

A National Oceanographic Partnership Program Award

Census of Marine Fishes (CMF): Definitive List of Species and Online Biodiversity Database

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Long-term goals

The primary goal of the project was to advance the Oceanic Biogeographical Information System (OBIS) for the Census of Marine Life with respect to marine fishes. This funding through NOPP provided a significant boost to projects already underway, led to some new directions, and, although funding from NOPP has ended, both major projects continue enthusiastically. We continue to aid other initiatives such as ITIS, Species 2000, and GBIF.

Objectives

The objectives were to (a) Compile a definitive list of marine and brackish water species of fishes, by scientific name; (b) digitize biodiversity information in specimen collections (for purposes of distribution maps, and (c) provide relevant biological information on the Internet.

Approach and work plan

The grant recipient organization was the California Academy of Sciences (CAS), with FishBase (ICLARM, International Center for Living Aquatic Resources Management) being a significant subcontractor, receiving over half of the funding. Other partners were taxonomic experts, institutions, collection managers of preserved fish collections, museums, etc.

(Objective a) The definitive checklist (objective a) was drawn from two on-line databases that were continually updated during the entire project. These databases had been being prepared for several years, and both CAS and FishBase worked closely on this project. Technicians and the PI at both CAS and FishBase continued to add information to both databases, with CAS concentrating on technical aspects of names, new species descriptions, technical name problems, classification, and status references. For each species, this database gives many technical details such as location of types, site of original publication, and a number of current references that treat that species. Habitat information was assigned for marine families, and habitat information on families having both marine and freshwater representatives was taken from FishBase. From the Catalog of Fishes [www](http://www.catalogoffishes.org) site it is possible to assemble a definitive list of marine and brackish water fishes (or a list of all species for that matter). No other zoological discipline of any size has such a definitive and accurate database.

The plan also included that FishBase download information from the CAS database as in prior years, but also continue to add significant additional information on habitat, distribution, size,

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biology, fisheries, pictures, and other information. From FishBase one may also automatically produce a definitive list of marine and brackish water fishes.

(Objective b) This objective involved the creation of digitized biodiversity information primarily from specimen collections for the purpose of creating distribution maps (georeferenced) for any marine species. This work was done by ICLARM. The plan was to find all digitized fish collections or partially digitized fish collections and enter that information into FishBase. Froese and his coworkers did all the programming and conceptual design (see Froese and Pauly 2000). Beginning in the first NOPP FY but really concentrating in FY 02, FishBase reached a total of over one million georeferenced locality records for fishes (about half marine). The maps can be created out of the FishBase www site.

(Objective c) Provide relevant biological information on the Internet. A large staff at FishBase (with a home base in the Philippines) were assigned tasks to collect relevant biological information on fishes, such as growth, maturity, reproduction, and resilience to fishing, concentrating on marine species. This has led to the largest compilation of such key information in any group of organisms.

Work Completed

The two databases both were added to significantly during the FY under consideration. At CAS, much progress was made during FY 02 in providing “status” references for species, concentrating on marine ones. This makes the database a guide to recent publications treating any species under consideration. These are still active databases that are updated on a regular basis. The “Catalog of Fishes” database is a continuation of a 2900-page publication in 1998 and goes back over 20 years in preparation with significant NSF funding. It can be found at <http://www.calacademy.org/research/ichthyology>. The FishBase database is at <http://www.fishbase.org/search.cfm>. These databases provide significant information on the approximately 28,000 valid species of fishes, about half of which are marine. [We suspect the final number of valid species to be about 35,000.] In ichthyology, about 250 new species are added each year, mainly from South America freshwaters, southeastern Asia, deep reef areas and some deep-sea areas. Fishes in many parts of the world, most commercial marine fishes and most large species are well known. In general, about 50,000 species have been named – and all these names are treated in the Catalog of Fishes database – this means each species has been described on average 2 times (from males and females, young and old, different geographic regions, etc.). So we have about 50% duplication. Often there is useful information under the duplicate names, and this database provides that information. At CAS, a fulltime technician, a part-time technician and the PI actively added status references, all new species described, and provided technical details on original descriptions, tied to a specific reference, etc. Much communication with authors on technical details was done by the PI.

Work at FishBase involved more people, all under the guidance of Rainer Froese. FishBase technicians also captured information on new species, but they also collected biological information on habitat, distribution, fisheries information, etc. (see Froese and Pauly 2000). Their programmer worked with collection managers to improve and transfer information to the occurrences database (for map preparation). It was found that in many old collections, species are often misidentified or are under old name combinations. Froese and his programmers created an algorithm to find misidentifications, species out of their ranges, etc., and forwarded their

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suggestions to individual collection managers to improve data reliability. During the project, over one million records were included in the FishBase mapping program. Records representing 21,868 species were included, and of these 12,384 species and 600,449 records were marine. Twenty two institutions, including the Smithsonian Institution (272,308 records), California Academy of Sciences (143,311), Natural History London (125,200) were among the top contributors. FishBase assisted (from non NOPP funds) some smaller European collections with funds and advice, and the NOPP project in FY 02 provided funds to the P.P. Shirshov Institute of Oceanology (Russia), University of Copenhagen (Denmark) and the Rijksmuseum in Vienna, Austria. The first two collections had very unique holdings of marine fishes, especially the Russian collection that has significant holdings of deep-sea fishes from unique areas.

Work on mapping continues, as does adding more digitized records from museums. We found museums were very willing to provide data for mapping purposes. Remaining is more work on data improvement – better identifications, consistent genus and species (spelling names correctly with the Catalog of Fishes as the authority file), identifying questionable identifications, and noting errors in latitude or longitude when the species was outside its normal range.

We learned we can make accurate distribution maps for species of marine fishes – much more could be done on improving identifications as suggested above, but we can also look at depth ranges, in many cases temperature ranges inhabited, and other useful biological data such as size at maturity, reproduction and larvae, genetics, growth, recruitment, and much more information [this incorporation/coordination of information continues]. More and more records are currently being added.

We learned that the input of specialists was especially important to the Catalog of Fishes database. We identified that many ichthyologists are nearing the ends of their careers, yet they have accumulated a wealth of information on groups in which they have specialized (but probably will never have time to publish on). This especially concerned many species for which we had no status – valid or a synonym. The specialists could help us. In FY 02 funds were provided in small amounts or \$400 to \$1500 depending on size of group being treated – most of these funds went to underemployed Russians. Using this approach and concept, the PI approached the National Science Foundation for a grant to publish “annotated checklists” of fishes prepared by specialists (many of them older workers of the 1950s-1990s). This grant was funded in June 2002 (074632456). Their knowledge will improve the Catalog of Fishes database, and also the definitive list of marine species. At present, we intend to publish this information group-by-group for free on the Internet for all fish groups, and we should be putting up some groups already underway in the next 3 months. The Catalog of Fishes staff does the preparation out of the database, and the specialists mostly edit printouts. When ready, their account goes on the Internet (essentially as a free Internet journal). We hope to treat all fish groups in this way over the next 5 years. This in essence says, “This is the state of ichthyology at this time in history, and the field is ready for new workers and approaches.” Certainly this concept originated out of the NOPP project.

At this time, the two databases mentioned are the most comprehensive for any animal group. The Catalog of Fishes is more tailored to specialists, and FishBase to a much broader audience, including educators, fishery biologists, and marine scientists and ecologists.

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Transitions

Economic Development

Fisheries stocks worldwide are by-and-large overfished. FishBase tracks information on stock abundance statistics, on endangered and threatened species, and other information involving economic development or preservation of fishery stocks. FishBase works closely with FAO and other agencies. They also have major interests and information on aquaculture.

Quality of Life

FishBase has components that are educational and instructive for lay people, including a fish quiz, plus thousands of color pictures of fishes and information on identification. They are moving into ecosystem analysis and resource management.

Science Education and Communication

For the specialist, no other animal group has a resource like the Catalog of Fishes database. For others, FishBase is huge, and it appeals to several audiences. It is especially useful to fishery scientists as a source of information and direction. They continue to make their database more educational and interesting to the general public, such as the addition of a biodiversity quiz on fishes. Both databases receive significant inquiries from the public. If you are surfing on the www, you will eventually find FishBase and the Catalog of Fishes databases. As mentioned above, FishBase received over 4 million hits a month.

Related projects

NOPP gave two grants for fishes in the round beginning in FY 01 and extending through FY 02. The one discussed above was to CAS (and FishBase) and the second to the University of Kansas. The approaches to mapping were different, but both used similar, and in many cases the same data. Froese (FishBase) always has related projects underway with a number of institutions.

References

Eschmeyer, W. N. (ed). 1998. Catalog of Fishes. Spec. Publ. California Academy of Sciences, 3 vols., 2905 pp.

Froese, R. and D. Pauly. 2000. FishBase 2000. Concepts, design and data sources. International Center for Living Aquatic Resources management, Makati City, Philippines.

Publications

Froese, R. and D. Pauly. 2000. FishBase 2000. Concepts, design and data sources. International Center for Living Aquatic Resources management, Makati City, Philippines.

Eschmeyer, W. N. Catalog of Fishes. Electronic database. <http://www.calacademy.org/research/ichthyology>. Latest version fall of 2002.

Froese, R. and D. Pauly. Fishbase 2000. Electronic version (continuously updated). At <http://www.fishbase.org/search.cfm>

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- Froese{ XE "Froese, R." }, R. and C. Binohlan{ XE "Binohlan, C." }. 2000. Empirical relationships to estimate asymptotic length, length at first maturity and length at maximum yield per recruit in fishes, with a simple method to evaluate length frequency data. *J. Fish Biol.* 56:758-773.
- Froese{ XE "Froese, R." }, R. and M.L.D. Palomares{ XE "Palomares, M.L.D." }. 2000. Growth, natural mortality, length-weight relationship, maximum length and length-at-first-maturity of the coelacanth *Latimeria chalumnae*. *Environ. Biol. Fish.* 58:45-52.
- Froese, R. and D. Pauly. Editors. 2000. *FishBase 2000: concepts, design and data sources*. ICLARM, 344 p. With 4 CD-ROMs. (43 chapters authored by RF).
- Froese, R. 1999. The good, the bad, and the ugly: a critical look at species and their institutions from a user's perspective. *Reviews in Fish Biology and Fisheries* 9:375-378.
- Froese, R., N. Bailly, G.U. Coronado, P. Pruvost, R. Reyes and J.-C. Hureau. 1999. A new procedure to evaluate fish collection databases, p. 697-705. *In* B. Séret and J.-Y. Sire (eds.) *Proceedings of the 5th Indo-Pacific Fisheries Conference*, Noumea, New Caledonia, 3-8 November 1997. Soc. Fr. Ichthyol., Paris, France.
- Froese, R. and A. Torres. 1999. Fishes under threat: an analysis of the fishes in the 1996 IUCN Red List, p. 131-144. *In* R.S.V. Pullin, D.M. Bartley and J. Kooiman (eds.) *Towards policies for conservation and sustainable use of aquatic genetic resources*, ICLARM Conf. Proc. 59, 277 p.