C-I13

Expert System for Phytoplankton Classification (ESPHYNKS)

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The goal of the work reported here was to build a Prototype Expert System for the identification of marine phytoplankton.

The system runs PC -AT compatible computer, an auxiliary video monitoring, a TV camera and a digital video processing card. A comercially available inference tool has been used to facilitate the development task.

At the present stage of prototype development, ESPHYNKS allows identification of 8 phytoplankton genus and 16 species belonging to the genus *Coscinodiscus*. The knowledge base of the system is developed from a matrix (Fig.1) organized with a data base program. The *Coscinodiscus* matrix is composed of seven variables visible under optical inverted microscope, sufficient for unambiguous identification of each species. The data base program is used to explore the combinations of morphological characters for all *Coscinodiscus* species. After testing the matrix, combinations of characters are translated into expert system rules.

SPECIE	AREOLAE ARRAY	CENTRAL AREA	VALVES FORM (AV)	CONCAVE CENTRE	CHROMATOPHORES	THIN AREOLATION
C. CENTRALIS	RADIAL ROWS	WITH ROSETTE	CONVEX			NO
C. CONCINNUS	RADIAL ROWS	WITH ROSETTE	CONVEX		IN ALL CYTOPLASM	YES
C. CONCINNUS	RADIAL ROWS	FREE AREA	CONVEX			
C. CURVATULUS	GROUPED IN SECTIONS					
C. EXCENTRICUS	CURVED TANGENCIAL					
C. GRANII	RADIAL ROWS	WITH ROSETTE	FLAT	YES		YES
C. GIGAS	RADIAL ROWS	FREE AREA	FLAT	YES		NO
C. LINEATUS	STRAIGHT TANGENCIAL					
C. MARGINATUS	IRREGULAR MESH					
C. MODULIFER	RADIAL ROWS	PAPILLAE				
C. NITIDUS	FREE AREOLAE					
C. OCULUS IRIDIS	RADIAL ROWS	WITH ROSETTE	FLAT	YES		NO
C. PERFORATUS	RADIAL ROWS	WITH ROSETTE	FLAT	NO		
C. PERFORATUS	RADIAL ROWS	FREE AREA	FLAT	NO		
C. RADIATUS	RADIAL ROWS	NO SP. FORM				
C. STELLARIS	RADIAL ROWS	STAR LIKE FORM				
C. THORII	RADIAL ROWS	WITH ROSETTE	CONVEX		IN CENTRAL & MARGINAL REGIONS	YES
C. WAILESII	RADIAL ROWS	FREE AREA	FLAT	YES		YES

Fig.1 - Matrix organized with a data base program useful to build the ESPHYNKS knowledge base.

An image bank build from observations of field and laboratory phytoplankton samples under optical and scanning electron microscopes is associated to the knowledge base. During consulting, the system combines image display with questions to facilitate the identification. At the present time the image bank includes more than 450 different views of about 150 species.

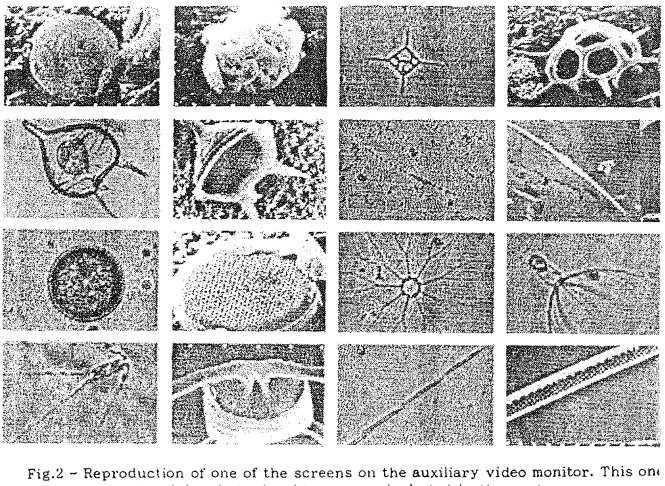

Fig.2 - Reproduction of one of the screens on the auxiliary video monitor. This one presents eight phytoploankton genus included in the system.

ESPHYNKS structure provides different ways for species identification in field samples being observed under the microscope or described by the user. Each session begins presenting a screen (Fig.2) on the auxiliary video monitor with images of the eight phytoplankton genus included in the system. Two possibilities are considered depending on wether the sample is identical or not to one of the images. In the first case, the answer is trivial and the system concludes about the genus directly. In the second, an interactive process isestablished with the user by means of questions, help menus and images displayed on the video monitor leading to the complete determination of the genus. After this first phase is completed satisfactorily, the same procedure is repeated for that particular genus until the species is identified or not, depending on the answers given by the user. Further development of ESPHYNKS would consist on the repetition of the method applied in the construction of the prototype.

This novel computerized system proposes a new way for species classification and greatly facilitates the task to non specialists in the field of phytoplankton (e.g., technicians working in environmental assessment projects, students, etc.). The system is also an excellent tool for educational purposes. The use of relatively inexpensive hardware also allows for remote use of the system once it is fully developed. Experts and technicians around the world may send their own optical or SEM images on diskette or through electronic mail to a central identification centre where full identificationcould be accomplished.