

DATA BASE DEVELOPMENT FOR COASTAL ECOSYSTEMS : A MODEL

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INTRODUCTION

Coastal areas can be regarded as the interface between three habitat media—land, air and sea. These areas contain three obvious habitats namely : (i) maritime zone—a home for many terrestrial animals and plants, (ii) sea itself, and (iii) an intertidal or littoral zone at the sea-land interface with a specialised flora and fauna. In the littoral zones—where marine sediments and soil meets—a specialised community of terrestrial halophytic plants and associated animals develop. Two of the most characteristic coastal communities of this nature are : (i) salt marshes found mainly in temperate to sub-polar climates, and (ii) mangrove swamps—of tropical to sub-tropical occurrence. The term 'mangrove' has been used to describe both an ecological group of flowering halophytic shrubs and trees (upto 30 m high) belonging to several unrelated families, genera, complete community or association of plants which fringe sheltered tropical shores. Such swamps are inhabited by a variety of terrestrial animals including insects, birds, etc. The complex root systems of plants provide suitable habitats for many marine crustaceans, fishes apart from growth of filamentous algae on the substratum giving rise to complex ecosystem. These habitats are studied by specialists from variety of basic disciplines. They collect data pertaining to their interest thereby giving rise to a large amount of information requiring careful, efficient management for future use. This information is mainly available in the form of documents like books, reports, journal articles, etc. and hence called 'documentary sources'. Students, R&D community are the main users of these sources. However, the process does not end here. The generators of such documentary information sources themselves become nondocumentary sources of information having large concern for policy makers and management personnel. Information about various institutions involved in such kind of studies, different projects apart from personnel themselves form part of the non-documentary sources of information. These exist other form of equally important information : the resources data itself. Their availability, distribution, ecology, classification, economic importance, social implications, etc., is of interest to both, researchers and policy makers. The contemporary technologies help in achieving this information in the form of data base(s) for their efficient retrieval and use. Several experiments are being carried out in this line.

This paper describes the importance of clubing all pertinent information (documentary, non-documentary sources) about any single aspect system (IIS). While emphasizing on the IIS, it also touches upon the areas of concern like hardware/software and compatibility issues. It also gives an outline of the model of an IIS developed for complex topics like 'mangrove ecosystem'.

INTEGRATED INFORMATION SYSTEMS (IIS)

Any complex, serious human activity, be it research, or management, or executing some task, requires resources such as knowledge and know-how, facilities, materials, human resources and finance. Each of this entity could be collected from specific sources as shown in Table 1.

Table 1 Requirements and availability of information

Resource entity	Source
Knowledge	Documents/Data sheets about specific geographic area
Facilities/Materials, human resources	Corporate entities : Institutions/Projects
Human resources	Specialists/Expertise profiles
Finance	Funding agencies/Project

If all these are put together in one single data base, for a query – say about a mangrove foliage and its decomposition, then the IIS should be able to retrieve not only the bibliographical citations on this topic but also an information on experts and/or institutions and projects working on it. While the principal objective behind this concept is to provide users a wide range of information as above, IIS also offers other advantages such as:

- a. Resource sharing : Multiple use of the same data and of data bases provide for better resource sharing and networking among components of the system.
- b. Standardisation : Implementation of norms and standards for information handling and thus ensuring greater compatibility among component systems and data bases. Exchange and merger of data from different data bases become easier.
- c. Co-operative efforts : Distributed data processing is facilitated enhancing the possibilities of more optimal use of computing and human as well as computer resources.

OTHER CONSIDERATIONS

HARDWARE AND SOFTWARE

Once the creation and maintenance of IIS is decided upon, one has to select appropriate hardware/software as per the requirements. The Data Base Management Softwares (DBMS) are system (Hardware) dependent. Comparatively lower investment in IBM compatible microcomputers and their increased easy use have made most of the institutions/organisations to have atleast one equipment with them. Large number of DBMS are also available in the market. However, the best known and widely advertised software packages for data management are specialised for numerical and tabulated data. The management of structured text information (such as bibliographic descriptions) demand specific consideration. The size of the length of the data cannot be predefined in the text information (e.g., length of a title or abstract). Similarly, number of occurrences of specific information (e.g., authors of research articles or number of projects in an institution) vary from record to record. The DBMS softwares developed for predetermined length of information (numeric/tabulated data) thus become useless while handling textural data. There

are few other softwares available specially for handling structured text information. The comparative evaluations of these (Besmer, *et al.*, 1987) have revealed that the CDS/ISIS (Computerized Documentation Service/Integrated Set of Information System) software used on IBM microcomputers and compatible is relatively powerful. Moreover, the licenced version of the CDS/ISIS can be had by any non-profit organisation from UNESCO (Publishers of the software) or their national distributing agencies in respective countries without any charge.

COMPATIBILITY

Distributed data processing, their sharing among components of the system and utilisation of the products need/pressurise for use of standard machinery, methodology, etc., for their compatibility. The hardware, software, structure and design used by sharing entities within the system should be compatible for easy transfer of such information among themselves. The availability of IBM microcomputers and their clones has considerably reduced the botheration about hardware compatibility issues. The use of CDS/ISIS software has also become a common place in last five years. The data stored on this software can be produced and/or converted to International standard format (ISO-2709) so that even if the entities within the system donot have 100% compatibility and the transfer is possible with little efforts. Thirdly the compatibility issues arise at deciding the structure of the data base. UNESCO - developed Common Communication Format (CCF) provides a detailed structural method for recording a number of mandatory and optional data elements in a computer readable bibliographic record for exchange purposes between two or more computer-based systems.

The proposed model of IIS takes into account these considerations. It uses CCF as a baseline for the structure, CDS/ISIS software for designing IIS on the commonly available hardware – microcomputers.

MODEL

The representation of the model is as shown below.

INTEGRATED INFORMATION SYSTEM

Inputs :	i) Documentary sources	Outputs :	i) Displays
	ii) Institute information		ii) Searches
	iii) Project information		iii) Prints
	iv) Personnel information		iv) Export

STRUCTURE

Different sources of information – Bibliographic, Institutional, Project Personnel – can be integrated. The concept of integration is based on the use of a common place (field) for diverse data elements at perceptive level but similar at conceptual level. The authors of a document, associated persons in the entries for institutions, projects, or the head of an institution, project leader and the expert himself, or abstract of a paper, descriptions of institutions, projects etc. are all conceptually similar though they differ at the perceptive level. Placement for such common data elements at similar areas (fields) can be seen in Table 2.

Table 2 Names of fields used in collecting information from different data types

Tag	Name	Len	Typ	Rep	Delimiters	DATA TYPES			
						DOCU	INST	PROJ	PERS
1	TRN	9	X			D	I	T	X
2	Document type	1	A			D			
3	Literary style	1	A			D			
4	Data type	1	A				I	T	X
8	Environmental regime	15	X			D			
9	Environment code	1	A			D			
10	Environment	5	A	R		D			
15	Bibliographic level	3	X			D			
22	Entry date	6	N			D	I	T	X
25	Entered by	4	X			D	I	T	X
40	Language	10	X	R	a	D	I	T	X
50	Physical medium	1	X			D			
51	Code for Phys Med/inte F	1	X			D			
52	Description of codes	40	X			D			
60	Intellectual form	1	X			D			
100	ISBN	20	X			D			
101	ISSN	9	P			D			
120	Document ID	30	X	R		D		T	
200	Title	320	X	R	ar	D	I	T	
201	Journal title	320	X	R	a	D			
210	Original title	320	X			D			
215	Title level 2	320	X	R	ar	D			
216	Original title level 2	320	X			D			
260	Edition	40	X			D			
300	Authors	160	X	R	r	D	I	T	X
301	Person name	100	X		td		I	T	X
302	Nationality	15	X						X
303	Date : Start/End ETC	11	X		asect		I	T	X
304	Qualifications	80	X	R					X
305	Work Experience	240	X						X
306	Visits abroad	80	X	R					X
307	Availability	80	X						X
308	Sex	6	X						X
309	Contact person	100	X	R	td		I	T	
310	Corporate body	320	X	R	lco		I		X
311	Finance Inst.	320	X	R	lco		I	T	X
320	Meeting name	240	X	R	lcd	D			
330	Affiliation	320	X	R	alc	D	I		
331	Tele Address	160	X	R	tfe		I		
332	Res. Address	320	X	R	alc				X

Table 2 (contd.)

Tag	Name	Len	Typ	Rep	Delimiters	DATA TYPES			
						DOCU	INST	PROJ	PERS
333	Inst. Code	5	X				I		
334	Associated entities	320	X	R	alc		I		
335	Equipment	240	X	R	m		I	T	
336	Services	240	X	R			I	T	
337	Collaborating Inst	320	X	R	alc		I	T	
338	Annual Publications	4	N				I		
339	Inst. Code Ref	5	X					T	X
400	Publisher	240	X	R	lc	D			
410	Manufacturer	80	X			D			

By doing so, the size of the structure of the data base, defining IIS, is reduced resulting in the efficiency at the data entry, retrieval and indexing activities. In the structure, one would notice that majority of the fields and for bibliographic information. This is due to the fact that this data structure is operational for last few years at National Institute of Oceanography (NIO) library. It is efficiently used for storage, search and retrieval of bibliographic data including housekeeping operations. It is also used for Indian bibliographic information input to Aquatic Sciences and Fisheries Abstracts (ASFA), one of the co-operative international information systems supported by FAO, IOC, UNEP, UNOALOS, etc. The publishers of ASFA have enquired about this structure in recent past for its study and possibility of its use for machine readable input by all agencies of the system in future.

DATA ENTRY OPERATIONS

One might think that having created so complex structured data base, the job of entry operators would be very difficult in searching for specific place (field) to add appropriate piece of information. But that is not true. Excellent facilities of built-in software can call specific fields for specific data type (journal article, personnel information, etc.). Such specified screens for data entry for each data type are termed as worksheets. Different worksheets developed so far with specific purpose are listed in Table 3. The last two lines of the screen display 'help' messages as an aid to the data entry operator while entering the information using these worksheets.

DISPLAY FORMATS

The data so entered can be displayed in a variety of forms (Table 4), depending upon users choice. The permutation of different data elements of the same information is possible. The formats named as MAIN, TITL, AUTH, SER are best examples of such shuffling used for printing main, title, author and series entries of catalogues cards of books respectively. The default display format (MGR), checks the kind of data type and displays information in a standard form while browsing the data base.

Table 3 Worksheets for data entry

Name of Worksheet	Used for
MGR	Default : having all fields defined Journal articles
JA	Journal articles
BK	Monographs, monographs with series, articles in monographs (conference proceeding articles), etc.
VENDO	Vendors information from whom books/ monographs are purchased
CP	Catalogue of periodical holdings
INST	Institutional information
PROJ	Project information
PERS	Personnel (experts) information

Table 4 Display/print formats

Name of Format	Displays/Prints
MGR	Default : Displays recorded information depending upon data type.
MAIN	Main entry of catalogue card for books
TITL	Title entry of catalogue card for books
AUTH	Author entry of catalogue card for books
SER	Series entry of catalogue card for books
NEWA	Main entry of book with classification numbers
CPERI	Periodical holdings
INST	Institute information
PROJ	Project information
PERS	Personnel information

SEARCH FACILITIES

CDS/ISIS has excellent facilities for indexing the data. It can index on each of the words occurring in any of the fields or even on complete contents. These indexes then provide powerful tool for searching available information in that data base. The software can even search for complex search strategies using boolean operators such as AND, OR, NOT, etc. Within this IIS, one can thus search for an integrated information on any specific aspect, i.e., retrieval from different data types – bibliographic, institutional, project or expertise at single stroke of the key or limit the output by searching on single data type alone.

SORTING/PRINTING

Searched information on any specific aspect can be sorted in a given order for subsequent printing. The print facility has options like : (i) single or multicolumn printing, (ii) page-by-page (by defining number of lines per page) printing and (iii) even in the form of a file for editing or printing using other softwares like DTP. Sample printouts of different data types are appended (Annexure I-IV).

EXPORT/IMPORT

Within a network of any system, sharing of the data bases has become a common practice. The compatibility issues discussed earlier find prime importance at such instance. The software has excellent capability of exporting/importing data to ISO-2709 format.

RESOURCES INFORMATION

While the above discussion is confined to the 'sources of information', a resources data can also be built. One such effort at international level has been noticed (Matthes and Kapetsky, 1988). Similar information can also be put on the CDS/ISIS software. The IIS on 'sources' have been tried and tested but the idea about the data base for resources still remains at conceptual level. The structure of such data base will be based on two main bearings (i) flora/fauna available in the ecosystem and (ii) physico-social conditions of a geographic area/ecosystem. Each of the genus species available/identified in one or other ecosystems will be recorded with relevant parameters such as distribution, ecology, biology, utilisation, conservation measures and management aspects, if any. The physico-social factors of a specific area where such ecosystem is available include information on aspects like : temperature, salinity, humidity, tidal action, climatic conditions, cyclones, rainfall, floods, soil/substratum type, sediment flow, etc. The social aspects may also be highlighted. Examples are industrialisation, educational/economic status of families within/surrounding that area, information from conservation point of view, etc.

These two aspects can be integrated by using flora/fauna code for specific ecosystem in geographic area as well as ecosystem code in specific geographic area having habitation of specific flora and fauna. The information once documented, can be updated after specific periodicity if such machinery exists. This would then eventually give a picture of biotic/abiotic changes in a given ecosystem over a period of time for planners and policy makers. This conceptual design needs to be tested on the data to correct the ideal concept, if any. However, it is felt that this type of IIS could act as an expert system in long run.

CONCLUSION

The concept of IIS has been tried and tested for the sources of information available for one or more types of coastal ecosystems. The model so designed is within the possibility of use in practice. The design is also suitable for network operations so that maximum information can be put-in by participating centres for sharing the same.

ACKNOWLEDGEMENTS

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REFERENCES

- Besmer, H. *et al.* (1987). Microcomputer applications for online and local information systems : a comparison of 30 software packages. Leiden : VOGIN.
- Matthes, H. and J.M. Kapetsky (1988). World-wide compendium of mangrove-associated aquatic species of economic importance. FAO Fisheries Circular No. 814. 236 p.
- Sieverts, H. *et al.* (1988). Information retrieval on a microcomputer, the evaluation of software for personnel information systems and CD-ROM products. In : Online Information 88. *Proc. of the 12th International Online Information Meeting, London: Learned Information 2* : 581-595. December 1986, Oxford.

ANNEXURE I**PRINT FORMATS****For Monographic entry**

DESHMUKH, S.V. and MAHALINGAM, R. Eds.

A global network of mangrove genetic resources centres. Project formulation workshop, January 15-19, 1991, Madras, India.

India, Madras : Cent. for Res. on Sustainable Agric. and Rural Dev. 1991 : 145 pp.

I95531 N91 21562

For Journal Article entry

00017 Wafar, S.; Untawale, A.G., Bhosle, N.B. (NIO : Bil. Oceanography Div. : Dona Paula, Goa 403 004; India) SEASONAL VARIATION IN THE HEAVY METAL CONCENTRATION OF MANGROVE FOLIAGE. *Mahasagar*, 13(3) : 1980 : 215-223.

Seasonal variation in the concentration of some heavy metals in the leaves of seven species of mangrove vegetation from Goa, revealed that maximum concentration of iron and manganese occurs during the monsoon season without any significant toxic effect on the foliage of mangroves. Other metals like copper, nickel, cobalt and lead showed somewhat uniform concentration patterns. Copper and nickel were found to be greater (119.41 µg/g) in *Avicennia officianalis*, while *Acanthus ilicifolius* showed high concentration (46.98 µg/g) of cobalt. Nickel was found to be greater in *Bruguiera gymnorrhiza* (113.66 µg/g average) and *Rhizophora mucronata* (231.06 µg/g average).

ANNEXURE II**INSTITUTE INFORMATION**

Institute Code : NIO

Institute Name : National Institute of Oceanography, Dona Paula 403 004, Goa, India.

- Tele Address : Telephone No(s) : 46253, 46254
 Telex : 0194-216 NIO IN
 Fax : 91-(0) 832-44612
 e-Mail:
- Foundation Year : 1964-03-12 'Working Language(s): En.
- Corporate Name : Council of Scientific & Industrial Research, Raffi Marg, New Delhi, India.
- Associate Entities : NIO Regional Centre, Sea shell Building, Seven Bungalows, Versova, Bombay 400 061, India.
 NIO Regional Centre, Kirlampudi Layout, Visakhapatnam 530 023, India.
- Principal Person : Dr. Desai, B.N. Director
- Other Persons : Sastry, J.S., Dr., Dy. Director
 Sen Gupta, R. Dr., Dy. Director
 Nayak, B.U., Dr., Dy. Director
 Desa, E., Dr., Dy. Director
- Contact Person : Kesava Das, V., Mr. Head, Publication & Reprography
- Subject Studied : Physical Oceanography, Chemical Oceanography, Biological Oceanography, Geological Oceanography, Ocean Engineering, Marine Instrumentation.
- Projects : Chemical & environmental studies in the seas around India;
 Sen Gupta, R.
 Biological resources of the exclusive economic zone of India;
 Parulekar, A.H.
- Description : Aimed at the studies of the brackish waters and seas in and around India.
- Available Equipment : R.V. Gaveshani; O.R.V. Sagar Kanya; Atomic Absorption Spectrometer, model 4. Perkin-Elmar.
- Services offered : Consultancy services pertaining to the seas around India and abroad.
- Source of Finance : CSIR, New Delhi, India
 DOD, New Delhi, India
- Annual Budget : 7,26,00,000.00
- Annual Publications : 150

ANNEXURE III

PROJECT INFORMATION

- Title of the Project : Environmental impact assessment on mangrove ecosystem along the West coast of India.
- Institute Affiliation : National Institute of Oceanography Dona Paula 403 004, Goa, India.
 Telephone : 46253, 46254
 Telex : 0194-216 NIO IN

Fax : 91-(0) 832 - 44612
 e-Mail:

Working Language : English
 Principal Person : Untawale, A.G. (Dr.) Asst. Director
 Other Persons : Wafar, S., Jagtap, T.G.
 Subjects Studied : Mangrove fauna, Mangrove flora, Effects of pollutants
 ASFA Code : 08504, 08482
 Description : Effect of wastes discharged by the industries along the West coast of India on mangrove flora and fauna is surveyed. The control measures are being suggested.
 Sponsorer : Department of Ocean Development, New Delhi, India
 Collaborating Institution(s) : M.S. Swaminathan Research Foundation, Madras
 Shivaji University, Kolhapur
 Infrastructure & Equipment : Microcomputer IBM PC386, HCL
 Services Offered : Development of Mangrove Ecosystem along West coast.
 Budgetory allocations : Rs.4,00,000.00
 Contact Number : abcd1234
 Dates :
 Proposal : 1991-01-14 Approval : 1991-05-10
 Start : 1991-06-01 Expected Completion : 1993-01-30

ANNEXURE IV**PERSONNEL INFORMATION**

Personal Information About : Untawale, Arvind G., Dr.
 Sr.Asst.Director

Office Address : National Institute of Oceanography
 Dona Paula 403 004, Goa, India
 Telephone : 46253, 46254
 Fax : 91-(0) 832-44612
 Telex : 0194-216 NIO IN
 E-Mail

Residential Address : Sagar Co-operative Housing Society, Dona Paula 403 004 Goa,
 India

Nationality : Indian
 Birth Date : 1940-06-24
 Language(s) : Working : En.
 Other Known : Marathi, Hindi

Qualifications : M.Sc. (Botany),
 Nagpur University (1966)
 Ph.D. (Plant Embryology),
 Nagpur University, (1972)

- Work Experience** : Scientist, NIO, Dona Paula, Goa, (1974)
- Current Subject Interest** : Resource Evaluation, Mangroves, Biodiversity, Marine Conservation
- Present Activities and Plans** : Ecology of different mangroves from West coast of India. Phytogeographical distribution of mangrove species. Seasonal variation in the major metabolites and trace metals in mangrove foliage. Biochemical changes of mangrove foliage during growth and decomposition. Effects of soils on mangrove seedlings. Continuing studies on mangroves related resources, their exploitation and management.
- Co-operative programmes with** : CSMCRI, Bhavnagar, India
- Visits Abroad** : Meetings: The Philippines (1985), expert, Male (1990); Consultant, Maldives (1991), Papua New Guinea, Cameroon, Senegal.
- Activities Financed by** : NIO, Dona Paula, Goa (India), DST, New Delhi (India), Dept. of Environment, New Delhi (India), UNESCO regional office, New Delhi (India), WWF, Indian Chapter, India.
- Availability** : Enquire for periodicity