State of Marine and Coastal Research in South Africa

1994 - 2008

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REPUBLIC OF SOUTH AFRICA

Final

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ACRONYMS

CSIR	Council for Scientific and Industrial Research
DAFF	National Department of Fisheries and Forestry
DEA	National Department of Environmental Affairs
EIA	Environmental Impact Assessment
GIS	Geographic Information System
HDI	Historically Disadvantaged Individual (HDI)" means a South African citizen (1) Who had no franchise in national elections prior to the introduction of the Constitution of the Republic of South Africa, 1983 (Act No 110 of 1983) or the Constitution of the Republic of South Africa, 1993, (Act No 200 of 1993) ("the interim Constitution); and/or (2) who is a female; and/or (3) who has a disability.
NGO	Non-governmental Organisation
NRF	National Research Foundation
SANBI	South African National Biodiversity Institute
SANCOR	South African Network for Coastal and Oceanic Research
SC&A	Scherman Colloty & Associates
SEA	Strategic Environmental Assessment
SoER	State of Environmental Report
ISI	Institute for Scientific Information now Thomson Reuters

1 Introduction

Marine and coastal research in South Africa is largely driven by tertiary institutions, affiliated research institutes and parastatal organisations, for example the Council for Scientific and Industrial Research (CSIR). Other role-players include government bodies such as the South African National Biodiversity Institute, Department of Fisheries and Forestry (DAFF) and Oceans and Coasts (National Department of Environmental Affairs – DEA). At the provincial level nature conservation authorities or provincial parks boards also conduct research. More recently Non-Governmental Organisations (NGO's) have also become involved in marine and coastal research.

Several reports assessing the state of marine and coastal research being conducted in South Africa have been produced in the past. These have focused mainly on a particular research field or form part of a series of progress reports linked to a particular research programme. The following are examples of these types of reports and amongst others include:

- SANCOR Estuaries Research Programme (1982 – 1986)
- South African Southern Ocean Research Programme (1987)
- Marine research in Natal (1986) – review of programmes and research trends
- SANCOR Occasional reports, e.g. Palmer *et al.* (2008)

Scherman Colloty & Associates was appointed to conduct a revised assessment of the state of marine and coastal science for the period 1994 – 2008. This was done in collaboration with SANCOR, National Research Foundation, Department of Environmental Affairs and the Department of agriculture Forestry and Fisheries.

It is thus the main objective of this report to assess the overall state of marine and coastal research in South Africa for the period 1994 to 2008, using research output as a measure of the current state. This report will encompass marine and coastal systems, inclusive of social and management sciences and is thus not only focused on the physical and biological environments. The rationale being to include all aspects of marine and coastal science and in order to produce a clearer idea of past research trends and focus areas. This within a largely disparate group of scientists that range from a broad spectrum of disciplines and geographic localities. Gibbons (2009) further indicated that this was a result of the nature of the marine and coastal environment, requiring a strong interdisciplinary approach using a variety of scientific fields, within varying habitats, based on the spatial distribution of institutions and personal research interests.

Of critical importance to this study with regard the assessment period, is the merger of a number of institutions, in 2001. Also related to the 2001 period is the NRF requirement for all research facilities that received funding from them to produce an annual report based on

research output. These two events had a significant impact on the production of this report and will be discussed in detail in results section.

The question been raised by the SANCOR community with regard, what and how should future research be managed and what are the current shortfalls with regard producing quality science and scientists. This is especially important with regard satisfying the needs of the funders' obligations to keep South Africa at the forefront of marine and coastal science, while ensuring that suitable redress also takes place with regard increasing the number of Historically Disadvantage Individuals (HDI) within the SANCOR group.

1.1 Terms of reference

SC&A adhered to the following terms of reference as extracted from the tender phase documentation:

The specific tasks of the project would include:

1. To provide an inventory of research projects undertaken over this period (1994 – 2008) and to categorise these according to research area/discipline/field.

2. To obtain a list of funding sources and to quantify funding amounts invested in the different areas/disciplines/fields of marine and coastal research - per funding source and over time.

3. To list research outputs in terms of:

- Publications in different categories e.g. international or local peer-reviewed journals, technical reports etc. per area/discipline/field
- Masters and Doctoral students (NRF and non NRF funded) trained by:
    - Institution
    - Level and type (taught masters or thesis only)
    - Race and gender (if possible)
    - Title of thesis (if possible)
    - Research area/discipline/field
    - Duration of registration, or if current, or dropped out without graduating
    - Supervisor
    - Funding source
    - Geographic locality of study

These were further clarified in a progress reports submitted to SANCOR during the course of 2010 and again presented to the group in February 2011 in Durban. Therefore the following database fields were populated in this study:

- Lead author
    - Co-authors
    - Research document title
    - Year of publication
    - Institution

- Honours
- Doctoral
- Masters
- Ph.D
- Supervisor
- Peer-reviewed journal
- Journal impact factor
- Book
- Conference proceedings
- Conference poster
- Internal research document
- Consultancy report / specialist study
- Other report
- Race
- Gender
- Domain
- Field
- Funding source
- Funding amount
- Study locality

3.4. To produce and analyse a research expertise database of researchers in South Africa who were active in marine and coastal research within the given time period. The database should provide an indication whether or not the researcher is still active in South Africa, has left the field, or has emigrated to another country.

3.5. To identify trends over time in relation to all of the above and to discuss the implications of these trends in terms of meeting government policy objectives (national mandates for marine and coastal research) and industry needs.

2 Methods

Past collaborative work has allowed SC&A to build relationships with a large number of research institutes and relevant research organisations throughout South Africa. This together with a series of interviews with research offices in particular have formed the basis of the study, allowing SC&A direct access to publication records or research databases with organisations listed in Table 1. It should also be noted that the Centre for Research on Evaluation, Science and Technology (CREST) from the University of Stellenbosch also provide a database of research outputs (27 000) used in this study.

For the purposes of this study the following step wise approach, linked to the requirements of the terms of reference:

Task 1 Database creation & field verification for inventory

From past experience in developing databases or inventories, it is important to develop a finite set of spreadsheet and database fields from the onset of the project. The steering committee should then accept this list before any of the databases or spreadsheets are populated with data. This will ensure buy-in form the steering committee, assist in making sure that all fields are accounted for or are relevant, and results in efficient construction of the databases. A list of the proposed database fields was provided to the Steering Committee in the form of progress reports during the course of the study. Microsoft (MS) Access Databases are well suited to developing a means to collect and interrogate data, but once constructed adding or deleting fields that are no longer required easily create problems with the field relationships or links needed to run database queries.

Summary of Task 1 subtasks

2.1 Identified database / spreadsheet fields

2.2 Prepared draft spreadsheet and Access database samples

2.3 Verified database fields using input from a suitable data subset

2.3 Presented draft database structure to Steering Committee for signoff in the form of a progress report (via email), which will include summary templates for the data analyses, i.e. the expected format for summary data analyses and data presentation to meet the overall project objective.

Note: (1) The term "Field" in this context is defined as a column heading in a database or spreadsheet, e.g. "Name of Institution" or "Researcher Name"

(2) The term "Database" can refer to either a MS Excel spreadsheet or a MS Access Database

Task 2 Data capture in project inventory

Once the structure of the database was accepted the process of populating the inventories commenced. This was conducted by suitable staff, each based in Western Cape, Eastern Cape and KwaZulu - Natal, guided by SC&A. Once the databases for each of the provinces were completed, a verification and quality control process was initiated, resulting in a combined database, where a process of removing all duplicate references was started.

External data sources were then consulted when data or information was lacking using the following online services:

- NRF databases
- Science citations
- Online journals
- Online libraries

Where data was lacking, telephonic interviews were also conducted with the Human Resources or Research Office staff to obtain this information. This was particularly needed for data on gender and race as this not indicated in research output. Several institutions were not able to provide this information, especially prior to any mergers and thus information on Gender and Race maybe undersestimated.

Summary of Task 2 subtasks

2.1 Data collection, capture and analysis

2.2 Database verification & quality control

Task 3 Final report production

Task 3 will include the production of a final report on the findings of the analyses and relevant conclusions of the study.

Summary of Task 3 subtasks

3.1 Production and submission of draft report

3.2 Final presentation at Steering Committee meeting

3.3 Submission of final report

Table 1: A list of information sources used in this study, amongst others

Tertiary groups & affiliated institutes
Albany Museum
Cape Peninsula University of Technology (Oceanography)
Department of Ichthyology & Fisheries Science - Rhodes University
Nelson Mandel Metropolitan University
Oceanographic Research Institute / South African Association for Marine Biological Research
Rhodes University
South African Institute for Aquatic Biodiversity
University of Cape Town
University of Fort Hare
University of Johannesburg / ECON&UJ
University of KwaZulu-Natal
University of Pretoria - Mammal Research Institute & CWMS
University of Stellenbosch (incl CREST)
University of Zululand
Walter Sisulu University
Companies & NGO's
Birdlife International
EnviroFish Africa
Ocean Planet
Ocean Research Africa / Biotech
Ocean Research Conservation Africa (ORCA)
World Wildlife Fund
Programmes & Networks
African Coelacanth Programme
AfrOBIS (Ocean Biogeographic Information System)
Agulhus / Somali Current Large Marine Ecosystem Programme
Benguela Current Large Marine Ecosystem Programme
Cape Action Plan for People & the Environment
Consortium for Estuarine Research and Management (CERM)
Eastern Cape Research Association for Marine Researchers (ECRAM)
KwaZulu-Natal Marine and Coastal Management Research Group (KZN-MRG)
Marine and Coastal Educators Network (MCEN)
Marine Linefish Research Group (MLRG)

River Health Programme - Provincial Technical Teams (Estuaries)
South African Environmental Observation Network
SANCOR
SEAchange
South African Marine Linefish Management Association (SAMLMA)
Government & Parastatal
Cape Nature
Council for Geosciences - Marine Geosciences Database
Council for Scientific and Industrial Research (CSIR)
Department of Science & technology (NRF/RISA)
Department of Water Affairs (RDM & RQS)
Eastern Cape Parks Board
Ezemvelo – KZN Wildlife
MCM / Oceans & Coasts / DAFF
Natal Museum
Portnet (Transnet)
River Health Programme - Provincial Technical Teams (Estuaries)
South African Biodiversity Information Facility (SABIF)
SANBI Marine Programme
South African National Parks Board
Water Research Commissions

3 Results

A total of 47 981 citations from the various information sources, as well as the citation indexes were reviewed. These yielded 9669 marine and coastal science related outputs for the period 1994 and 2008. This is an average production of ca. 645 publications per year for the 15 year period (Figure 1). Furthermore the number of publications showed a year on year increase, with the exception of the year period 1997 – 1998, which showed a sudden reduction in the number of publications (445 and 506 respectively). This generalised trend of a year on year increase in publication output for the period 1987 – 2007 was also reported by Dieb & Gevers (2009), who also showed that these was a decrease in annual output in 1996 – 1998.

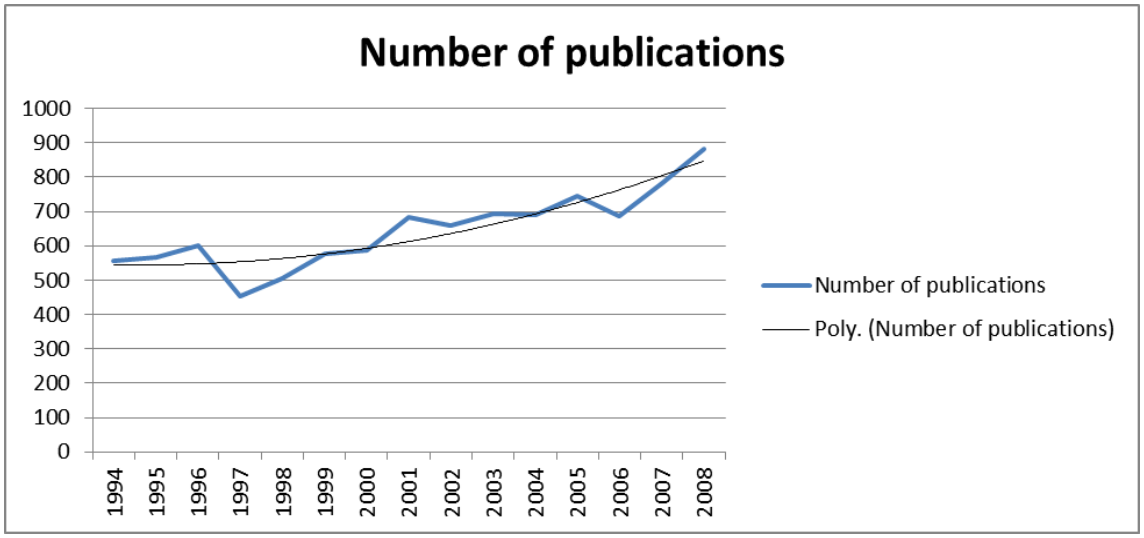

Figure 1: Total number of marine and coastal related publications per annum for the study period

Based on the information collected, the peer-reviewed system of research output remained the favoured form of publication, with 34.2% (3336) of the 9669 total number of annual publications appearing in rated journals (Figure 2). This was not only evident within the formal institutions, but also within the NGO's. NGO's when questioned in this regard, indicated that publishing in peer-reviewed journals not only gained them credibility amongst the formal tertiary institutions, but with their funders as well.

Of the ISI (Thomson Reuters) / Department of Higher Education and Training listed journals, approximately 72% (3336) of the peer-reviewed publications appear in international journals (includes African publications), with the remaining 28.8% (2843) appearing local journals.

Popular journals include:

- African Journal of Marine Science (SA J of Mar Sci)
- South African Journal of Science
- African Journal of Aquatic Sciences (SA J of Aquatic Sci)
- Ichthos
- Estuarine Coastal and Shelf Science
- African Journal of Zoology

Dieb & Gevers (2009) showed that a total of 47891 papers were published during the period 1995 – 2007, as compared to the 3336 papers in this study, i.e. marine and coastal versus the national total of all papers published by all the universities.

The publication of books or the production of book chapters, on a year on year basis remained low (Figure 2), with this form of publication only contributing 1% of the total number of publication per annum (i.e. an average of 6 books or chapters per year). Reports or grey literature contributed a significant proportion, with a steady increase in the production non-peer reviewed outputs over the 15 year period. This was linked mostly to the following:

- The increase in the need for information dissemination within the popular press
- Changes in environmental legislation (National Environmental Management Act and the Integrated Coastal Management Act), requiring the production of EIA specialist reports, Strategic Environmental Assessments, especially when new legislation was promulgated (1998 and 2006) or when large port, coastal developments or offshore mining activities required assessment.
- A steady increase in the production of management related reports associated with marine protected areas, fisheries management and in the latter year's coastal protection, policy documents and or climate change issues.

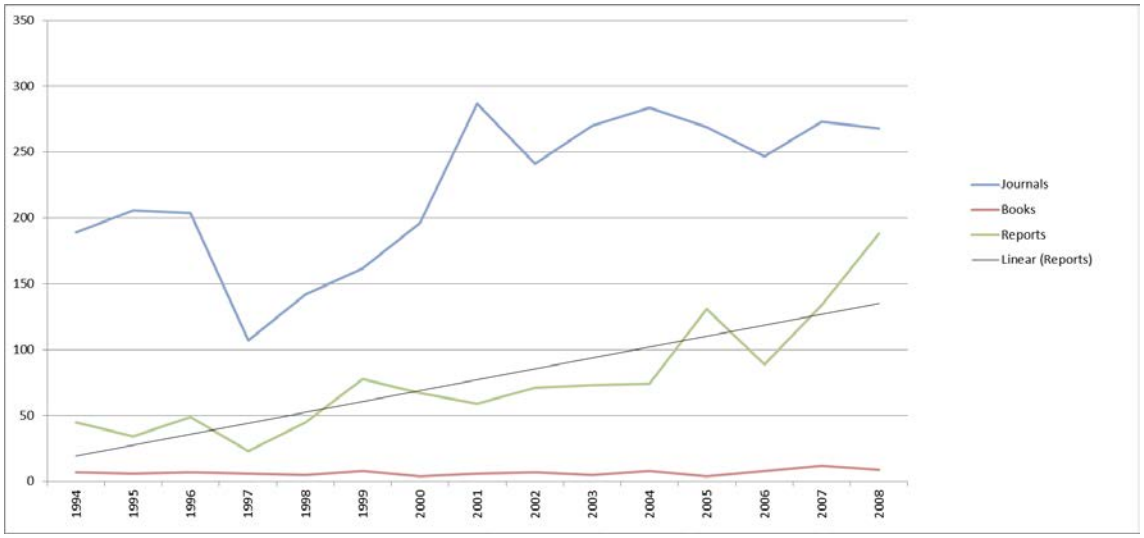

Figure 2: The annual contribution of peer-reviewed journal, books and reports to the number of publications

This was contrasted by number of publications produced by post-graduates student (Figure 3), with no real increase in the number of publications over the 15 year period. This could be attributed to number of post-graduate intake openings available, which is in turn limited by the capacity of tertiary institutions. The numbers of students accepted is limited by the supporting infrastructure (e.g. number of labs), staff capacity or the funding made available. NGO's that provided research opportunities to students to further their postgraduate studies, confirmed that they are usually inundated by applicants, which were turned down by tertiary institutions due to the intake numbers being limited.

Honours students contribute the largest proportion (37% or 3182) of publications (non-journal related publication), followed by Masters (14% or 1344) and then PhD theses (5% or 463) per annum, contributing a total of 4989 publications for the study period. However Masters and PhD students go on to produce the highest number of peer-reviewed journal publications, usually in collaboration with their supervisor. It should also be noted that Masters and PhD studies within research programmes, with long-term funding cycles go one to produce the highest number of journal publications, after their post-graduate studies have been completed. This indicates that there is a greater potential for the student to stay on within the field as opposed to a once off – 'self-funded" study, i.e. funding was obtained for that postgraduate study alone and did not form part of a greater research programme.

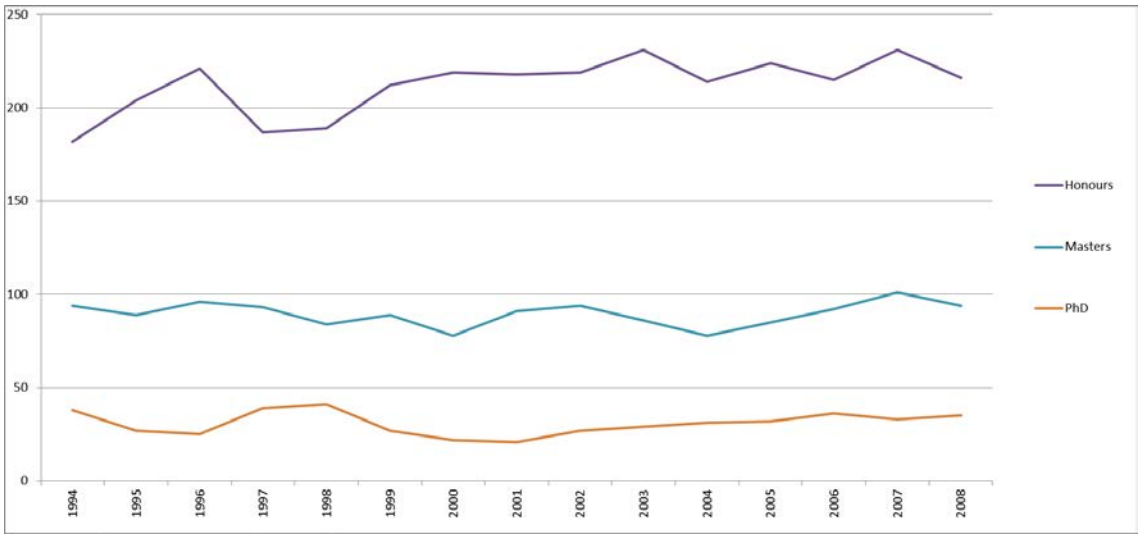

Figure 3: The number of post-graduate publications for the study period

The research demographic has remained relatively unchanged over time, with only a marginal increase in the number female lead authors (Figure 4). Lead female authors have only contributed to 8.6% or 808 of the total number of publications within the 15 year period, with significant increases only being evident from 2006. This does not however account the true picture, as based on the information collected approximately 46% of the postgraduate / staff complement within the various institutions surveyed were female. A similar scenario exists within publications produced by Historically Disadvantaged Individuals (HDI). Although Figure 5 indicates that less than 20% (678) of lead authors are HDI, with the percentage of lead authors increasing from less than 2% (15) in 1994 to close on the 20% (174) in 2008. However when considering co-authorship, historically disadvantaged individuals, aided in the publication of more than 20% of the reports for the period 2005 – 2008. Sadly, as indicated by Gibbons (2009), the main contribution of publications is at the level of conference papers or presentations and is limited within the formal publication environment. Although encouragement can be sought in the fact the increase in HDI publication rate is led by female contributions, with a steady increase at the Masters and PhD level.

The overall age of scientists within South African has always been a concern, due to the low number of publications authored by young researchers (Figure 6). Averaged results from this study indicate that approximately 59.6% (5720) of the lead authors are aged 50 years or older, while 33.9% (3294) are between 31 and 49 years old. Of the 9969 publications assessed only 6.9% (655) were produced by young scientists (< 30 years old) (Figure 6). This substantiated by ages reported by Dieb & Gevers (2009), who showed that on a national basis for all biological sciences, that the <30 year old group only account for 6.9% (655) of publications (2002 – 2004). However, only 41% of all South African biological scientist were 50 years and over in 2002 – 2004 (Dieb & Gevers, 2009).

Although accurate trends were difficult to assess, as the exact ages of authors could not be ascertained, thus generalised trends (Figure 6) indicate that the number of publications being produced by young scientists has remained relatively constant over the study period. While a slight increase in the number of publications by the 31-49 year old group was in contrast to a small decline in publications by the > 50 year old cohort. This would seem to indicate over the study period, there has been an almost 10% increase in the number of publications by the middle cohort assessed (Figure 6).

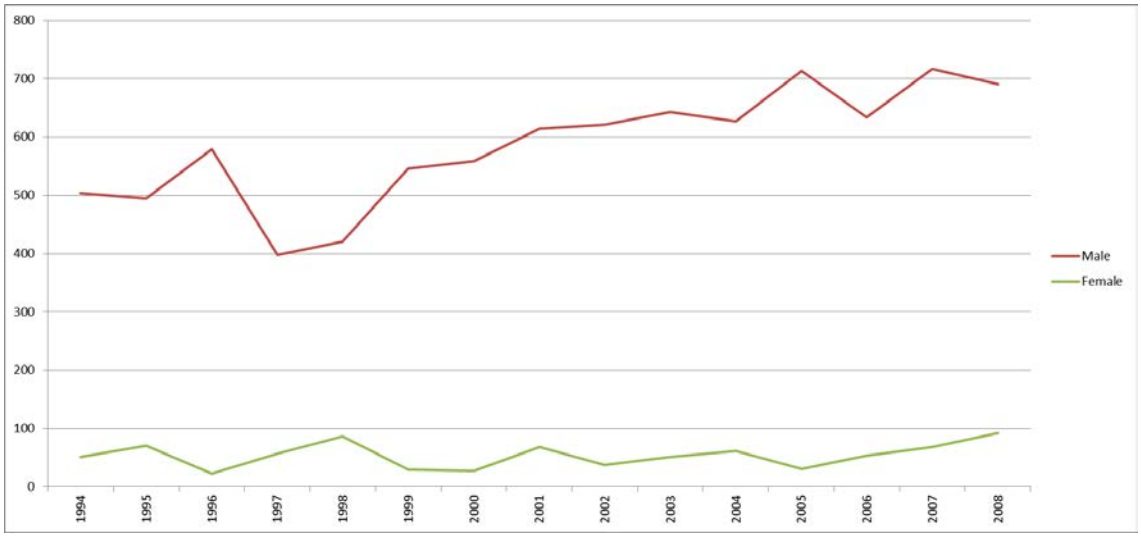

Figure 4: The total number of reports contributed by male and female lead authors

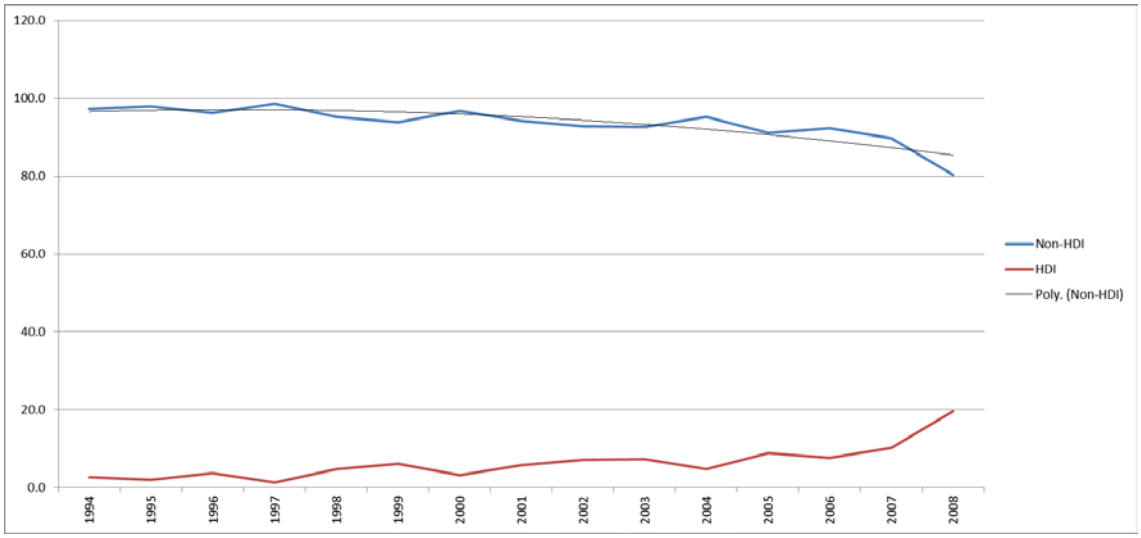

Figure 5: The percentage of Historically Disadvantaged Individuals as lead author for the study period

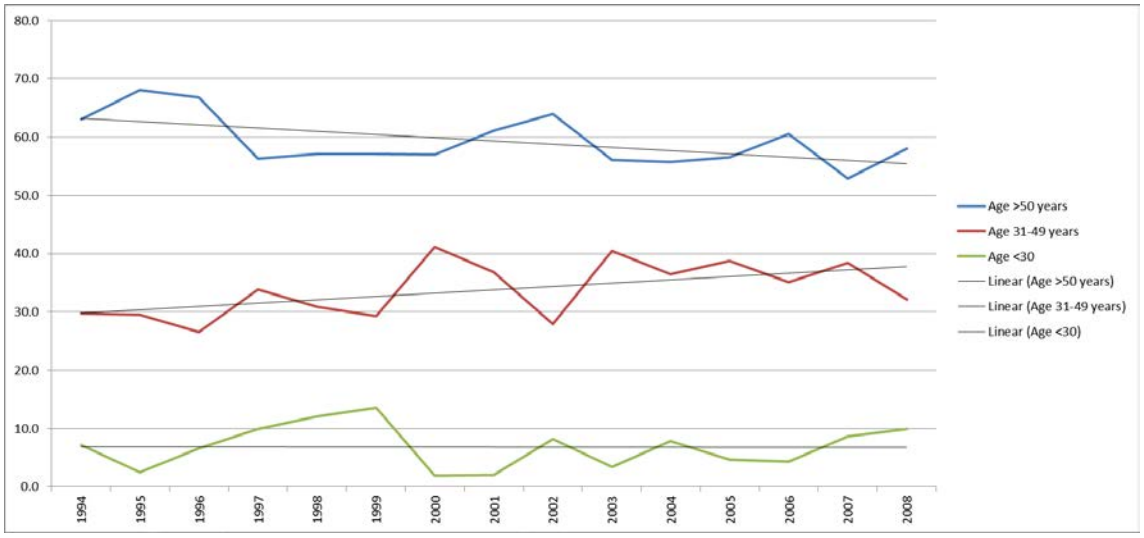

Figure 6: The percentage contribution of publications by the three age groups assessed

From a disciplinary perspective, the broad biological (53.2% or 5142) and physical (18.5% or 1757) disciplines still dominate publication rates. These are the followed by legislative / management related reports (13.1% or 1306) and engineering (10.9% or 1407) publications, while humanities / social sciences contribute 4.3% (417) (Figure 7). A similar scenario was show in the State of Science Report (Dieb & Gevers, 2009) for the period 1995 – 2007, where natural sciences accounted for 53.6% of the total national ISI (Thomson Reuters) output, while social sciences and humanities contributed 8 and 3% respectively.

Figure 8 indicates the summary per province of the various types of publications as a percentage. It is evident that the Western Cape, Eastern Cape and KwaZulu-Natal provinces are most often used as study locality. The Northern Cape is the least studies region, possibly due to the fact that this province has no tertiary institutions within the province. The Western Cape and KwaZulu-Natal regions showed the highest number of reports, books and scientific journals (Figure 8), as a favoured form of publication possibly due to the high number of formal institutions and groups such as Oceans & Coasts, DAFF, ORI, Natal Sharks Board and the local conservation authorities (Western Cape Nature Conservation & Ezemvelo KZN Wildlife) found within these two provinces. This trend altered with respect to formal degrees (PhD, Masters and Honours theses) as the highest numbers that were being produced were found in the Western and Eastern Cape provinces (Figure 8). Of interest was that Eastern Cape produced the highest number of Honours theses within the study period. This possibly linked to the type of course work being offered by Rhodes University. NMMU, Fort Hare and Walter Sisulu University, coupled to a direct focus on the coastal zone by these institutions, within the social as well as biological sciences, i.e. most publications are focused on coastal resource use, the large number of estuaries and the broad coastal vegetation groups within the province.

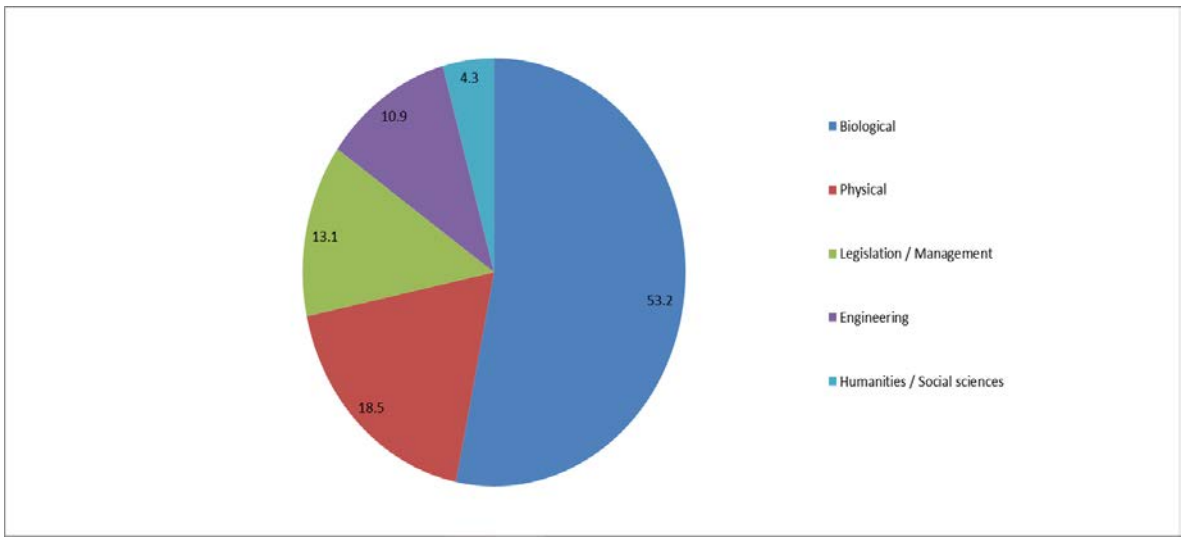

Figure 7: The percentage contribution of the 5 broad disciplines that dominated publications

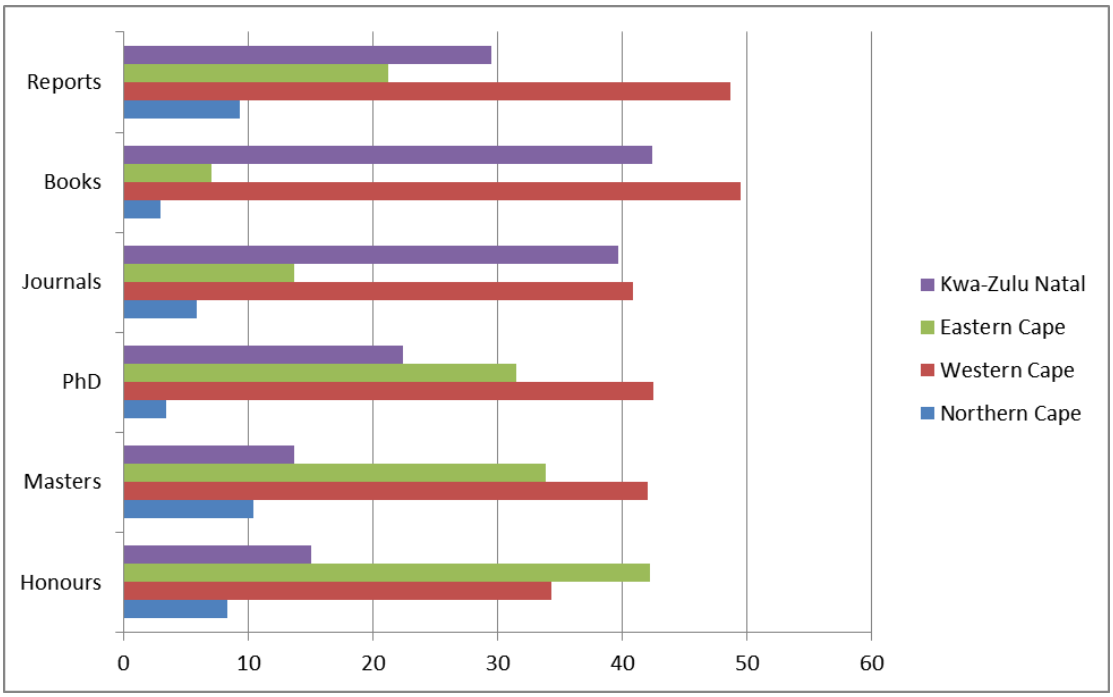

Figure 8: Percentage of publications found in each of the coastal provinces

4 Discussion and Conclusion

From this study it would seem to be evident that science within marine and coastal environments is still able to produce a high rate of publication within the study period, regardless of the obstacles faced. It was also evident that publication output is driven by research programmes vs. pursuits of an individual's interest. However although publications are being driven by large collaborative studies, the overall focus is still on trying to understand species, habitats and smaller ecosystems. Research focus was as follows:

- Biology of utilised species or their habitats (90's)
- Population trends and resource use patterns (late 90's)
- Management and social engagement around resource use (Early 2000's)
- Large ecosystem projects and adaptive monitoring techniques (observation networks) (Mid 2000's)

Although this study did not assess student numbers within the various research groups, as it was based on research output, it was evident that multi-disciplinary programmes encouraged the highest retention of authors. Younger scientists, usually authored or co-authored publications for the entire during of a long-term project or programme, i.e. published for a 2 – 4 year period, with a great deal of these remaining within the field. The retention of younger scientists was further encouraged by the establishment of the various marine and coastal observation networks, and formal marine programmes within SANParks, SANBI, WWF and the increase number of research based NGO's in the mid 2000's.

Marine and coastal science mainstreaming, with research focused on or production of generalised guidelines, user friendly field guides and marine and coastal awareness publications has also increased the number of documents being produced in recent years. These publications involved a large proportion of the scientific community as specialist authors and resulting in dissemination of important scientific information, notably around sustainable resource use and habitat conservation.

Similarly current trends with regard environmental management as a result of the National Environmental Management Act (Act No. 107 of 1998 as amended), National Water Act (Act No. 36 of 1998) and the National Environmental Management: Integrated Coastal Manage Management Act (Act No. 24 of 2008), has resulted in the production of a high number of reports either related to the implementation of the acts, research related studies, impact assessment specialist reports and guideline documents. These are largely being driven by groups such as CSIR, SANBI, environmental assessment practitioners and consulting specialists. Although these reports, may only pass through a process of internal review, this body of literature, based on science has resulted in a significant increase in the number of publications, since the promulgation of the respective laws.

Part of the scope of this study was to investigate the various sources, of funding for the various publications. Those researchers interviewed that were willing to indicate the sources and usually not the amounts of funding named the following important sources of funds:

- National Research Foundation
- Water Research Commission
- University grants or bursaries
- Corporate partnerships
- Banks loans (usually related Honours studies)

5 References

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6 Appendices

Summary results for the period 1994 - 2008

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Number of publications	555	566	602	455	506	576	586	682	659	694	689	745	687	784	883	9669
Male	504	495	579	398	420	546	559	614	621	643	627	714	634	717	691	8762
Female	51	71	23	57	86	30	27	68	38	51	62	31	53	68	92	808
Age >50 years	350	385	402	256	289	329	334	417	421	389	384	421	416	415	512	5720
Age 31-49 years	165	167	160	154	156	169	241	251	184	281	251	289	241	301	284	3294
Age <30	40	14	40	45	61	78	11	14	54	24	54	35	30	68	87	655
Non-HDI	540	554	579	449	482	541	567	642	612	643	656	679	634	704	709	8991
HDI	15	12	23	6	24	35	19	40	47	51	33	66	53	80	174	678
Honours	182	204	221	187	189	212	219	218	219	231	214	224	215	231	216	3182
Masters	94	89	96	93	84	89	78	91	94	86	78	85	92	101	94	1344
PhD	38	27	25	39	41	27	22	21	27	29	31	32	36	33	35	463
Journals	189	206	204	107	142	162	196	287	241	270	284	269	247	273	268	3336
Books	7	6	7	6	5	8	4	6	7	5	8	4	8	12	9	99
Reports	45	34	49	23	45	78	67	59	71	73	74	131	89	134	188	1144
Biological	243	304	375	251	265	269	305	375	367	392	371	401	389	412	423	5142
Physical	156	107	107	95	89	121	119	118	94	103	134	122	143	121	128	1757
Legislation / Management	89	86	57	45	43	87	61	65	74	65	74	102	84	141	233	1306
Engineering	52	57	49	41	75	76	76	72	81	98	84	86	57	76	67	1047
Humanities / Social sciences	15	12	14	23	34	23	25	52	43	36	26	34	14	34	32	417
Local Joutnal Publications	142	168	174	78	104	119	168	189	215	263	257	245	235	232	254	2843
	555	566	602	455	506	576	586	682	659	694	689	745	687	784	883	9669
	555	566	602	455	506	576	586	682	659	694	689	745	687	784	883	9669

Summary results for the period 1994 – 2008 as a percentage

%	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
Male	90.8	87.5	96.2	87.5	83.0	94.8	95.4	90.0	94.2	92.7	91.0	95.8	92.3	91.5	78.3	90.7
Female	9.2	12.5	3.8	12.5	17.0	5.2	4.6	10.0	5.8	7.3	9.0	4.2	7.7	8.5	21.7	9.3
Age >50 years	63.1	68.0	66.8	56.3	57.1	57.1	57.0	61.1	63.9	56.1	55.7	56.5	60.6	52.9	58.0	59.3
Age 31-49 years	29.7	29.5	26.6	33.8	30.8	29.3	41.1	36.8	27.9	40.5	36.4	38.8	35.1	38.4	32.2	33.8
Age <30	7.2	2.5	6.6	9.9	12.1	13.5	1.9	2.1	8.2	3.5	7.8	4.7	4.4	8.7	9.9	6.9
Non-HDI	97.3	97.9	96.2	98.7	95.3	93.9	96.8	94.1	92.9	92.7	95.2	91.1	92.3	89.8	80.3	93.6
HDI	2.7	2.1	3.8	1.3	4.7	6.1	3.2	5.9	7.1	7.3	4.8	8.9	7.7	10.2	19.7	6.4
Honours	36.1	41.2	38.2	47.0	45.0	38.8	39.2	35.5	35.3	35.9	34.1	31.4	33.9	32.2	31.3	37.0
Masters	16.9	15.7	15.9	20.4	16.6	15.5	13.3	13.3	14.3	12.4	11.3	11.4	13.4	12.9	10.6	14.3
PhD	6.8	4.8	4.2	8.6	8.1	4.7	3.8	3.1	4.1	4.2	4.5	4.3	5.2	4.2	4.0	5.0
Journals	34.1	36.4	33.9	23.5	28.1	28.1	33.4	42.1	36.6	38.9	41.2	36.1	36.0	34.8	30.4	34.2
Books	1.3	1.1	1.2	1.3	1.0	1.4	0.7	0.9	1.1	0.7	1.2	0.5	1.2	1.5	1.0	1.1
Reports	8.1	6.0	8.1	5.1	8.9	13.5	11.4	8.7	10.8	10.5	10.7	17.6	13.0	17.1	21.3	11.4
Biological	43.8	53.7	62.3	55.2	52.4	46.7	52.0	55.0	55.7	56.5	53.8	53.8	56.6	52.6	47.9	53.2
Physical	28.1	18.9	17.8	20.9	17.6	21.0	20.3	17.3	14.3	14.8	19.4	16.4	20.8	15.4	14.5	18.5
Legislation / Management	16.0	15.2	9.5	9.9	8.5	15.1	10.4	9.5	11.2	9.4	10.7	13.7	12.2	18.0	26.4	13.1
Engineering	9.4	10.1	8.1	9.0	14.8	13.2	13.0	10.6	12.3	14.1	12.2	11.5	8.3	9.7	7.6	10.9
Humanities / Social sciences	2.7	2.1	2.3	5.1	6.7	4.0	4.3	7.6	6.5	5.2	3.8	4.6	2.0	4.3	3.6	4.3
International journal publications	25.6	29.7	28.9	17.1	20.6	20.7	28.7	27.7	32.6	37.9	37.3	32.9	34.2	29.6	28.8	28.8

Summary of publications per coastal province, i.e. the province in which the study was conducted

Northern Cape	Total	%		**Eastern Cape**		%
Honours	265	8.3		Honours	1345	42.3
Masters	140	10.4		Masters	455	33.9
PhD	16	3.5		PhD	146	31.5
Journals	198	5.9		Journals	458	13.7
Books	3	3.0		Books	7	7.1
Reports	107	9.4		Reports	243	21.2
Western Cape		%		**Kwa-Zulu Natal**		%
Honours	1093	34.3		Honours	479	15.1
Masters	565	42.0		Masters	184	13.7
PhD	197	42.5		PhD	104	22.5
Journals	1365	40.9		Journals	1324	39.7
Books	49	49.5		Books	42	42.4
Reports	557	48.7		Reports	338	29.5

Summary of the number of citations reviewed per institution for the 15 year period:

University of Cape Town	10219
University of Witwatersrand	8523
University of Pretoria	6998
University of KwaZulu Natal	6670
Stellenbosch University	6150
University of the Free State	2181
Rhodes University	1963
University of Johannesburg	1562
North West University	1456
University of the Western Cape	1212
Nelson Mandela Metropolitan University	1047
TOTAL	47981