Annual report -- NOPP – January 2001 for

BIOGEOINFORMATICS OF HEXACORALLIA (CORALS, SEA ANEMONES, AND THEIR ALLIES): INTERFACING GEOSPATIAL, TAXONOMIC, AND ENVIRONMENTAL DATA FOR A GROUP OF MARINE INVERTEBRATES (funded by NSF as OCE 0003970)

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WEBSITE www.kgs.ukans.edu/Hexacoral/

OBJECTIVES To link biogeographic information across spatial scales, greatly augmenting the minimal biogeographic data available for most benthic marine invertebrates; to permit formulation and testing of biogeography and biodiversity models; and to support forecasting and hindcasting of distribution changes due to environmental alteration. To accomplish these goals, we will focus on hexacorals, members of phylum Cnidaria that include sea anemones and reef-forming corals. Specifically, we will:
        1) Create a taxonomic database to all species except Antipatharia (black corals); these belong to orders Corallimorpharia and Actiniaria (sea anemones; already compiled by Fautin), Ceriantharia (tube anemones), Scleractinia ("stony" or "true" corals), and Zoanthinaria (zoanthids). Specimen-based, it will contain three-dimensional distribution data (including geospatial precision of each record) and bibliographic reference to the description of each species.
        2) Develop an application to permit retrieval of data by all synonyms of a species, flagging taxonomic and nomenclatural problems.
        3) Allow interaction of this database with physicochemical and ecological databases important to marine biogeography. The core databases will be those assembled and linked as part of the UNEP/GEF-funded program within the LOICZ (IGBP) Typology effort (www.nioz.nl/loicz).
        4) Develop and adapt tools to allow interactive analyses of the biological and environmental data, including by visualization on map displays.

PERSONNEL
        Individuals
Adorian Ardelean, University of Kansas, USA – developing the synonymy tool
Stephen D. Cairns, Smithsonian Institution, USA – providing data for Scleractinia
Laura David, Bits & Parity, Manila, Philippines – entering data for Scleractinia
Tina Molodtsova, Shirshov Institute of Oceanology, Russia – providing data for Ceriantharia
John Ryland, University of Wales, UK – providing data for Zoanthinaria
J. E. N. Veron, Australian Institute of Marine Science, Australia – providing data for Scleractinia
        Institutions
LOICZ (IGBP), Netherlands
ICLARM, Malaysia
NCRI (Nova University), Florida, USA
NOAA, USA

ACCOMPLISHMENTS 1 September 2000 – 10 January 2001

Environmental database and analytical tool development:

In cooperation with, the partner project LOICZ (Land-Ocean Interactions in the Coastal Zone; IGBP), the world ocean and coastal zone were gridded into 0.5^{o} cells to provide a geographical basis for database design. This resolution is the most realistically useful compromise between coastal and open-ocean environments, and between desired resolution and the available data and methods. Of 259,200 half-degree cells on the earth's surface, 49,683 are "coastal zone" cells, which extend about one degree seaward and landward of the shoreline. The remaining oceanic cells (about 120,000) are included to provide complete coverage for the OBIS program. Distribution of cells in relation to the coastlines is shown on maps at water.kgs.ukans.edu:8888/public/Typpages/typcells_1.htm.

The database currently contains about 70 environmental variables selected for expected uses, drawn from publicly available global coverages, and adapted to format requirements; they include location, and atmospheric, oceanic, geomorphic, population, and terrestrial variables (the latter two are relevant to assessment of marine impacts but not to the ocean itself). In addition to the data provided by modern technology, historical data will be added (where available) in the form of measurements such as bottom temperature and substratum type for sites where specimens were collected. The structure also serves the needs of other partner projects and will:

> classify coastal and marine environments in a conceptually useful fashion;
> permit integration and consistent analysis of available global data sets dealing with land, sea, air, and human dimension variables;
> operate at a scale of resolution useful for the data and applications envisioned; and
> provide a manageable number of data points for analysis and global upscaling or extrapolation.

For internet use, a front end for the database has been developed at www.kgs.ukans.edu/Hexacoral/index.html. This provides access to the component databases and their walkthrough pages. Although the geospatial linkage of the biogeographic and taxonomic databases to the environmental variables will be the focus of attention after all the taxonomic data are entered, substantial progress has also been made in development and incorporation of the LoiczView geospatial clustering tool. The database and LoiczView sites are password-protected during development. A general "access to information" presentation for the database and clustering tool, as well as image-based tutorials, are accessible at www.kgs.ukans.edu/Hexacoral/Workshops/jump.html; legitimate users can request passwords from the Principal Investigators.

Taxonomic database and analytical tool development:

An Access database (biocomplexity.nhm.ukans.edu/anemones/images/Version.html) containing information on sea anemones was modified in Oracle to accommodate growing demands on it. The Oracle database allows contribution of data from multiple collaborators simultaneously. Current NSF funding to Fautin under the PEET program (Partnerships to Enhance Expertise in Taxonomy) has permitted adding all uses of names of sea anemones to those from the original descriptions, which were already in the database. Collaborators Cairns, Molodtsova, and Ryland, along with Hazel Loaring, student of Ryland, and three interested others, attended a workshop at the University of Kansas (KU) during the first week of November to learn the database and provide feedback to Keith Hunsinger, a PEET-supported student who is the Systems Administrator for the project. Molodtsova remained through November to add all data on adult cerianthids; she will visit KU next August to add data for larvae. Ryland and Loaring should soon complete entering zoanthid names and references to the database. During the latter half of December, Laura David was at KU to learn functionalities of the system for addition of data on scleractinian corals.

Ardelean has finalized the synonymies application, Syngraph, thanks to input from collaborators during their visits to KU. Syngraph was alluded to in the article by Fautin in the October 2000 issue of "Oceanography" that was devoted to OBIS -- Electronic atlas of sea anemones: an OBIS pilot project. At the annual meeting of the Society of Integrative and Comparative Biology (4-7 January, Chicago), Ardelean, Fautin, and Hunsinger presented a poster about it. A manuscript describing Syngraph is nearly ready for submission. Help files, image-based tutorial, and download pages for Syngraph are available at web.nhm.ukans.edu/inverts/syngraph/index.htm.

As part of an atlas and gazetteer that will enhance the geographical portion of the database, Hunsinger is developing a method for expressing precision of locality data. The issue was discussed at the OBIS meeting in Rhode Island in September. A convention will soon be arrived at that is agreeable at least to Census of Marine Life projects FishBase and CephBase, in addition to our hexacoral project.

Database implementation

Both components of the hexacoral database are running on the Oracle server at the Kansas Geological Survey. Queries are being designed in ColdFusion by Girmay Misgna. Portable versions have been extracted into Microsoft Access (and into an Oracle version running on a laptop) to permit testing and application at remote locations, and in preparation for distributable free-standing (CD-ROM) versions for use at sites wishing to adapt and apply the concepts and tools. These versions are currently in test and development in a series of UNEP-GEF sponsored LOICZ workshops. To provide feedback opportunities for the user community, e-mail links are provided on the websites, and a discussion board has been established at www.kgs.ukans.edu/Hexacoral/discutions.html.