

**Final Report for Period:** 09/2000 - 08/2003**Submitted on:** 11/07/2003**Principal Investigator:** Fautin, Daphne G.**Award ID:** 0003970**Organization:** U of Kansas Ctr for Res In**Title:**

Biogeoinformatics of Hexacorallia (Corals, Sea Anemones, and Their Allies): Interfacing Geospatial, Taxonomic, and Environmental Data for a Group of Marine Invertebrates

**Project Participants****Senior Personnel****Name:** Fautin, Daphne**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Buddemeier, Robert**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Molodtsova, Tina**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Tina is the world authority on cerianthids; she is employed by the Shirshov Institute of Oceanography in Moscow. She spent two months in our laboratory entering data into the database on these animals. She participated in both workshops related to this project.

**Name:** Ryland, John**Worked for more than 160 Hours:** Yes**Contribution to Project:**

A retired Professor, University of Wales, Swansea, John is the world authority on zoanthids. He participated in both workshops associated with this grant and supervised his graduate student Hazel Loring in entering data on zoanthids into the database.

**Name:** Cairns, Stephen**Worked for more than 160 Hours:** No**Contribution to Project:**

A curator at the US National Museum of Natural History, Steve was one of two consultants on scleractinian corals. He obtained the literature to be entered for non-reef-forming corals and attended the first workshop associated with the project.

**Name:** Veron, John**Worked for more than 160 Hours:** No**Contribution to Project:**

'Charlie,' as he is called, is employed by the Australian Institute of Marine Science. He contributed publications and electronic files containing data that were entered into the database for reef-forming corals, on which is an authority.

**Name:** David, Laura**Worked for more than 160 Hours:** No**Contribution to Project:**

Laura is associated with the Institute for Marine Studies in the Philippines. In her consulting business, she supervised entry of data on corals into the database.

**Post-doc****Name:** Daly, Marymegan**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Meg is supported on a post-doctoral fellowship funded by my NSF PEET grant. She collaborated with people supported on this grant and contributed to some of its products.

### Graduate Student

**Name:** Ardelean, Adorian

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Adorian had been supported on my NSF PEET grant at the beginning of his graduate work and completed his Ph.D. supported on this grant, contributing to many aspects of the research.

**Name:** Iqbal, Asif

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Asif is completing his master's degree in computer science. He developed search tools and web interfaces for them to intersect biological and environmental data.

**Name:** Guinotte, John

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

John is completing his Ph.D. in Australia, and was supported part-time on this grant in the interests of enhancing the GIS capabilities of the system, which provided data and tools for his Ph.D. research as well.

**Name:** Sandhei, Peder

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Peder was supported part time on this grant while a master's student and contributed to development of tools.

**Name:** McLaughlin, Casey

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Casey was supported part time on the grant while a master's student, and contributed to development of tools

**Name:** Hunsinger, Keith

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Keith worked on GIS issues while paid as systems administrator on my other NSF grant; he had previously been funded to do research on an REU supplement to my other NSF grant

**Name:** Loring, Hazel

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Hazel was the student of John Ryland, a collaborator on this project, doing a master's degree at the University of Wales, Swansea; some of the funds for the subcontract of Ryland was for her support. She attended the first workshop associated with this project and visited the laboratory one other time to consult on data entry and analysis.

**Name:** Shankaran, Ganesh

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Ganesh is supported on my other NSF grant. He has contributed a great deal to this one by designing data-entry forms and geo-referencing localities.

### Undergraduate Student

**Name:** Schulze, Ryan

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Ryan initially did data-entry in support of this grant; he then supported him on an REU supplement to my NSF PEET grant. One aspect of his project was to add records on black corals to the database. It was the only group of hexacorals not included in this grant because the authority on it declined to participate. But another person contributed the necessary data, and Ryan added them.

**Name:** Atwater, Dan

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dan was supported on an REU supplement to my other NSF grant to develop a module for the database into which common names could be entered.

**Technician, Programmer**

**Name:** Bartley, Jeremy

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Jeremy began to work on this project at its outset funded on an REU supplement to another NSF grant. He is now employed by the Kansas Geological Survey and continues to be involved in GIS aspects of the hexacorallia project. He developed the OBIS mapper, and has been involved in several publications.

**Name:** Misgna, Girmay

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Girmay was supported on this grant to develop searches and web interfaces.

**Other Participant****Research Experience for Undergraduates****Organizational Partners****Land-Ocean Interaction in the Coastal Zo**

This is a component of the IGBP; its efforts were built on by our project and vice-versa.

**Other Collaborators or Contacts**

The databases and some of the tools built as a result of this project contribute to the Ocean Biogeographic Information System (OBIS: [www.iobis.org](http://www.iobis.org)), which is a component of the Census of Marine Life. OBIS is an Associate Partner of the Global Biodiversity Information Facility (GBIF: [www.gbif.org](http://www.gbif.org)).

**Activities and Findings****Research and Education Activities:**

The major activities have been to enhance the content of a biological and an environmental database, and to create interactivity between them. The resulting website 'Biogeoinformatics of Hexacorals' is at <http://www.kgs.ku.edu/Hexacoral/>. Some print publications have been created using products of these data and tools. We have made presentations on the databases and their capabilities and contents. As well as locally, the tools and data are served as part of the Ocean Biogeographic Information System (OBIS), which was the major objective of the grant. Using funds from this grant, in November 2000 we organized a workshop of data providers to discuss the philosophy of the project and train them in data entry. A follow-up workshop, demonstrating the product and making plans to extend the database to other taxa, was held with other funds in July 2003.

A major education activity has been training students. Two undergraduates have done research associated with this grant, but others have learned from entering data into the databases. At least five master's students, two Ph.D. students, and a post-doc have been directly involved in the project, and others have been indirectly involved in a variety of ways. One of the undergraduate projects was to build a module for the

database using common names for species, so now a user can gain access by either common or scientific name; this has enhanced use of the database by divers, aquarists, and other hobbyists.

### **Findings:**

Since this was a project to develop databases, electronic tools, and a website, the findings extend well beyond our activities to those of the people who make use of these resources. The sorts of applications are mapping distributions of organisms and environments to understand tolerances of organisms and potentials for extinction or invasion. Some of the tools have been developed from or extended to applications such as analysis of freshwater resources in the mid-continent, or run-off into oceans.

### **Training and Development:**

Seven graduate students were supported on this grant and other students were involved at both undergraduate and graduate levels. All of them made presentations at professional meetings and most of them have published papers resulting from this project in the peer-reviewed literature.

### **Outreach Activities:**

The major outreach activity we have undertaken for the public is to have common names become part of the database. Our data are served through OBIS, the Ocean Biogeographical Information System, which has a strong outreach component and thereby exposes our efforts to a large audience.

## **Journal Publications**

J. M. Guinotte , R. W. Buddemeier and J. A. Kleypas, "Future Coral Reef Habitat Marginality: Temporal and Spatial Effects of Climate Change in the Pacific Basin", *Coral Reefs*, p. , vol. 22, (2003). published online October 2003 (DOI: 10.1007/s00338-003-0331-4) -

Daphne G. Fautin, "Reproduction of Cnidaria", *Canadian Journal of Zoology*, p. 1735, vol. 80, (2002). Published

M. Daly, A. Ardelean, H.-R. Cha, A. C. Campbell, and D. G. Fautin, "A new species, *Adamsia* \*\*\* (Cnidaria: Anthozoa: Actiniaria), from the Gulf of Mexico and a discussion of the taxonomy of carcinoecium-forming sea anemones", *Bulletin of Marine Science*, p. , vol. , ( ). Accepted

M. Daly, D. G. Fautin, and V. C. Cappola, "Systematics of Zoantharia", *Zoological Journal of the Linnean Society*, p. , vol. , ( ). Accepted

S. V. Smith, D. P. Swaney, L. Talaue-McManus, J. D. Bartley, P. T. Sandhei, C. J. McLaughlin, V. C. Dupra, C. J. Crossland, R. W. Buddemeier, B. A. Maxwell, and F. Wulff, "Humans, hydrology, and the distribution of inorganic nutrient loading to the ocean", *BioScience*, p. 235, vol. 53, (2003). Published

A. Ardelean, "Morphological and color variability of the sea anemone *\*Actinodendron arboreum\** (Cnidaria: Anthozoa: Actinodendridae)", *Hydrobiologia*, p. , vol. , (2004). Accepted

A. Ardelean, "Variability in nematocysts from a single individual of *\*Actinodendron arboreum\** (Cnidaria: Anthozoa: Actinodendridae)", *Hydrobiologia*, p. , vol. , (2004). Accepted

H.-R. Cha, R. W. Buddemeier, D. G. Fautin, and P. Sandhei, "Distribution of sea anemones in Korea analyzed by environmental clustering", *Hydrobiologia*, p. , vol. , (2004). Accepted

R. W. Buddemeier and D. G. Fautin, "Large-scale dynamics: the state of the science, the state of the reefs, and the research issues", *Coral Reefs*, p. 1, vol. 21, (2002). Published

R. W. Buddemeier and D. G. Fautin, "Editorial: Social behavior in a research society", *Coral Reefs*, p. 9, vol. 21, (2002). Published

D. G. Fautin and J. C. den Hartog, "An unusual sea anemone from slope depths of the tropical west Pacific: range extension and redescription of *Isactinernus quadrilobatus* Carlgren, 1918 (Cnidaria: Actiniaria: Actinernidae)", *Zoologische Verhandelingen*, p. , vol. , ( ). Accepted

A. Ardelean, "Reinterpretation of some tentacular structures in sea anemones (Cnidaria: Actiniaria)", *Zoologische Verhandelingen*, p. , vol. , ( ). Accepted

- A. Ardelean, "A new species of the sea anemone *Megalactis* (Anthozoa: Actiniaria) from Taiwan and designation of a neotype for the type species of the genus", *Proceedings of the Biological Society of Washington*, p. , vol. , ( ). Submitted
- C. J. McLaughlin, Smith, C., Buddemeier, R. W., Bartley, J. D., and Maxwell, B. A., "Rivers, Runoff, and Reefs", *Global and Planetary Change*, p. 1, vol. 820, (2003). Published
- D. Scavia, Field, J. C., Boesch, D. F., Buddemeier, R.W., Burkett, V., Cayan, D. R., Fogarty, M., Harwell, M. A., Howarth, R. W., Mason, C., Reed, D. J., Royer, T. C., Sallenger, A. H., Titus, J. G., "Climate change impacts on U.S. coastal and marine ecosystems", *Estuaries*, p. 149, vol. 25, (2002). Published
- B. A. Maxwell and R. W. Buddemeier, "Coastal typology development with heterogeneous data sets", *Regional Environmental Change*, p. 77, vol. 3, (2002). Published
- R. W. Buddemeier, Crossland, C. J., Maxwell, B., Smith, S.V., Swaney, D., Bartley J. D., Misgna, G., Smith, C., Dupra, V. C. and Marshall Crossland, J. I. (eds), "LOICZ/UNEP regional synthesis workshops: Australasia-Asia, the Americas, Africa-Europe. Summary report and compendium", *LOICZ Reports & Studies*, p. 1, vol. 22, (2002). Published
- R. W. Buddemeier, S. V. Smith, D. P. Swaney, and C. J. Crossland, "The role of the coastal ocean in the disturbed and undisturbed nutrient and carbon cycles", *LOICZ Reports & Studies*, p. 1, vol. 24, (2002). Published
- A. T. Peterson, V. Sanchez-Cordero, J. Soberon, R. W. Buddemeier, J. Bartley, and D. R. B. Stockwell, "Future projections for Mexican faunas under global climate change scenarios", *Nature*, p. 626, vol. 416, (2002). Published
- S. V. Smith, W. H. Renwick, J. D. Bartley, and R. W. Buddemeier, "Distribution and significance of small, artificial water bodies across the United States landscape", *The Science of the Total Environment*, p. 21, vol. 299, (2002). Published
- Fautin, D. G., T. R. White, and K. E. Pearson, "Two new species of deep-water *Corallimorpharia* (Cnidaria: Anthozoa) from the northeast Pacific, *Corallimorphus denhartogi* and *C. pilatus*", *Pacific Science*, p. 113, vol. 56, (2002). Published

### **Books or Other One-time Publications**

#### **Web/Internet Site**

**URL(s):**

<http://www.kgs.ku.edu/Hexacoral/>

**Description:**

This is the major product of the award. This site links and provides access to both the biological and the environmental databases, and through it tools that allow data from both to interact are accessible.

#### **Other Specific Products**

**Product Type:** Software (or netware)

**Product Description:**

The OBIS Mapper is an application that intersects biological and environmental data. Created by Jeremy Bartley, it analyzes the habitat from which a species is known and displays other places in the world where such a habitat exists.

**Sharing Information:**

The OBIS Mapper is served as part of "Biogeoinformatics of Hexacorals"; it is shared bilaterally with FishBase ([www.fishbase.org](http://www.fishbase.org)) and CephBase ([www.cephbase.org](http://www.cephbase.org)), and data in OBIS can be analyzed through it.

#### **Contributions**

**Contributions within Discipline:**

The goal of this project was to create an easy-to-understand data source for 1) taxonomic and distributional information about hexacorallian animals (corals, sea anemones, and their kin) and 2) relevant environmental parameters. User-friendly tools link biogeographic information across spatial scales, thereby greatly augmenting the minimal biogeographic data available for most benthic marine invertebrates. Such interactions between the biological and environmental data allow them to be visualized, analyzed, and extracted, as desired. In particular, the tools permit formulation and testing of biogeographical and biodiversity models; and support forecasting and hindcasting of distribution changes due to environmental alteration.

Many presentations have been made at professional meetings. Most are available at <http://www.nhm.ku.edu/inverts/abstracts/index.htm>

**Contributions to Other Disciplines:**

The data we have provided can be used in management and conservation. Some of the tools have been applied to issues such as ground-water and coastal pollution.

The hexacoral database and similar ones in OBIS ([www.iobis.org](http://www.iobis.org)) may be important sources of biological data for the oceanographic community. Fautin has participated in several workshops attended primarily by physical and earth scientists to learn from them and inform them about possible interactivity of their projects and OBIS.

**Contributions to Human Resource Development:**

The main contribution has been training of students.

**Contributions to Resources for Research and Education:**

**Contributions Beyond Science and Engineering:**

There may be conservation and management implications of some of the data we have made available.

**Categories for which nothing is reported:**

Any Book

Contributions: To Any Resources for Research and Education