.57)	21 (41.18)
5 to 6	2 (33.33)	4 (40.00)	5 (14.29)	11 (21.57)
7 to 8	0 (0.00)	1 (10.00)	3 (8.57)	4 (7.84)
9 to 10	0 (0.00)	1 (10.00)	5 (14.29)	6 (11.76)
11 to 20	1 (16.67)	1 (10.00)	4 (11.42)	6 (11.76)
>21	1 (16.67)	0 (0.00)	0 (0.00)	1 (1.96)
<b>Engineering &amp; Instrumentation</b>				
1 to 2	0 (0.00)	9 (36.00)	5 (7.46)	14 (15.22)
3 to 4	0 (0.00)	5 (20.00)	18 (26.87)	23 (25.00)
5 to 6	0 (0.00)	4 (16.00)	13 (19.40)	17 (18.48)
7 to 8	0 (0.00)	4 (16.00)	8 (11.91)	12 (13.04)
9 to 10	0 (0.00)	2 (8.00)	11 (16.42)	13 (14.13)
11 to 20	0 (0.00)	1 (4.00)	12 (17.92)	13 (14.13)
>21	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)

oceanography as a discipline and also for all decades except in two cases (Table 7). An interesting trend in all subjects indicates that in the decade 1973 to 1982 the authors preferred to publish more in the range of 1 to 10 pages. However, a shift has been noticed during 1983 to 1992. There is a decrease in the percentage of the contributions having length in the range of 1 to

10 pages during 1983 to 1992 and this is compensated mostly with the length of 11 to 20 pages in all subjects. In spite of a decrease in the percentage of 10 page documents, over 70% of the documents continued to be of 10 pages.

A microanalysis of the first 20 pages in the range of two pages each indicates over 50% of the documents in the range of 3 to 8 pages (Figure

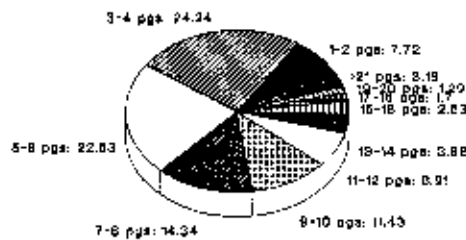


Fig. 8

#### Size of the contributions (Number of pages)

8). Among these the highest percentage is for 3 to 4 pages with an exception of PS and ES (Table 7). A large size of the documents in PS can be attributed to comparatively more number of figures in the contributions. Contributions in the range of 5 to 6 pages are more in these subjects. A growing tendency in contributing large size papers is noticed in most of the subjects, thereby reducing contributions of the range of 1 to 2 pages. Even the percentage of

items of range 3 to 4 pages reduced from second to third decade in most subjects. This also means that the contributions in the form of notes and letters are reduced to a large extent. Short notes and scientific letters have their own merits. These kinds of contributions help the authors in reporting first hand information so they can have their claims on the research work. However, since there are no other competitors in the field of oceanographic research in India, the contributions in the form of letters and notes appear to be neglected. The other reason could be the fancy for publishing in 'high impact' serials. There are less number of 'high impact' core oceanography serials with a facility to publish letters. So the authors prefer to contribute as full articles.

#### 3.5.3 Number of References Cited

The contributions were sorted on the basis of number of references cited by the authors in the

**Table 8**  
Number of contributions having citations

Length in Pages	Number of contributions during the period			
	1963 to 1972	1973 to 1982	1983 to 1992	Total
<b>Oceanography</b>				
=0	16 (7.58)	22 (2.39)	44 (3.27)	82 (3.31)
1 to 10	90 (42.65)	359 (39.02)	445 (33.11)	894 (36.12)
11 to 20	62 (29.38)	367 (39.89)	510 (37.95)	939 (37.94)
21 to 30	22 (10.43)	116 (12.61)	213 (15.85)	351 (14.18)
>30	21 (9.94)	56 (6.10)	132 (9.83)	209 (8.43)
<b>Biol., Ecol. &amp; Living Resour</b>				
=0	8 (6.25)	4 (0.82)	11 (2.76)	23 (2.26)
1 to 10	54 (42.19)	179 (36.53)	105 (26.32)	338 (33.24)
11 to 20	36 (28.13)	199 (40.61)	160 (40.10)	355 (38.84)
21 to 30	15 (11.72)	75 (15.31)	84 (21.05)	174 (17.11)
>30	15 (11.71)	33 (6.72)	39 (9.76)	87 (8.54)
<b>Physical Sci.</b>				
=0	1 (5.26)	1 (0.95)	3 (1.10)	5 (0.35)
1 to 10	16 (8.21)	59 (56.19)	135 (49.45)	210 (52.90)
11 to 20	2 (10.53)	36 (34.29)	105 (38.46)	143 (36.02)
21 to 30	0 (0.00)	6 (5.71)	17 (6.23)	23 (5.79)
>31	0 (00.00)	3 (2.85)	13 (4.77)	16 (4.04)



Table 8 Contd . . .

Length in Pages	Number of contributions during the period			
	1963 to 1972	1973 to 1982	1983 to 1992	Total
<b>Chemical Sci.</b>				
=0	0 (0.00)	4 (2.45)	5 (2.16)	9 (1.11)
1 to 10	7 (41.18)	60 (36.81)	70 (30.17)	137 (33.25)
11 to 20	6 (35.29)	76 (46.63)	98 (42.24)	180 (43.69)
21 to 30	3 (17.65)	18 (11.04)	31 (13.36)	52 (12.62)
>31	1 (5.88)	5 (3.06)	28 (12.06)	34 (8.25)
<b>Earth Sci.</b>				
=0	2 (6.25)	3 (2.46)	9 (2.86)	14 (1.59)
1 to 10	7 (21.88)	41 (33.61)	66 (20.95)	114 (24.31)
11 to 20	17 (53.13)	47 (38.52)	120 (38.10)	184 (39.23)
21 to 30	4 (12.50)	17 (13.93)	73 (23.17)	94 (20.04)
>31	2 (6.25)	14 (11.48)	47 (14.91)	63 (13.43)
<b>Materials Sci.</b>				
=0	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
1 to 10	5 (83.33)	5 (50.00)	13 (37.14)	23 (45.10)
11 to 20	0 (0.00)	5 (50.00)	14 (40.00)	19 (37.25)
21 to 30	0 (0.00)	0 (0.00)	5 (14.29)	5 (9.80)
31	1 (16.67)	0 (0.00)	3 (8.57)	4 (7.84)
<b>Engineering &amp; Instrumentation</b>				
=0	0 (0.00)	6 (24.00)	7 (10.45)	13 (9.09)
1 to 10	0 (0.00)	14 (56.00)	48 (71.64)	62 (67.39)
11 to 20	0 (0.00)	4 (16.00)	10 (14.93)	14 (15.22)
21 to 30	0 (0.00)	0 (0.00)	2 (2.99)	2 (2.17)
31	0 (0.00)	1 (4.00)	0 (0.00)	1 (1.09)

(Numbers in brackets indicate percentage)

range of 10 citations each (Table 8). Maximum number of contributions (over 65%) cite 1 to 20 references. Ninety percent of the contributions in the PS cite 1 to 20 references only. Whereas, the least percentage (65%) of contributions in the ES cite 1 to 20 references. 20% of ES contributions had 21 to 30 citations. A general trend of increase in the number of references per contribution is observed. This can be seen from a gradual decrease in the percentage of contributions having 1 to 10 citations over a period of time. Based on the number of citations, 3% of the contributions could be categorised as papers of 'popular' nature having no citations. Nearly 8% of the papers were having more than 40 citations

in oceanography as a whole discipline. They may be the review papers. Most of these belong to the CS and ES.

An increase in the average number of tables, figures, pages as well as bibliographic references in the Indian oceanographic contributions is noticed. This indicates that the evolution is still taking place in the discipline and it is yet to mature. The decrease in the number of smaller size papers also indicates the reduction in the number of letters and notes which is an alarming situation. The increase in the number of citations could also be attributed to easy access to the computerised bibliographic databases.

## 4 CONCLUSIONS AND SUGGESTIONS

### 4.1 Conclusions

Oceanography as a multidisciplinary subject has been dominated by the research in BS, though the number of contributions in this branch decreased towards the third decade (1983-1992). The age of the scientist appears to be the dominant factor influencing his/her productivity by way of number of contributions in BS.

Keeping the scientist occupied in the non-scientific areas could also adversely affect the number of contributions. On the other hand participation in time-bound international programmes, providing better infrastructure, etc., yield larger number of contributions. Increase in the number of scientists has not shown an equivalent increase in the number of contributions in Indian oceanographic research over a period of time. Participation in the conferences, seminars, etc., have shown a positive effect on the number of contributions without influencing the contributions in the serials. In all subjects dealing with the Indian oceanographic research, except EI, the number of contributions in the serials have been found to be dominating, though there is a reduction in the percentage over a period of time. Higher number of EI contributions in non-serial forms is in accordance with the trends in other engineering disciplines.

A normal trend of highest citations to serials followed by the books, technical reports and conference proceedings is observed except EI. The significant number of reference to the 'personal communication' indicates the use of informal communication channels among Indian oceanographic scientists. A trend of decreasing number of citations to the serials needs serious attention. Accessibility to the serial literature on diverse topics needs to be enhanced.

Single authored contributions have been decreasing in the Indian oceanographic research.

However, significant collaboration among the authors from PS and MS is observed. Most of the contributions have two to three authors.

Average number of tables and figures in the contributions is yet to stabilize. Larger proportion of tables is noticed in contributions to CS and BS but never exceeding an average of two per contribution. Presentation of data in the form of figures is preferred over tables by the Indian oceanographers. An average of five figures (maximum number) was noticed in the PS. Figures in contributions to other subjects of oceanography were also never below two. The average for last decade in oceanography was of four figures. While most of the documents ranged between 3 to 8 pages, the size of contributions pertaining to PS was highest. This is attributed to a large number of figures. The percentage of documents of smaller size (1 to 2 pages) is reducing indicating the trend of publishing full articles in the place of letters and notes.

The number of citations to most of the contributions were in the range of 1 to 20. Contributions in the earth sciences (ES) have more than 20 citations during the latter years. In all subjects the number of contributions were found to be increasing.

### 4.2 Suggestions

- i) The funding allocation for the acquisition of literature in a specific form needs to be made according to the percentage of items cited for that form. Based on this study, nearly 66% of the funding need to be devoted to the serials acquisition. The rest could be utilised for other forms.
- ii) Flat rates for the document delivery charges could be decided considering the average size of the oceanographic contributions rather than counting number of pages copied every time to reduce large labour costs. Most of the contributions in

oceanography are within 3 to 8 page range.

- iii) The membership fee and the entitlements of members could be decided based on the average items consulted by a scientist. The average number of items consulted could be traced from the number of references cited in their contributions and number of contributions they authored per year. The Indian oceanographers cite on an average 20 references per contribution.
- iv) The average number of pages and non-textual matter in the contributions help the editors and other professionals dealing with publishing in framing publishing policies and predicting the possible requirements. The size of the average contributions range between 3 and 8 pages. Two tables and upto five figures seem to be the present trend.
- v) The preference of publishing in serials by Indian oceanographers needs to be continued. The contributions in conference proceedings or any other monographic form should not cause reduction in the number of contributions in serials. Close control of the number of contributions to the non-serials literature is required.
- vi) Since smaller size articles are reducing in number, the practice of reporting initial results to the 'letters' serial and miscellaneous research in the form of 'notes' needs to be restored for wider dissemination, claiming pioneer rights and also for increasing the number of contributions.

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