Computer-Aided Approaches to Identification I. Expert Systems

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Introduction

Identification of aquatic organisms is a difficult and time-consuming job. Our working group (Computer-aided Identification of Aquatic Organisms, CIAO) tried to find out how computers could provide solutions to this problem. Because some kind of expert knowledge seemed to be required, one idea was to build an expert system for identification. The result of about one year's work was IDEXSYS, our IDentification EXpert SYStem. Another idea was to use the possibilities of modern databases (i.e., query-by-forms and limited-choice fields) for identification. Finally we tried to use a numerical approach, i.e., perform several measurements on the organisms and let the computer identify the species. The results of these different methods will be presented in a series of three FISHBYTE articles, starting with the present one on IDEXSYS.

IDEXSYS, the questioner

Expert systems are the first viable products of artificial intelligence research. They are typically built around one question, e.g., "to which species does my fish larva belong", or "what disease do my fish suffer from", or "is my site suited for aquaculture", or "what is the best species (strain) for my aquaculture system", etc. Expert systems consist of (i) an inference engine and (ii) a knowledge base. The inference engine puts a question to the user, receives the answer(s), and decides which question to ask next, until it reaches an advice (e.g., "your larva is probably *Trachurus trachurus*") or runs out of questions. The knowledge base normally consists of a semantic net, i.e., a well-structured tree which contains the questions and final responses. Such a knowledge base is very similar to a printed identification key; thus, we implemented a key for fish larvae of the Northeast Atlantic recently developed at our institute (Halbeisen 1988).

With IDEXSYS, the user must answer a sequence of questions, as when working with a printed key. The main advantages of the system are:

- besides "yes" and "no" the user can answer "probably yes" or "probably not" (see Fig. 1). If an identification fails (the final question is answered "no"), the program will return to the questions that were answered with "probably ...", thus giving the user a chance to select a different answer;
- every question is supported by a picture illustrating the subjects of decision (see Fig. 2 and 3);

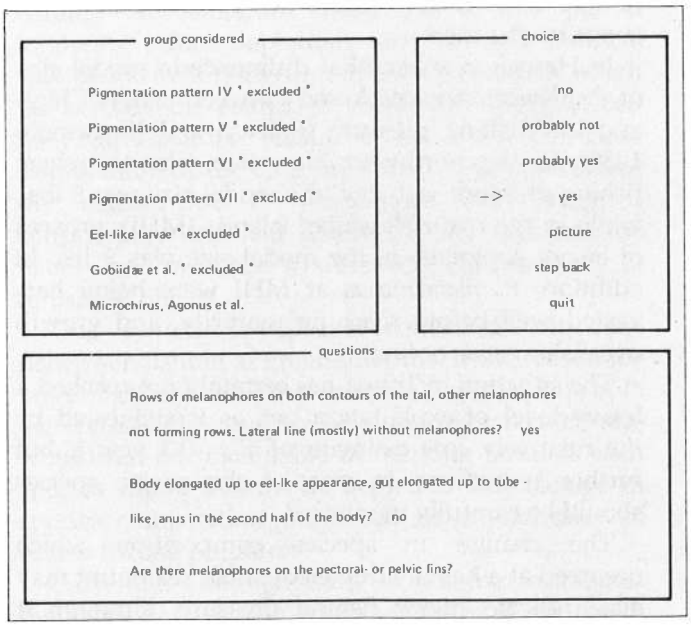

Fig. 1. Working screen of IDEXYS. The upper left window shows the groups considered, some of which are already excluded. The lower window shows the last questions, and the answers given. The upper right window shows the possible answers, which can be selected with the cursor keys or a mouse.

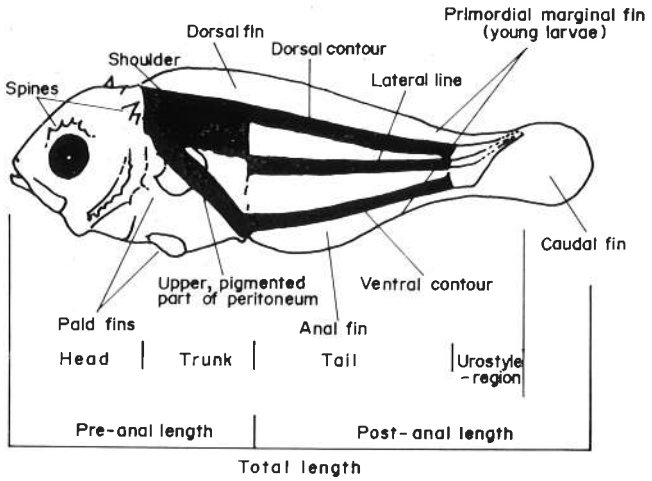

Fig. 2. Nomenclature used throughout the key.

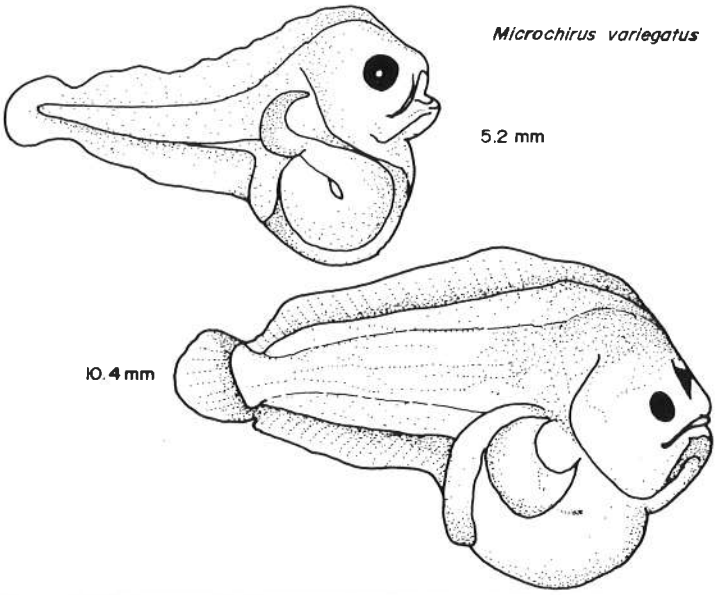

Fig. 3. Example of a screen display of a larva (*Microchirus variegatus*).

- with every question, the group considered is displayed, and the user can see which characters characterize which group (see Fig. 1);
- if the user feels she/he is on the wrong track, she/he can backtrack through the key;
- experienced users can select any starting point within the key, e.g., "flatfish" or "eel-like larvae";
- the user can easily update the knowledge base;
- the user can create new keys for other objects; and
- the program can produce a formatted printout of the knowledge base which can be used like a conventional printed key.

Thus, although IDEXSYS offers nothing that could not be done with a printed key, it provides a very comfortable way of identifying organisms. Its main advantage is, probably, the ability to continuously update existing keys and to easily construct new ones. At the moment, we are working on a key for fish larvae of the Mediterranean in cooperation with the Instituto de Ciencias del Mar, Barcelona and the University of Athens, and on a key to identify fish diseases.

IDEXSYS runs on IBM compatibles with 640 K RAM. A HERCULES graphics card is required to display the pictures. IDEXSYS is available from the ICLARM Software Project in return for five 5 1/4" blank diskettes. For a more detailed description of IDEXSYS, see Froese and Schöfer (1987).

References

Froese, R. and W. Schöfer. 1987. Computer-aided identification of fish larvae. ICES C.M. 1987/L:23.

Halbeisen, H.W. 1988. Bestimmungsschlüssel für Fischlarven der Nordsee und angrenzender Gebiete. Berichte des Instituts für Meereskunde an der Universität Kiel No. 178:76 p.