

Distributional Databases of Fishes in Taiwan

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Abstract

Currently, eight distributional databases of fishes are included in the “Fish Database of Taiwan.” They are (1) coastal fishes mainly from underwater census; (2) inshore economic fishes from fishery harvest; (3) checklist of Dongsha (Pratas) and Nansha (Spratly) Island in the South China Sea; (4) freshwater fishes in Tzengwen River; (5) freshwater and estuarine fishes; (6) endemic freshwater fishes; (7) bottom trawling fishes; (8) deep-sea organisms. While the third to the fifth databases can be accessed interactively by using ArcView/Map Info, the last one can be accessed by using ArcIMS on Web GIS service. All of the above distributional databases are linked to “The Fish Database of Taiwan,” or to the global fish database – “FishBase” of ICLARM. By using the species names as the primary key, a more detailed information of each particular species can be obtained, which includes specimen photos, biological information, literatures and other distributional data in Taiwan (Chinese version) or in the world (English version). Such collaboration between local and global database has shown a good example for local or regional biodiversity database moving toward international cooperation.

Introduction

Biological distribution data includes both temporal (daily, weekly, monthly, seasonal, or yearly) and spatial (among monitoring stations, regional, geographical, or global) distribution data. The accumulated long-term distribution data of either the individual number or biomass on population, species, community, or ecosystem level is essential for conducting further research, education, conservation, and resources management. Therefore, to construct a distribution database is one of the most important works of recent biodiversity database. The progress of geographical information system (GIS) on the web also facilitates and popularizes the establishment of biological distributional databases. Two types of distribution databases need to be distinguished. The first type is the distribution data of specimens, which is based

on the specimens that are collected and deposited in various museums; the second type is field record or observation data without collecting voucher specimens. These two types of databases usually are treated separately. In this article, an introduction on the second type of distribution data will be given by using the fish data in Taiwan as an example.

The Fish Database of Taiwan

Since 1984, the Laboratory of Fish Ecology and Evolution at the Institute of Zoology, Academia Sinica (IZAS) has been working on the faunistic study of fishes in Taiwan. The survey sites cover almost all of the coastal waters around Taiwan, as well as some islets that includes its adjacent Hsiaoliuchiu, Orchid Islands, Green Island, and Pescadores Islands; Quemoy and Matsu near Fujian Province of China; and also the Pratas (Tongsha) and Sprately (Nansha) Island in South China Sea. The marine ecosystem covers from coral reefs, sandy/muddy bottom, rocky shore, sandy barrier lagoon, estuary /mangrove along the coastal waters to the open ocean and deep sea. The temporal and spatial distribution data have been accumulated very rapidly. The total numbers of fish species in Taiwan have increased to more than 2,550 within the past 8 years despite those unidentified or doubtful species. Therefore, constructing a good database system is necessary for data management and data analysis especially when GIS can be cooperated.

The “Fish Database of Taiwan (FDT)” that contains the distributional databases has been established and opened on the web for public enquiries since 1997. The website of FDT is <http://fishdb.sinica.edu.tw> (Shao et al, 2002). Other major databases in the FDT checklist of all native fishes, basic information, and biological data, which includes specimen photos of each species, curatorial or specimen database of the fish collections in the IZAS, and bibliographic database that comprises all of the local publications that are related to the fish taxonomic and ecological works in Taiwan. All of the above databases in the FDT are linked together by using the species names as the primary key. Through the scientific name of each fish species, more related information of that particular species in the world can be accessed directly from the global fish database - FishBase (<http://www.fishbase.org>) (Froese & Pauly, 1998). The fish data of checklist, specimens, distribution in Taiwan can also be enquired or browsed from the FishBase. This intimate collaboration between local and global database has given a good example for local or regional biodiversity databases moving toward international cooperation.

Distributional Databases and Their Sources

Currently, there are eight different distribution databases that are existed in FDT. The titles,

data, and funding sources are listed below in chronological order.

- (1) The Coastal Fishes of Taiwan (1989 – 1994) – sponsored by the National Science Council (NSC). The data mainly comes from underwater census of SCUBA diving by researchers themselves. Hence, the fish species mostly contains coral reef fishes and non-economic species. So far, this database has not yet been cooperated with GIS.
- (2) The Economic Fishes of Taiwan (1991-1996) – sponsored by Council of Agriculture (COA). The data mainly comes from the questionnaires of local fishermen, but the species names are verified by the researchers. Only abundance and localities data of economic fishes in the coastal waters are recorded without collecting fish specimens. The GRASS is first used and then converted into ArcView under the technical support of the Computing Center of Academia Sinica.
- (3) Distribution Database of the South China Sea (1990 & 1994) – included the atoll of Pratas (Tongsha) Islet, which is sponsored by Kaoshiung City Government in 1990, and Sprately (Nansha) Islet sponsored by COA in 1994. The species that is occurred at each different monitoring station can be enquired at both islets.
- (4) River and Estuary Fishes of Tzengwen River (1996-1998) – sponsored by Ministry of Economics for data collection and Academia Sinica (AS) for database establishment under the team project of “Networking of Taiwanese Research (NTR).” This database is sophisticated for it includes the video images of all monitoring sites and data plotting of environmental factors such as water temperature, pH, dissolved oxygen, and turbidity etc of each sampling time in addition to the individual number of fishes that are observed or collected at each station. The GIS of ArcView is used here under the support of the Institute of Information Sciences, AS.
- (5) Freshwater Fishes of Taiwan (1998-1999) – sponsored by the NTR project of AS. All of the distribution data of freshwater fishes are compiled from the literatures. Users enquire the species that are occurred from the selected monitoring station, river, watershed, or biogeographical regions of Taiwan as well as the literature information where the data is originated.
- (6) Endemic Freshwater Fishes of Taiwan (2000) – sponsored by the NSC for the Digital Museum Project. The distribution areas and basic biology of these 30 endemic freshwater fish species can be browsed on the web.
- (7) Trawlbase of Taiwan (1999-2003) – sponsored by COA. This database list individual number and biomass of all fishes, crabs, shrimps, and echinoderms harvested by the bottom trawl. These data can be sorted according to the order of their quantities. Different sampling stations, different water depths ranging from 50 m to 800 m, and different seasons in the regions of the north, northeast, southwest, northwest Taiwan and Pescadores Island can be chosen by users. The specimen photos of most species on the list are

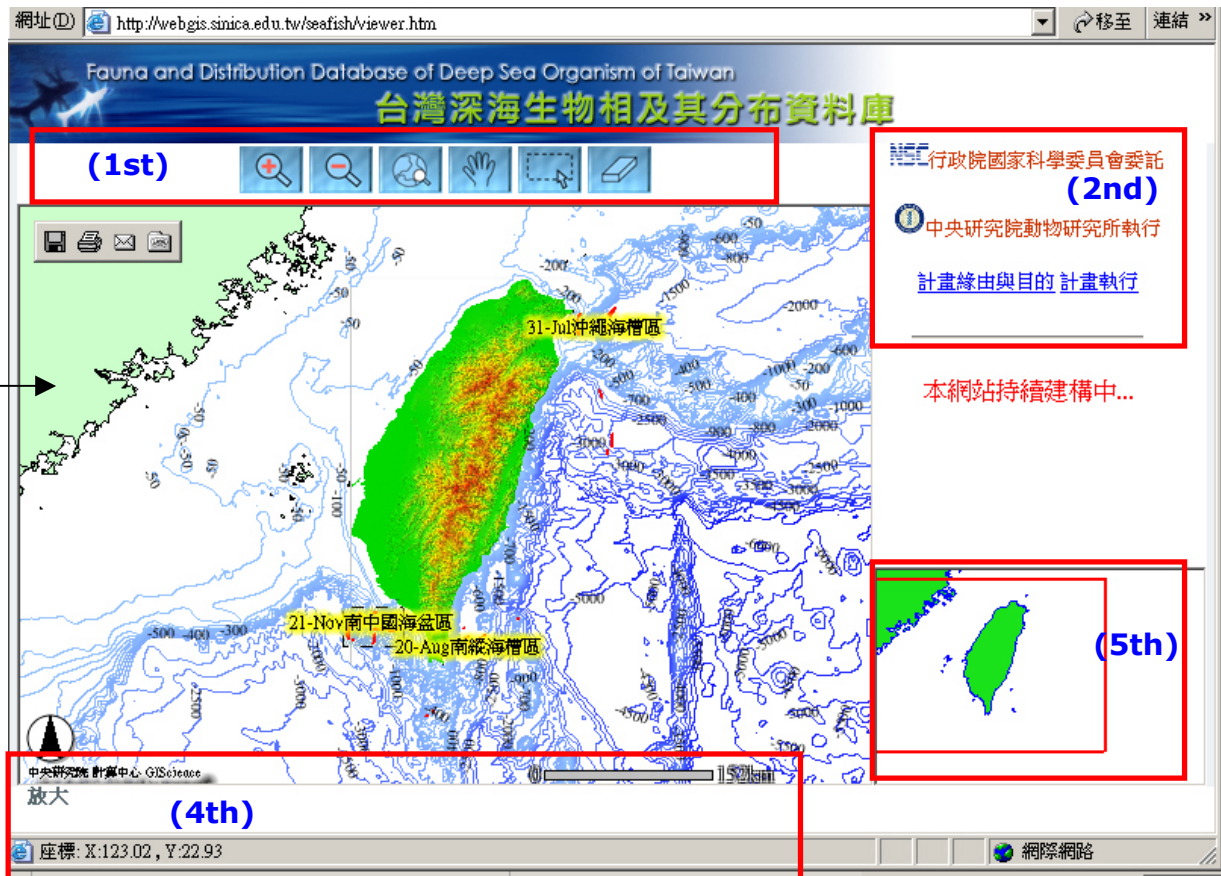
available, and basic information of each fish species can be enquired as well as via the linkage of FDT and global FishBase. GIS has not yet applied to this database.

- (8) Fauna and Distribution Database of Deep-Sea Organisms of Taiwan (2001-2004) – sponsored by NSC. This database uses ArcIMS and Web GIS for service. All of the marine organisms that are collected by using beam trawl, otter trawl, and IKMT on the Ocean Research Vessel No.1 could be deployed down to 2000 m depth. The sampling sites are not fixed, so it is different from the above TrawlBase.

Apply WebGIS on Fauna and Distribution Database of Deep-Sea Organisms of Taiwan

Web-based geographic information systems (WebGIS) is a process designed to present spatial information with friendly interface. The web based application prototype has its new architecture and compares to the desktop GIS applications. The end user only needs a web browser to query, access, display, and analyze GIS dataset. The applications and dataset of geographic information are hidden on the server. Therefore, it is the most efficient way to deploy and maintain the GIS applications.



The deep-sea WebGIS is consisted of Taiwan topographic map, submarine contour in the waters around Taiwan, species composition and abundance database harvested from each sampling station. This is where GIS on the internet offer the distribution of spatial pattern of deep-sea organisms of Taiwan, efficiently. Users can search and query what they want, such as fish species, quantity, depth. These databases could provide the management and evaluation of the environmental resources for the future.







The WebGIS interface of this distribution database include the following five areas:

1. 1st area is operation toolbar. are listed below in next paragraph.
2. 2nd area is document with this project.
3. 3rd area is main map area. Include the topographic map on Taiwan, submarine contours along the Taiwan coast and collected stations.
4. 4th area is status bar. Users can read the map scale(in kilometer) and map units with mouse pointer(in decimal degree).
5. 5th is the index map area. Index area display extent position of the map area immediately.

There are six operation tools on this website, and they are:

1.  Zoom In tool. Zooms in on the position you click or the box you define on map area.
2.  Zoom Out tool. Zooms out from the position you click or the area you define on map area.

3.  Zoom to Full Extent button. Zooms to the full extent of all the themes in map area. Click this button when you want to be able to see everything in map area.
4.  Pan tool .At any time, you can pan the view by dragging it in any direction with the Pan tool.
5.  Zoom to Selected Features button. Zooming to the selected stations through rectangle region. Click the Zoom to Selected Features button to zoom to the extent of the collected stations you have selected in the map area. In this way you'll be able to focus on the collected stations you selected. Users will read more information about selected stations.
6.  Clear tool. Unselects the selected feature of all collected stations.

Integrating and Linking to the Global Biodiversity Information Network

All of the eight distribution databases that are existed in FDT have not yet been integrated. The databases with or without specimen collection should not be mingled with each other because usually the data with specimen collections is qualitative, i.e. presence/absence or binary data. However, the data without specimen collection is quantitative, i.e., multistates or continuous data. The species identification of the former data can be verified through the voucher specimens that are deposited in the museums, but cannot be verified through the latter kind of data.

Currently, most of the distribution data with GIS application are the terrestrial organisms in the land including freshwater fishes. Very few GIS data sets are available in marine organisms. Part of the reason is because of the sampling difficulty on the sea especially by the researchers themselves. Most of the collection sites of the marine organisms are from the fishing harbors or fishing markets where the fishes are landed, but not from real collection site in the sea. Thus the insufficient latitude and longitude data of collections will make the distribution data of marine organisms much less incomplete than the terrestrial organisms. Consequently, the marine conservation and resources management will be hindered by the data insufficiency.

Nevertheless, the species checklist and the curatorial database of fish specimens that are deposited at IZAS (ASIZP) have been provided to FishBase, so the distribution of Taiwanese

fish in the waters around Taiwan can be integrated into FishBase and show on their global map.

Through the global databases or global biodiversity networks such as Species 2000 and BioNET- International, most of the updated data in Taiwan can be accessed through Global Biodiversity Information Facility (<http://www.gbif.org>). Via this approach, we will be able to achieve our goal of working locally and share information globally.

References cited

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Figure 1. Homepages of several distributional databases available in the “Fish Database of Taiwan”.