Short Communication

Interactive digital database on coral biodiversity of Andaman – an ICT initiative to digitize and manage an ecologically sensitive resource due to climate change

M. BALAKRISHNAN*[1], GRINSON-GEORGE[2], P. KRISHNAN[2], M. KALIYAMOORTHY[2], TITUS-IMMANUEL[2] and S.K. SOAM[3]

[1]*Bioinformatics Unit*
[2]*Division of Fisheries Science, Central Agricultural Research institute, Port Blair-744 101*
[3]*ICM Division, NAARM, Hyderabad-500 030, Andhra Pradesh*
E-mail:mbkrishnan@hotmail.com

The Andaman and Nicobar Islands (ANI) comprise of a chain of 572 major islands in addition to a number of islets and rock outcrops in the Bay of Bengal lying between latitudes 06° and 14° N and longitudes 92° and 94° E. The Andaman Island and Nicobar Islands are distinctly separated by the wide 10° channel which is about l50 km wide and 400 fathoms deep (Ramakrishna *et. al.,* 2010). The total land area is about 8249 km^2 with a coastline of 1962 km.

These islands have a tropical maritime climate and endowed with both the southwest and northeast monsoons. The pristine nature of the waters around these islands along with the tropical climate favours the growth and survival of corals. Corals are marine organisms of the class *Anthozoa* of phylum *Cnidaria* typically living in compact colonies of many identical individual "polyps". The group includes the important reef builders that inhabit tropical oceans, which secrete calcium carbonate to form a hard skeleton (Wallace, 1999). A coral "head," which appears to be a single organism, is a colony of myriad genetically identical polyps (Steffen *et. al.,* 2009). Each polyp is typically only a few millimeters in diameter (Veron 2000). Over many generations the colony secretes a skeleton that is characteristic of the species. Individual heads or colonies grow by asexual reproduction of individual polyps (Vaughan and Wells 1943; Wells 1956; Cairns 1988; Veron 2000).

Corals also breed sexually by spawning. Polyps of the same species release gametes simultaneously over a period of one to several nights around a full moon (Wallace 1985; Harrison, 2011). Although corals can catch small fish and animals such as plankton using stinging cells on their tentacles, most corals obtain most of their energy and nutrients from photosynthetic unicellular algae called zooxanthellae (Lewis and Price, 1975). Such corals require sunlight and grow in clear, shallow water, typically at depths shallower than 10 m. Corals are the major contributors to the physical structure of coral reefs that develop in tropical and subtropical waters. Other corals that do not have associated algae can live in much deeper water, like the cold-water genus *Lophelia* surviving as deep as 3,000 m (Witzany and Mad, 2009).

Corals are facing extreme challenges owing to climate change in the last decade with massive bleaching of corals during the years 1998, 2002, 2005 and 2010 (Krishnan, *et. al.,* 2011, 2012). It is imperative to support initiatives that focus on conservation and protection of coral reefs. The present paper is a compilation of various survey data carried out in Andaman in the form of a database. This database will serve as a ready reckoner for a reef manager to have immediate reference on this diminishing resource.

Data Collection

Extensive surveys were conducted in North Bay, Jolly buoy and various places of ANI, to get primary data about the coral reefs. The information collected was crosschecked and authenticated. The abundance and diversity of corals in these sites were noted during these surveys and details of individual coral species such as size, colour, habitat, growth form etc. were also documented. Secondary data from previous publications by reputed institutes around India such as Zoological Survey of India were compiled and included in the database.

Database Designing

The database was designed in Ms SQL Server (Delaney, 2006) at the backend and the interface was created using ASP. Net (van Otegem, 2007; Walther, 2007). The webpage interface was interactive and was designed to be user friendly for easy accessibility to desired data. The database was updated with latest information collected through recent surveys and also contains other data from earlier publications of Zoological Survey of India. Entity relationship (ER) diagram for the data base is as shown in Fig.1.

The developed coral resource database contains precise information on coral diversity of selected sites in the ANI. It
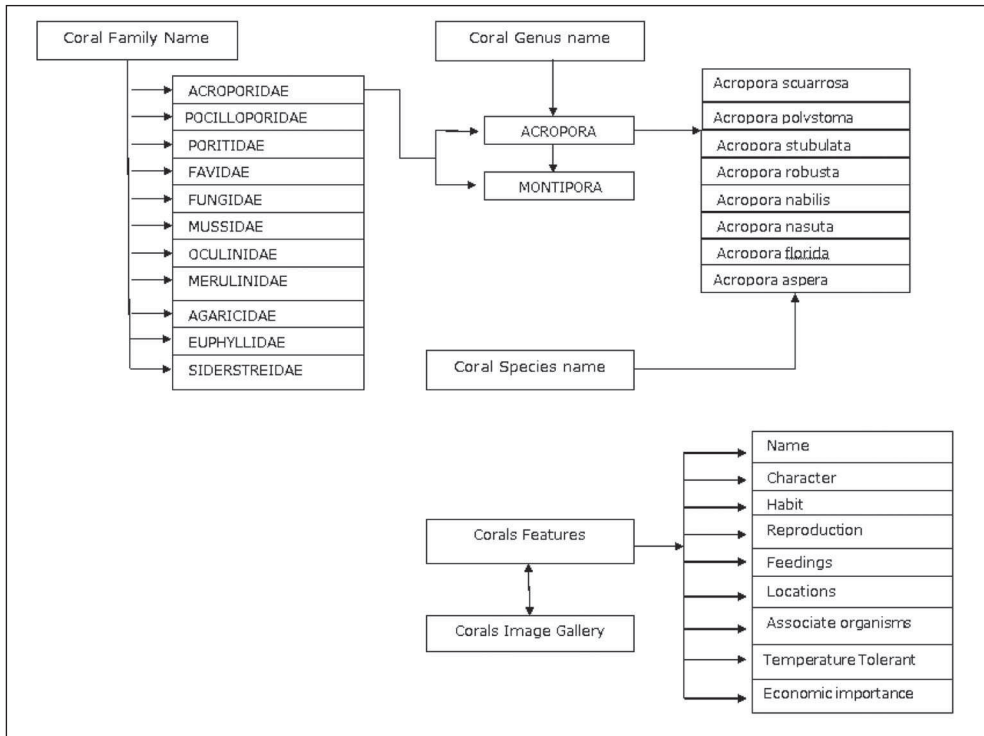
Fig 1 : Data Flow Diagram

Fig 2 : Home page of Coral resources

also comprises general information on corals of ANI, with details of individual species such as scientific name (binomial nomenclature), colour, similar species, habitat and description (Fig. 2,3). Once logged on, the user will get access to the entire database with different categories of coral resources based on their family and then genus. Each of these categories comprises of links to coral belonging to each category, which will take the user to a page where precise data on individual coral species is furnished. Under the field of data entry, sub-fields were created to add, modify, delete and view corals through which, the above-said operation could be made.
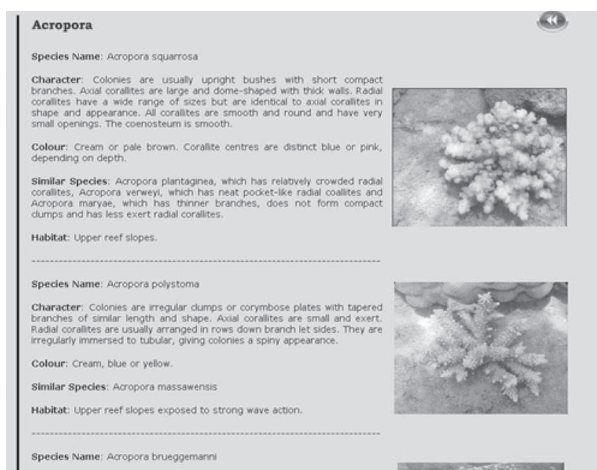

Fig 3 : Database page of corals resources

Our mandatory online web address: http://cari.res.in/Sub_DIC/Coral/Home.asp. To access the database one needs to login to the website. The administrator on request for access will provide the username and password.

The database has information on latest island-wise coral transect surveys and other relevant secondary data. Information on 110 species of corals and 23 species of sponges were collected and entered in the database along with the extreme events faced by the reefs *viz.,* tsunami, elevation of sea surface temperature, storm surge. Aggregate reef health data assessed based on the percentage abundance of live corals is also provided.

This repository can contribute in the conservation and protection of coral resources by providing information on the vulnerability of reefs in the island ecosystem and increasing awareness on the need for conservation. It is needless to state that coral resources play an essential role in the ecological sustainability of the islands. With major drug research having a pivotal role in bio-prospecting of drugs from the sea, the coral database is an information window for researchers working on organisms with drug potential from reef habitats. When compared to Peninsular India, there is a higher diversity of corals in these islands. This database provides a common user-friendly forum for accessing information with regard to coral reefs of ANI. This database would be updated on a regular basis, so that it could provide status about the corals resources, which could be useful to scientists, research scholars, pharmacy companies and nature enthusiasts. The effect of mass bleaching events on coral and associated organisms resulting in changes in the community structure have been documented and both pre and post bleaching scenario is known. The database serves as a decision support tool for management of reefs that have suffered from the recent bleaching event in 2010.

REFERENCES

Cairns, S.D. (1988) Asexual reproduction in solitary scleractinia. In: "Proceedings of the 6th international coral reef symposium, vol 2, Townsville". Pp. 641–646.

Delaney, K. (2006). Inside Microsoft SQL Server 2005: The Storage Engine, Microsoft Press, Redmond, Washington Pp 400.

Harrison, P.L. (2011) Sexual Reproduction of Scleractinian Corals. In: "Coral Reefs: An Ecosystem in Transition". (Eds. Z. Dubinsky and N. Stambler) pp. 59-85. (Springer   Science+Business Media B.V).

Krishnan, P., Dam Roy, S., Grinson-George, Anand, A., Murugesan, S., Kaliyamoorthy, M., Vikas, N and Soundararajan, R. (2011). Elevated Sea Surface Temperature during 2010 induces mass bleaching of corals in Andaman. *Curr. Sci.,* 100 (1): 1800-1804.

Krishnan, P., Grinson-George, Vikas, N., Titus-Immanuel, Goutham-Bharathi, M.P., Anand, A., Kumar, K.V. and Kumar, S.S. (2012). Tropical storm off Myanmar coast sweeps reefs in Ritchie's Archipelago, Andaman. *Environ. Monit. Assess.* DOI 10.1007/s10661-012-2948-7.

Lewis, J.B. and Price W.S. (1975) Feeding mechanisms and feeding strategies of Atlantic reef corals. *J. Zool.* 176(4): 527-544.

Ramakrishna, Raghunathan, C. and Sivaperuman, C. (2010) Biodiversity of Andaman and Nicobar Islands – An overview. In: "Recent trends in Biodiversity of Andaman and Nicobar Islands". (Eds. Ramakrishna, C. Raghunathan and C. Sivaperuman). pp. 1-42. (Published by the Director, Zoologiocal Survey of India, Kolkata).

Steffen, W., Burbidge, A.A., Hughes, L., Kitching, R., Lindenmayer, D., Musgrave W., Smith, M.S. and Werner, P.A. (2009) Australia's Biodiversity and Climate Change. (CSIRO Publishing) pp. 248

Van-Otegem M. (2007). Interview with Scott Guthrie, creator of ASP.NET. http://www.vanotegem.nl/PermaLink, guid, d9826145408cafb9893979d7e6a19121-8.aspx.

Vaughan, T.W. and Wells, J.W. (1943) Revision of the suborders, families and genera of the Scleractinia. *Geol. Soc. Am. Spec. Pap.* 44: 363.

Veron, J.E.N. (2000) Corals of the world. Vol 1-3. (Eds. M. Stafford-Smith) pp. 1382. (Australian Institute of Marine Science, Townsville, Australia).

Wallace, C.C. (1985) Reproduction, recruitment and fragmentation in nine sympatric species of the coral genus Acropora. *Mar Biol.* 88:217–233.

Wallace, C.C. (1999) Staghorn corals of the World: a revision of the coral genus Acropora. CSIRO, Collingwood pp. 438.

Walther, S. (2007). ASP.NET 3.5 Unleashed, Sams Publishing, USA Pp. 1920.

Wells, J.W. (1956) Scleractinia. In: "Treatise on invertebrate palaeontology. Pt. F. Coelenterata". (Ed. R.C. Moore) pp. 328–444. (Geological Society of America, University of Kansas Press, Lawrence)

Witzany, G and Mad, L.P. (2009). Biocommunication of corals. *Int. J. Integrative Biol.* 5(3): 152–163.