Part II. Improving the estimation of L_∞. Fishbyte 4(1):18-20.
Pauly, D. and N. David. 1981. A BASIC program for the objective extraction of growth parameters from length-frequency data. Meeresforsch. 28:205-211.
Pauly, D. and J.L. Munro. 1984. Once more, on the comparison of growth in fish and invertebrates. Fishbyte 2(1):21.
Radhakrishnan, E.V. 1977. Breeding of laboratory reared spiny lobster *Panulirus homarus* (Linn.) under controlled conditions. Indian J. Fish. 24(1-2):269-270.
Rikhter, V.A. and V.N. Efanov. 1976. On one of the approaches to estimation of natural mortality of fish populations. ICNAF. Res. Doc. 79/VI/8,12 p.
Sanders, M.J. 1977. Estimation of mortality coefficients for exploited fish populations in which the sexes exhibit divergent growth rates. J. Cons. CIEM 37(2):192-193.
Sanders, M.J. and M. Bouhlel. 1984. Stock assessment for the rock lobster (*Panulirus homarus*) inhabiting the coastal waters of the People's Democratic Republic of Yemen. FAO, Project for Development of Fisheries in Areas of the Red Sea and Gulf of Aden. RABSI/002,68 p.
Sanders, M.J. and S.M.M. Kedidi. 1983. Introduction to stock assessment. UNDP/FAO:RAB/81/002/MAN/3,243 p.
Smale, M.S. 1978. Migration, growth and feeding in the Natal rock lobster *Panulirus homarus* (Linn.). Oceanogr. Res. Inst. (Durban) Invest. Rep. 47:1-56.
von Bertalanffy, L. 1938. A quantitative theory of organic growth. Hum. Biol. 10(2):181-213.
Wetherall, J. 1986. A new method for estimating growth and mortality parameters from length-frequency data. Fishbyte 4(1):12-14.

D.S. JAYAKODY *is from the National Aquatic Resources Agency, Crow Island, Colombo 15, Sri Lanka.*

MAPPER, a Low-Level Geographic Information System

GRACE CORONADO and RAINER FROESE

Abstract

A Low-Level Geographic Information System (LL-GIS) was developed to provide a simple low-cost mapping program which can be executed in any personal computer, by individuals with different levels of knowledge in computing. MAPPER is an add-on module of FishBase - a global database with key information on the biology of fish - where it creates on-screen maps with information on biodiversity and the occurrence of species. In another application, MAPPER is used to display and analyze geographical information on the Philippines.

Introduction

Geographic information systems (GIS) are important tools that deal with spatial data. To date, the main use of GIS by government and other agencies is to produce colorful thematic maps of areas of special interest to help the decisionmaking process. While it is convenient to have such maps generated by the computer, one has to realize that the very same output can also be produced by handcoloring photocopies of existing maps, which is still much faster and cheaper.

A GIS is only justified when one or both its main capabilities are used, i.e., i) to automatically produce a variety of maps out of a continuously changing database and ii) to analyze spatial data in a nontrivial way to provide insights which, for example, cannot be gained by putting three transparencies on top of each other.

The disadvantages that must be evaluated carefully before the user invests in the development or acquisition of a GIS are:

- the high cost of commercial GIS packages can only be justified if there is a continuous, substantial supply of spatial data, e.g., from remote sensing or a long-term monitoring program. Such data are normally very expensive to obtain;
- the initial effort of converting existing geographic data into a format suitable for GIS through digitizing, scanning, or related data conversion is substantial;
- a large amount of technical as well as financial overhead is required to maintain a GIS unit (e.g., computer, digitizer, color printer, large plotter, skilled technicians, software maintenance, etc.).

The main objective of this study was to develop a Low-Level Geographic Information System which performs basic capabilities of a commercial GIS but only requires an IBM compatible personal computer with 640KB RAM, a VGA color monitor, a hard disk, a mouse and a dot matrix or laser printer. The system was designed for different levels of users with different levels of computer experience.

Specifically, the study aimed to develop the following routines/algorithms:

- a "digitizer-like" routine for creating/editing maps and overlays using a mouse or the keyboard;
- a plotting routine to draw a map (any part of the world) and overlay data files of different types (points, lines, polygons);
- an algorithm for computing perimeters and areas;
- miscellaneous routines for zooming, printing, saving, and redrawing the displayed map.

Procedure

The program was written in the computer language C using the Borland C++ compiler and the MetaWINDOW

graphics library. The program consists of two subprograms called MAPPER and CREATMAP. MAPPER is used for plotting and overlaying different topological data and for computing map measurements and producing printer output. CREATMAP, which is not yet ready for distribution, is used for creating new maps/overlays and editing existing ones. MAPPER is available as ICLARM software for US$20.

MAPPER and FishBase

A Low-Level Geographic Information System (LL-GIS) was developed as part of ICLARM's FishBase project. The original purpose of MAPPER was to serve as a tool to display and analyze geographic information in FishBase, an interactive database of key information on the biology of fishes important for aquaculture and fisheries (Pauly and Froese 1991; Froese et al. 1992; Coronado 1993). The database is intended to substitute for the lack of large and costly holdings of taxonomic, biological and other materials in the libraries of fish research institutions in the tropics.

Fig 1. *A standard PC running FishBase and the Low-Level GIS software, MAPPER. The screen shows occurrence data of* **Plectropomus leopardus.**

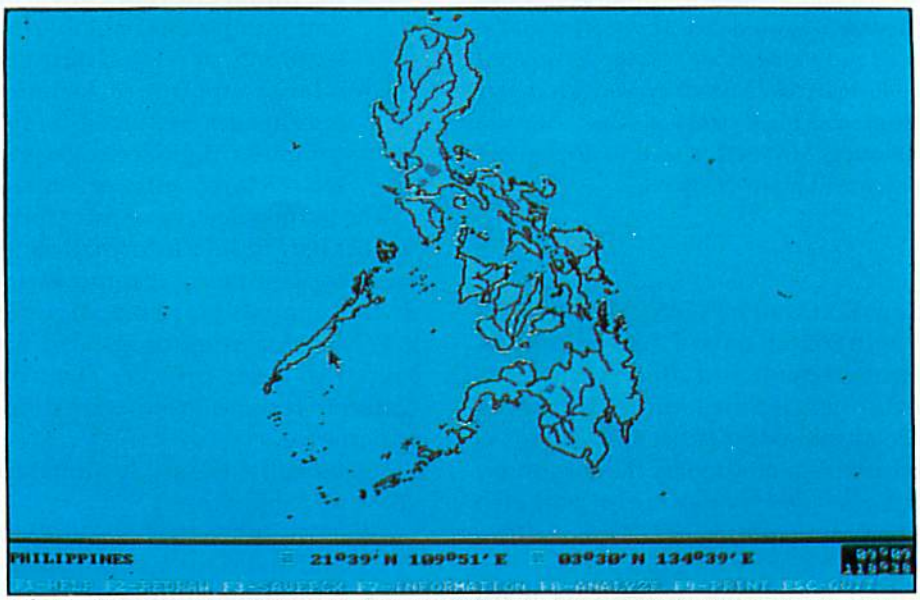

Fig 2. *An example of the adaptation of MAPPER to a country: the Philippines with overlays of coral reefs, lakes, and rivers.*

Inside FishBase, MAPPER is used to draw maps showing the global occurrence of fish species. Vector data of the world were obtained from Micro World Data Bank (MWDB-II). MWDB-II is a highly compressed version of the full WDB-II, a digital map database of 200 megabytes initially produced by US Central Intelligence Agency (CIA), then released for public distribution by the National Technical Information Service (NTIS), US Department of Commerce.

The basic map consists only of coastlines which can be overlayed with points, symbols, lines, polygons and labels. Overlays for the world-level consist of lakes, rivers, country boundaries (also from MWDB-II), and fish occurrence points. The latest version of the FishBase demo disk has the basic map, which consists of coast lines and country borders, as .PCX file.

The maps produced from data in FishBase are not distribution maps but rather a display of the information which is used to construct such maps; the exact localities where a certain species has been found by scientists are plotted as points and the countries which claim to have the species in their inland or marine territory are highlighted. MAPPER produces automatically such maps from the latest information on any of the more than 8,000 species contained in FishBase to date. Biodiversity maps showing the number of families or species by FAO area or by country can also be produced.

Fig. 1 shows the basic hardware requirement of MAPPER: personal computer, color monitor, mouse and printer. The map on the screen displays the world map with several overlays: country boundaries, lakes, rivers, and the occurrence data of *Plectropomus leopardus*, with highlighted countries of occurrence. The figure also shows the capability of the system to track down the cursor position in terms of geographic location, which enables the system to perform the "digitizer-like" routine.

The Philippine Module

Different levels of detail for the Philippine coastlines/islands were obtained from the MWDB-II world map using the CREATMAP program. Added information for the Philippines consists of lakes, rivers, mountains, major cities, coral reefs and fish occurrence. Vector data were taken from MWDB-II and occurrence data from FishBase. Other information was digitized from existing maps using CREATMAP. Similar modules can be generated for other countries.

The Philippines with overlays of lakes, rivers, and coral reefs is shown in Fig. 2.

Further Enhancements

Improvements to the MAPPER routine can be obtained by:

- increasing the plotting speed (the plotting of the world map with all overlays now takes three minutes and 10 seconds on a 20 megaHz 386-computer without co-processor.);
- including more advanced spatial concepts and image processing techniques to expand the analytical capabilities of the system and improve its performance.
- porting MAPPER to the WINDOWS environments which will make it easy to display for example, a map, a picture, and passport data of a fish simultaneously on screen.

Acknowledgement

The FishBase project is funded by the Commission of the European Communities (Contract No. B7-5040/92/14). It is developed in close collaboration with the Food and Agriculture Organization of the United Natons (FAO) and with many national institutions.

References

Coronado, G.U. 1993. Low-Level Geographic Information System (LL-GIS). University of the Philippines at Los Baños, College, Laguna. 73 p. M.S. thesis.

Froese, R., D. Pauly and M.L.D. Palomares. 1992. Draft user's manual of FishBase: a biological database on fish. ver. 1. ICLARM Software 7, 57 p.

Pauly, D. and R. Froese. 1991. FishBase: assembling information on fish. Naga, ICLARM Q. 14(4):10-11.

G. CORONADO *is ICLARM Programmer and* R. FROESE *is FishBase Project Leader.*

ICLARM Contribution No. 986.

Letter to the Editor

Shortwave Radio: An Alternative for Computer Communications

What can be done when there is a desire to communicate and exchange information with colleagues who share common research interests, but are faced with problems of distance, malfunctioning telephone lines, high costs of service and in some places are even without telephone services and a lack of economic resources? I would like to point out a possible solution which many of you know already, but maybe you have not given it a second thought. Everyone knows of the existence of shortwave radios and that worldwide, there are many people from different countries communicating with each other through the radio just for the pleasure of making acquaintances. These persons are amateur radio operators which are commonly called "Hams". Well, I had the pleasure and fortune of meeting two of these persons; one a dentist and the other an electronic engineer (both excellent professionals and friends), who have shown me some of the "goodies" of radio communications. One of the things I found out is that many of these Hams do not talk to each other any more. The reason is not because they are mad at one another; rather, it is due to the fact that they have gone into computers and instead of talking now, they are sending all sorts of files to one another. Besides exchanging files, there is a strong trade of unrestricted shareware program files, and also they can have access to the hard disks of colleagues which have authorized them to do so. The possibilities are many and the software for sending and receiving is continuously being improved. My friends have a shareware program for this purpose which first compacts the file, fragments it into a number of user-specified parts and then sends it (at this stage there is a verifying process that checks that each fragment has reached its destination properly). Can you imagine receiving your favorite newsletter even before it is out of the press? Personally, I believe this is a good option for establishing communication and exchange with colleagues at a local, regional, national and intercontinental basis.

Initially, I thought that those who could benefit the most from this means of communication would be in developing countries where some or all of the problems mentioned above occur. But a colleague from the USA who has a telephone modem thought of it as an attractive option. Some of the things he mentioned were: sending a 100 Kb file through a phone modem takes about 90 minutes. Besides the time spent, there is an added cost per minute which is also a function of the distance plus your normal monthly service rent. With a radio system the cost is only the initial investment. The price of a radio and the interface (the one I saw is called "KAM") which hooks up to your computers serial port, has a global cost equivalent or slightly above an initial telephone service contract. Afterwards, there is no monthly rent or long distance services to pay. All you have to do is program your computer to send or receive at your convenience or a previously established time with your colleagues.

I hope that these comments may have been of some help. I am sure a Ham Radio Operator lives in your locality who can show you some of the things that I have mentioned. They already have a worldwide network and we are the only ones they are missing; let's join in. As soon as we obtain some funds for our equipment we will be on the air and in direct contact. Until then: best regards.

Julio A. Sánchez
EPOMEX Program