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MULTIMEDIA UPDATE: ADVANCES IN COMPUTER-BASED APPLICATIONS RELEVANT TO FISH AND FISH HEALTH

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Abstract. Computer software has become an important tool for fish health managers, diagnosticians, veterinarians, researchers and educators. This article reviews selected software applications which are either currently available, under development, or which may serve as inspiration for future development of appropriate applications in the fields of fish health. Computer-based multimedia is exemplified using the interactive fish anatomy and necropsy program *FishGuts*. The utility of other applications including programs for fish health (*Aqua Medic, Aqua-Vet, AquaPath*), data archiving ("*Animal Care System*" by Relevant using *4th Dimension, Nutshell Plus II, Filemaker Pro*), and general resources and entertainment (*LIFEmap, OceanLife, World of Sharks, Fishes of the Red Sea, Fishes of the Caribbean, Oceans Below, Aquazone, Undersea Adventure, Sakana Hakkei*) are also discussed. Development costs, effort, and the compartmentalized expertise of educators/scientists and programmers tend to hinder the production of quality software products. Collaboration and networking are necessary and fundamental to the expansion of utilitarian computer-based applications in aquatic animal health.

Keywords. Computer education, Multimedia outreach, Data archiving, Fish health

INTRODUCTION

Three days of chronic mortalities inspired hatchery manager Wayne Darling to search his hard drive for the *SwimRite*™ software (Salmonid version 2.01). With two sedated fish placed in the sample aquarium, Wayne launched the software and began the automated laser alignment. Three sets of lasers, which align the transceivers in three dimensions, swung into action above, below and to one side of the partitioned aquarium. The software application prompted a series of questions to which the manager responded; number of mortalities, observation parameters, water quality data download. On the bottom of the computer screen a small window appeared with text verifying the contents of the sample aquarium:

Specimen 1: *Oncorhynchus mykiss*, Kokanee strain, male, displacement = 356 cc
Specimen 2: *Oncorhynchus mykiss*, Kokanee strain, male, displacement = 477 cc

Wayne entered a keystroke to accept the species verification and begin the automated physical analyses. Within several minutes, the tests were complete and the primary screen display indicated potential etiologies. On the list was parasitic infestation in the posterior intestine. Apparently the lasers and magnetic resonance detectors picked up the cuticular structure of several nematode larvae in the gut of Specimen #1. Based on the number of nematodes found and the fact that only one of the specimens showed infestation (yet both had originally showed outward symptoms), Wayne correctly ruled out parasitism as an incidental finding. Next on the list was gas bubble disease. The hatchery manager sat up in his chair, clicked on the option, and stared intently into the monitor. He had not noticed any obvious

bubbles on the fins or exopthalmia in the affected fish. The water quality monitoring modules indicated that all parameters had remained within acceptable limits. So why was the software offering gas bubble disease as a possible cause of death? Wayne clicked on the analysis review sequence to evaluate the individual findings. Hundreds of minute gas bubbles were detected in the microvasculature of both specimens. They were so small that overt symptoms were not evident. The problem was caused by a recently-installed valving system downstream of the dissolved gas and temperature probes. The Kylar valves were installed backwards (things like this do happen), which caused cavitation and the formation of imperceivably tiny bubbles in the fish, particularly those animals which kept up with the current in the upstream-most portion of the raceways. Proper re-installation of the valves would correct the problem. One day, perhaps in the not-so-distant future, a scenario like this using sophisticated analytical software with integrated hardware for fish health diagnostics may be commonplace. Sorry Wayne, for now you'll have to rely on your intuition and the assistance of the state diagnostic laboratories.

Application of computer software in fish health, fish management and educational subjects including aquatic biology is not just a thing of the future. It is here and now. We are watching the birth and growth of the digital age and its application in many branches of the sciences. This article will review selected software applications which are either currently available, under development, or which may serve as inspiration for future development of appropriate applications in the field of fish health. This review will explore the concept of computer-based multimedia using the interactive fish anatomy and necropsy program *FishGuts* as an example. The utility of other applications, directly or closely related to fish health and biology, will be discussed. Mention of software pricing or manufacturer availability is based on best information at the time of submission to this journal. Some of the software listed may also be available through retail dealerships (e.g. Computer City, Comp USA, Egghead Software) or mail-order houses (e.g. EduCorp, Tiger Software, Mac/Micro Warehouse). Reference to software, manufacturers or distributors by the author does not constitute endorsement.

By definition, multimedia is the use of more than one type of media element for presentation purposes. In its simplest form, a textbook which incorporates text and pictures fits the multimedia definition. Many public display exhibits at museums, galleries and entertainment parks have used the multimedia concept more fully. Effective displays and presentations in these venues take advantage of multiple synchronized slide shows, text, moving pictures, sound, smell, vibration, motion, gravity, centrifugal force, and live or animated narration. Display effectiveness is related to the degree of participant engagement and, of course, to the content or message of the display itself.

Using computer-based multimedia to present factual information and games has been a thriving business over the last 10 years. The majority of informational computer-based presentations are, for the most part, electronic textbooks; click a button, turn a page. Some software applications are able to fit massive amounts of information, equivalent to multiple bound volumes, onto a single CD-ROM disk. Elegant examples of this include Microsoft's *Encarta* and the *Grollier Multimedia Encyclopedia.* These programs exemplify a significant reduction in space and weight, and a gain of an exciting media retrieval format including sound and movies. Of course, the CD-ROM disk is meaningless without a computer to run it on. Access to multimedia-equipped computers determines that degree of "portability" which the CD-ROM format proffers. For most professionals, given a choice of reading a page of text from a well-printed book versus a computer screen, the book page is preferable. The book page is both easier on the eyes and portable (you can take it from your office to the conference room, or even to the beach). To compensate for computer constraints (costs,

accessibility, comfort, etc.), a computer-based presentation should provide a combination of elements, subject matter, and a level of engagement not easily fostered by a printed (or video) format. Many publishers realize this and have produced an astounding variety of dictionaries, encyclopedias, games, etc. which incorporate text, color pictures, sound, movies and navigable environments. According to a review in the Wall Street Journal (Multimedia Hype Hides Virtual Reality: An Industry Shakeout, 2/28/95, by Don Clark), the number of multimedia titles produced from 1993 to 1994 has increased as much as 20 fold. Yet 90% of these titles sold less than two copies. No wonder a recent survey (noted in the same review article) indicated that 96% of software developers fail to turn a profit. Profit margins are often very slim; development costs for the majority of multimedia applications range from $100,000 to 300,000.

THE FISHGUTS PROGRAM

At the, University of Maryland's Aquatic Pathobiology Center, emphasis is placed on aquatic pathology and toxicology as it relates to Chesapeake Bay and the environment. We focus on effects of water quality and xenobiotic stressors, aquaculture, fish and amphibian health, and fish

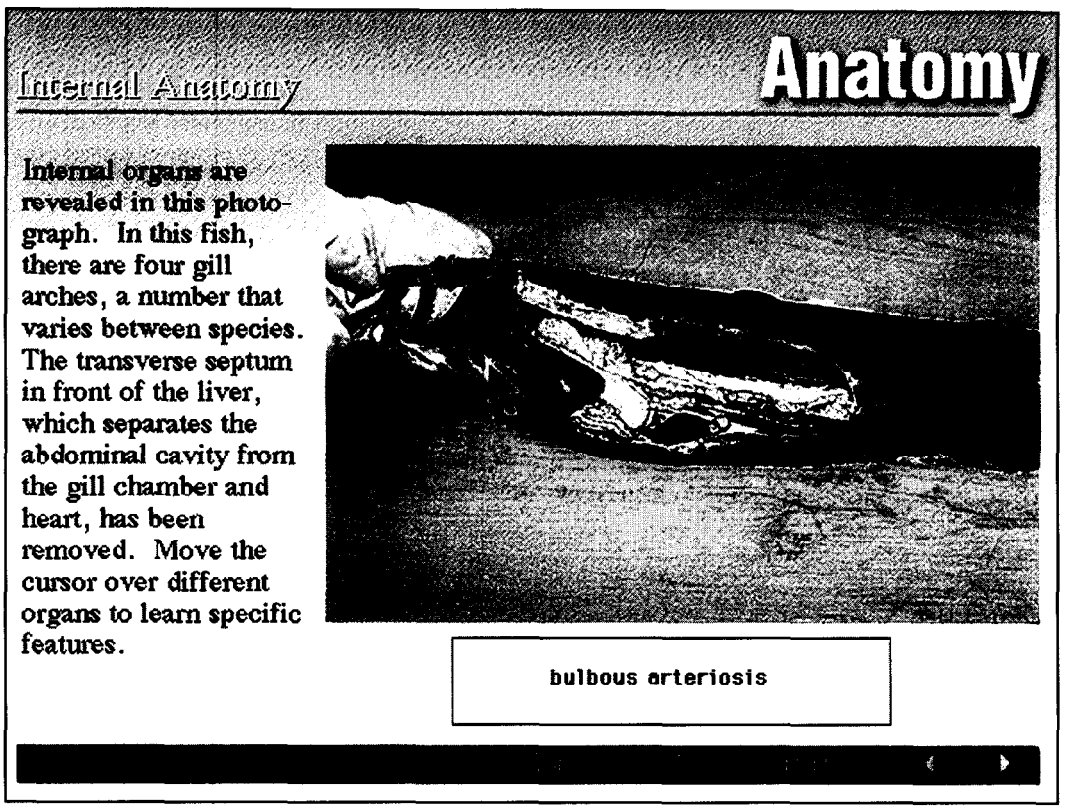

Fig. 1a. *FishGuts* illustrates fish anatomy and necropsy techniques: (a) interactive "rollovers" with the mouse cursor bring up names of anatomical features inside an information box, (b) QuickTime movies exemplify systematic necropsy techniques while various information buttons on the user interface support relevant animation, recipes and additional pictures, (c, d) sample cases reinforce procedures gleaned from preceding sections and include histopathology and parasitology.

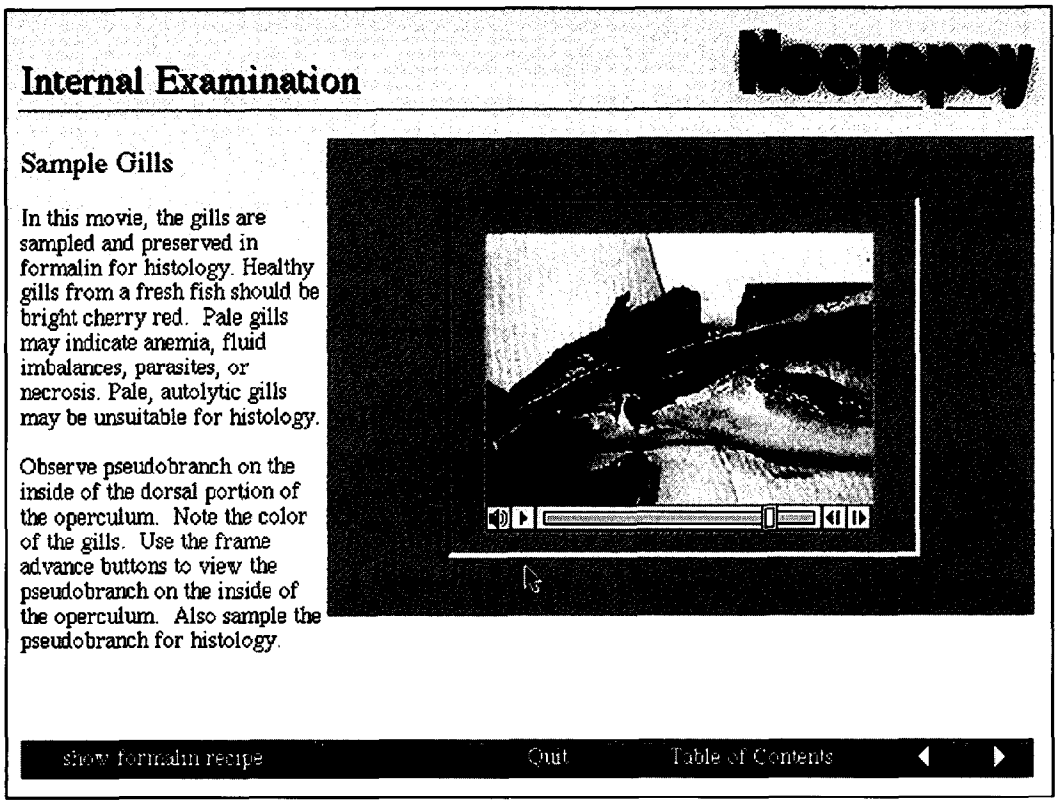

Fig. 1b.

as models of human disease. Over the years, our laboratory has seen thousands of diagnostic cases, with animals (mostly fish) from public aquaria, state fish hatcheries, ornamental fish breeders, hobbyists, pet shops and other fish research laboratories. Because of this vast breadth of clients, we have seen a great diversity of diagnostic cases. It became apparent that a multimedia training module would be an excellent vehicle to present a "hands-on" introduction to fish anatomy and the art of necropsy science, and that our database would serve as appropriate subject matter for storyboard development. As a training tool, this program could instruct off-site fish health managers, new interns, technicians, and graduate and veterinary students. Such a program would greatly reduce their learning curve for doing first-time necropsies. Against the odds of breaking even, but with utility in mind, so began the birth of *FishGuts*.

Use of a multimedia application like *FishGuts* cannot substitute for gaining actual necropsy experience. However, the software does offer a good (fun) review of general fish anatomy and standard fish necropsy protocol. The well-constructed screen layouts and banjo music should help keep you going through several hours of the program (less time if you choose not to read all the screens or venture into the "information buttons"). The *FishGuts* software is divided up into five navigable sections, each with separate subsections. These sections include:

Section 1: About FishGuts

- How to use the program (an animated narrative).
- Program credits and resources (including bibliography).

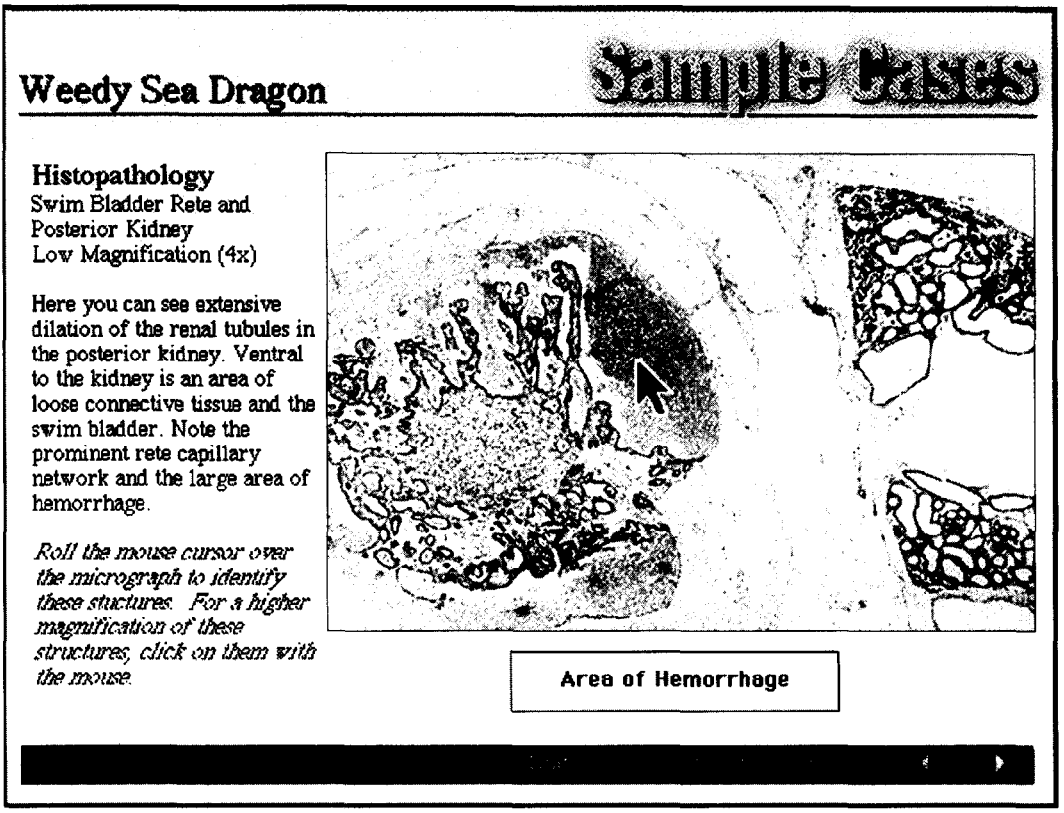

Fig. 1c.

Section 2: Anatomy

- Differences worth knowing (special sense organs, poisonous and dangerous fish, intraspecific differences).
- External anatomy (channel catfish model).
- Internal anatomy (rainbow trout, bluegill and channel catfish models).

Section 3: Necropsy

- External examination (non-lethal methods to examine a fish including anesthesia, general observations, skin scrape, gill biopsy, blood sampling, hematocrit and plasma protein, and gill function animations).
- Internal examination (sacrifice, systematic methods to dissect all organ systems and take samples for preservation and histopathology).

Section 4: Taking a case history

- Taking an organized case history specifically regarding fish.

Section 5: Sample cases

- Weedy sea dragon.
- Channel catfish.
- Toadfish.
- Additional case(s).

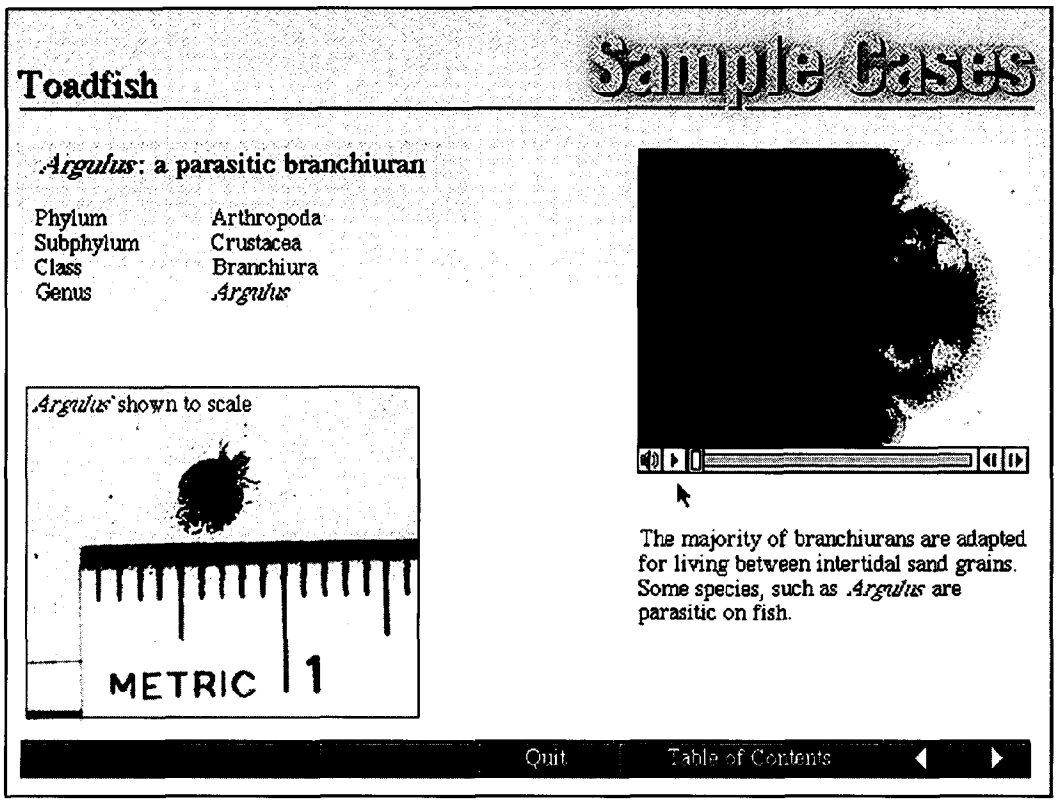

Fig. 1d.

Users learn how to use the program in the first section, and may utilize bibliographic information on fish anatomy, physiology and pathology. Once basic navigation skills are developed, the user moves on to learn about fish anatomy (Fig. 1a). The use of interactive "rollovers" becomes apparent in the Anatomy section. By rolling the mouse cursor over the external and internal characteristics, users may identify and magnify the different anatomical features. The section "Taking a Case History" reviews the collection of pertinent information to keep in mind while taking a relevant account of an animal's recent background (including water quality and animal- and tank-specific observations). The next section, Necropsy, is comprised of QuickTime movies which allow the user to view an actual necropsy of a rainbow trout. QuickTime movies permit the user full movie viewing control, including stop action, frame advance, fast forward and rewind. Internal and external necropsy subsections systematically go through sampling procedures for all organ systems (Fig. 1b). After the first four sections, users can go through several different sample cases. The sample cases are presented with a case history and results of examination procedures. Results include skin scrapes, gill biopsies and gut scrapes for parasites, histopathology, bacteriology, and parasitology (there is a movie of each of the parasites found, with information on parasite taxonomy and the ecological relationship with the host) (Fig. 1c, d). A final diagnosis is presented for the user to compare their observations with. Although

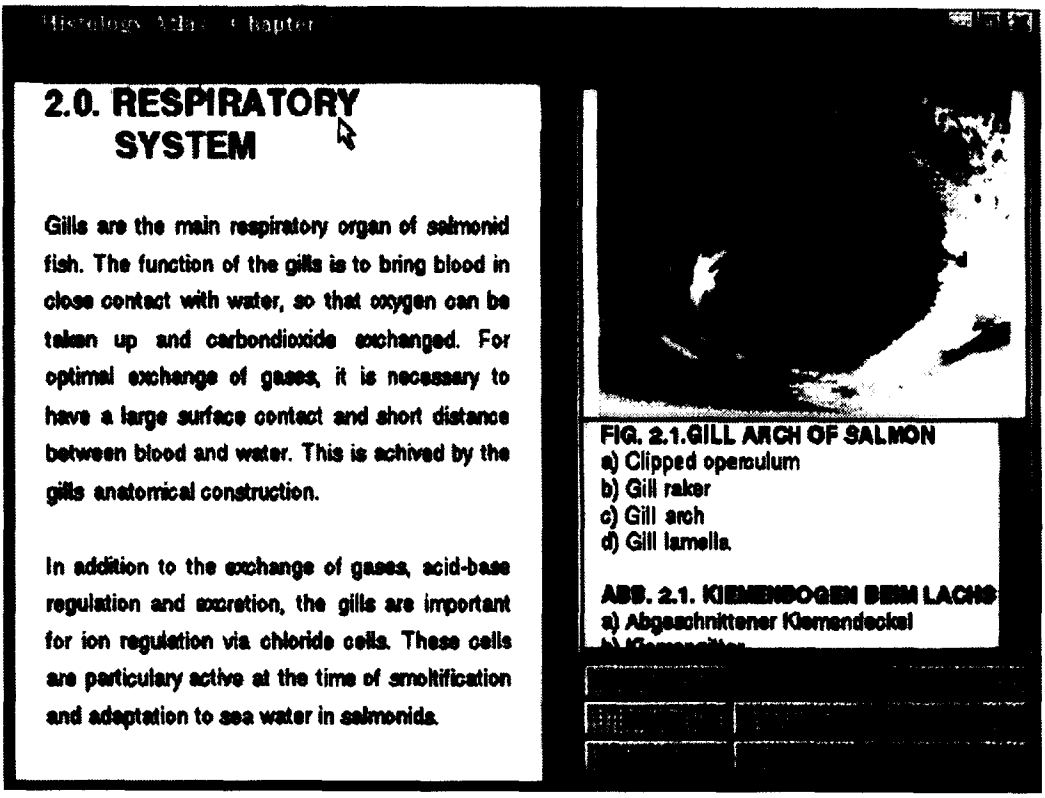

Fig. 2

FishGuts presents detailed fish anatomy and necropsy procedures, the program does not provide a diagnostic function or cross-referenceable disease attributes.

FishGuts was created using a several software packages including Photoshop (for image manipulation), *Premier* and *MoviePlayer* (for QuickTime movie editing), *SoundEdit 16* (for editing movie narration and creating sound bytes) and *Director* (for compiling the media elements and authoring the final interactive program). However, none of these software packages are required to run the distributable *FishGuts* program. System requirements for running *FishGuts* (as with many multimedia applications) include access to a Macintosh or Intel-based computer (running Microsoft Windows) with a CD-ROM drive, 8 MB RAM, QuickTime (software to run the movies), and a 14″ color monitor (640 × 480 pixels or greater). Most Macintosh computers with a CD-ROM drive are probably already "multimedia smart," and ready to use. For IBM-like computers, a sound board and video card are required to take advantage of the audio and movie portions of the program. In general, as with all multimedia CD-ROMs, more RAM and faster clock speeds (MHz) offer smoother program operation (particularly the movies).

At the time of this account, the *FishGuts* program is in final stages of development. We hope to have a cross-platform (i.e. hybrid disk for both Macintosh and Windows) CD-ROM version ready for distribution March 1995 at a cost of under $200. For additional information send email to: akane@umabnet.ab.umd.edu or contact Andrew Kane at the University of Maryland's Aquatic Pathobiology Center by mail or telephone (410) 706–7230.

OTHER FISH HEALTH SOFTWARE

In 1986 Michael Stoskopf (then veterinarian for the National Aquarium in Baltimore, presently Professor of Aquatic and Wildlife Medicine, Environmental Medical Consortium, College of Veterinary Medicine at NC State University) developed the program *Aqua Medic* for the DOS environment. This black and white, text-only program offers fish diagnostics using frame based programming. This type of programming allows for a disease to be characterized by various attributes (or symptoms). *Aqua Medic*, produced on floppy disks, includes approximately 100 diseases which are cross-referenced by over 190 attributes. By browsing through the program and choosing a disease, all associated attributes are listed. This program contains no graphics, color or sound, and is currently "out of print."

Another fish diagnostic program, *Fish-Vet*, distributed by Shawn Prescott, marine biologist and aquaculture consultant (Fish-Vet, Inc., 12620 Ivy Mill Road, Reisterstown, MD, 21136, 410–526–0573, $395), is currently available for the Windows platform. This application, inspired in part by Stoskopf's earlier efforts, also cross references attributes with diseases. Users are able to choose a browse function and look up marine and freshwater diseases with their associated symptoms. In many cases, clicking on the disease text brings up a color picture of the disease. There is also a diagnose function whereby users choose from various symptom categories (e.g. behavior, water quality, pathology, etc.) and check-off observed attributes from a scroll screen. Once the attribute list is complete, clicking on a diagnose button shows a list of diseases with relative probabilities listed for each disease. Users are able to go back and alter the attribute list to reconfigure the differentials at any time. For most diagnoses, pictures and treatments are offered. The diseases associated with the various attributes are derived by empircally algorithms, some of which still appear to require additional tweaking. For example, I entered typical symptoms associated with a *Trichodina* infestation. Although parasites, including *Trichodina*, came up in the prioritized diagnosis column, *Trichodina* was not listed in top (most probable) 5 diseases. Although the current version of this program should not be used for diagnostic purposes, *Fish-Vet* has utility for reviewing symptoms associated with various diseases and viewing related gross and histologic images. The still images presented in this program are nice although little explanation is offered of what is seen. Users should be cautioned that, contrary to its title and publisher, this software was not authored by a veterinarian and it does not serve as a substitute for the expertise of a veterinarian or fish pathologist.

AquaPath: Normal Structure of Salmonids is a new instructional software program on fish histology (Windows platform, available from Akvapatologisk Laboratorium A/S, Tollbugt. 10, Box 773, N-8001 Bodø, Norway; telephone 47 75 52 68 52; $630-U.S.). Anil Amin and Mikail Schuster have patterned this digital histology atlas after their hardcover 1992 volume (*Histology Atlas: Normal Structure of Salmonids*) co-authored with Liisa Mortensen and Trygve Poppe. The software offers twelve navigable chapters on the different organ systems and includes text, photographs, and micrographs which can be magnified (Fig. 2). A glossary allows users to define specific terminology. Hypertext permits jumping from glossary terms to the different chapter sections. Figure legends are offered in English, German, French and Spanish, and the program includes chapter quizzes for self-assessment. Although the image quality in the current version of *AquaPath* may not be quite as nice as the original book, an updated version of the program promises textbook-quality images in addition to the ability to use "bookmarks" and "notepads" for different users.

Additional multimedia projects by this author underway at the University of Maryland's Aquatic Pathobiology Center include *FishPath* and *Perfect Parasites*. *FishPath*, under

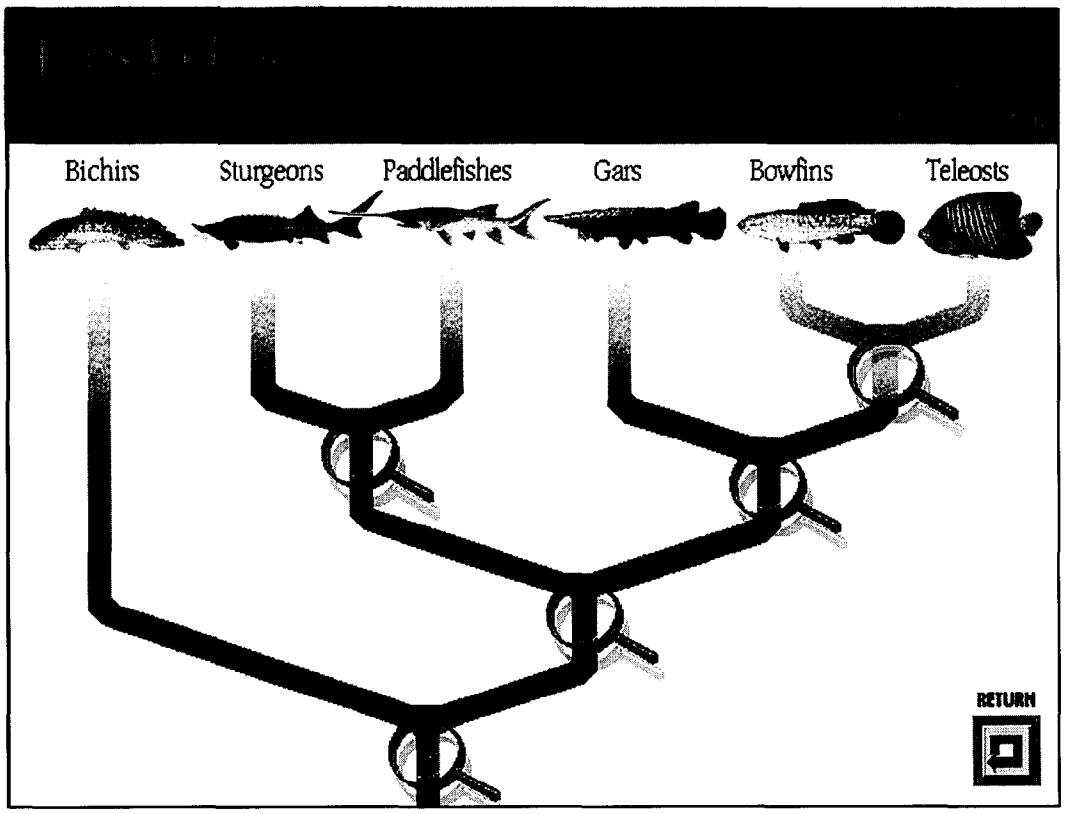

Fig. 3a. The *LIFEmap* series allows users to learn about adaptive radiation between similar groups of animals by (a) clicking on the respective magnifying glasses of the cladogram, and specific aspects of the different taxa by (b) clicking on the animals.

development with Renate Reimschuessel, with serve as a compendium of cross-referenced fish diseases. Cases will include fresh- and saltwater fishes with history, color high resolution gross photographs and histologic micrographs, and final diagnoses. All materials will be accessible such that users may systematically look up examples of specific diseases/infections referenced by disease, organ system or species. *Perfect Parasites*, under development with Sarah Poynton, will reference a wide variety of protozoan and metazoan fish parasites. This volume will also contain color photographs and micrographs, as well as QuickTime movies of fresh specimens. We hope that both of these volumes will serve as utilitarian teaching and reference materials.

DATA ARCHIVAL SOFTWARE

Several investigators have innovatively adapted archival software packages for storing fish health data. Howard Krum at the New England Aquarium has been working with Ray Haarstick (Relevant Technologies, Inc.) to make custom-programmed databases using commercially available *4th Dimension* software. Relevant's "*Animal Care System*" (currently Macintosh, expanding to include Windows) permits archiving of individual medical records including

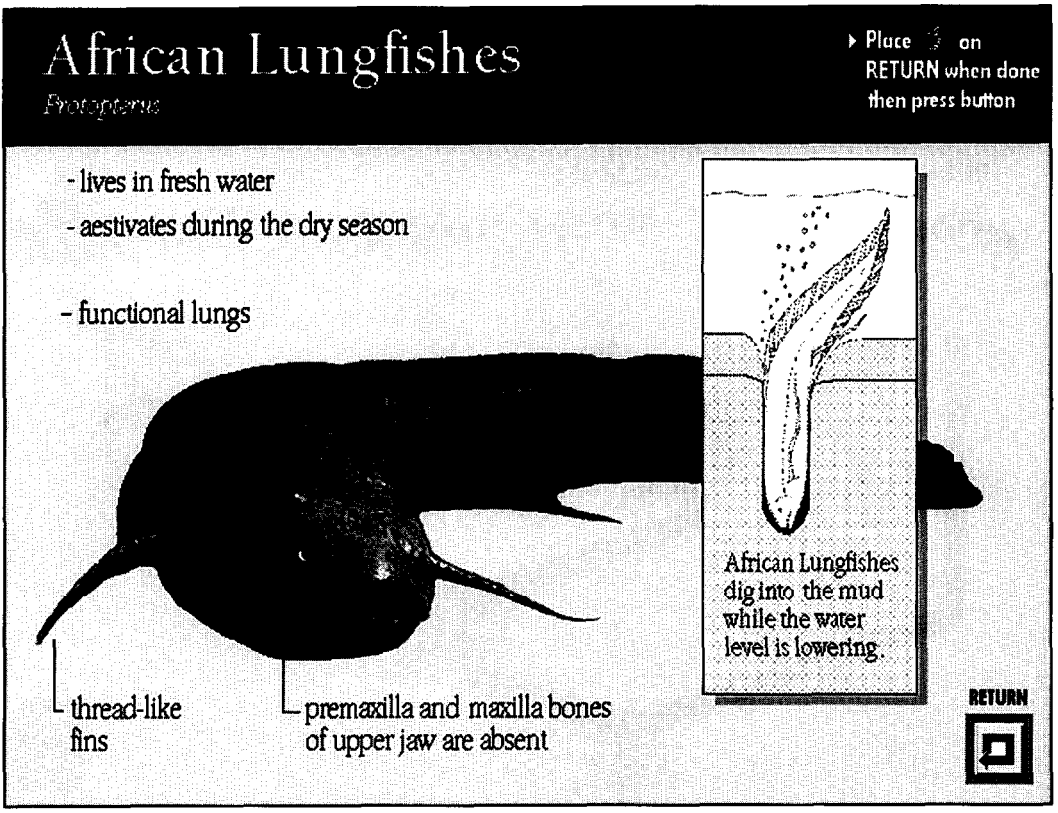

Fig. 3b.

background, treatment and husbandry data, full color photographs, histological micrographs, X-rays, ultrasound, movies, and anything which may be digitally scanned. Users may retrieve records based on the case or cross-referenced attributes. Data entry is obviously a time consuming process, but well worth the effort to be able to have instant in-depth access to similar cases, and the ability to transmit the already-digitized files using file transfer protocols (ftp) anywhere in the world. Software installation and training is available from Ray Haarstick at Relevant (617–864–9500, ext. 234).

Templates for other archival software are also being used for storage and reference of diagnostic databases. Ron Thune and John Hawke (Louisiana State University, 504–346–3312) utilize the Windows-based *Nutshell Plus II* package by Iris Software. LSU fish diagnosticians have made specific templates for this text-only database application. Thune and Hawke use their customized templates for in-house data management, with ease of cross-referencing cases by various attributes and amassing epidemiological data. Templates on floppy disk, which are easily re-customized, are available by contacting John Hawke at LSU. Larry Hanson (Fish Diagnostics Laboratory, Mississippi State University, 601–325–1202) similarly uses a custom template on the Macintosh platform using *Filemaker Pro* by Claris. He is also willing to share his templates with interested persons. In either case, the templates are useless without the original software on which to run them.

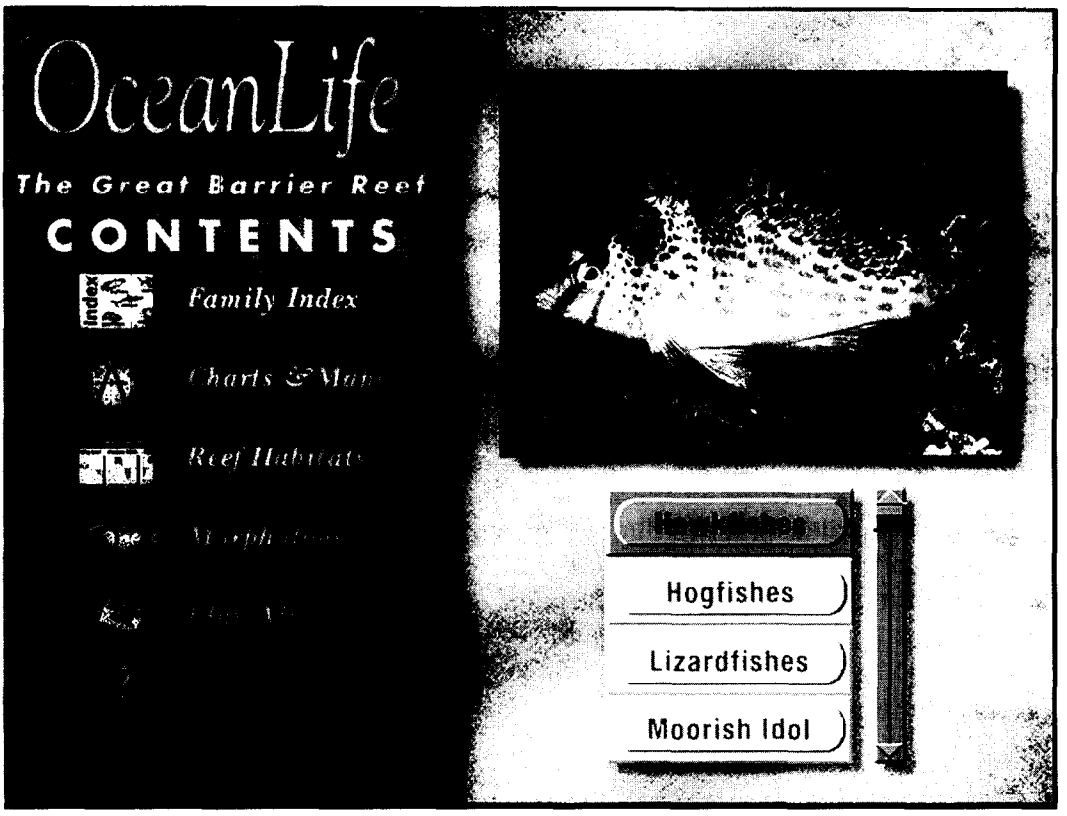

Fig. 4a. The *OceanLife* series shows (a) an intuitive user interface with scroll selections for different groups of fishes. By clicking on a fish group of interest (b), specific taxa are brought up with a layout offering text, narration, distribution range and movies.

OTHER FISH-RELATED APPLICATIONS

Perhaps worth mentioning are a few commercial applications for the general market which deal with fish, although they do not focus on fish health or disease. One such program is *LIFEmap* (California Academy of Sciences, distributed by Warner New Media, 3-CD set available individually, Macintosh platform only, $45 each). Originally designed as a museum kiosk, this program addresses the evolution of eukaryotes. The volume entitled "Animals With Backbones" visually examines diversity and evolutionary relationships between fish (both living and extinct), amphibians, reptiles and mammals. An esthetic interface guides the user through phylogentic trees (Fig. 3a) which are linked to color photographs (including hagfish through advanced teleosts and lunged tetrapods) explaining respective evolutionary advancements through the various taxa (Fig. 3b). Although this program may not contain sufficient depth for college-level teaching or reference, it does provide a nice phyletic overview of vertebrate evolution.

Another CD-ROM set, epitomizing educational multimedia for the general public, is the four-volume *OceanLife* series (Sumeria, 329 Bryant Street, Suite 3D, San Francisco, CA. 94107, 415–904–8000, hybrid Macintosh/Windows CDs, $49/volume). Each two-disk volume contains beautiful color still photos and QuickTime video clips exemplifying fish and other

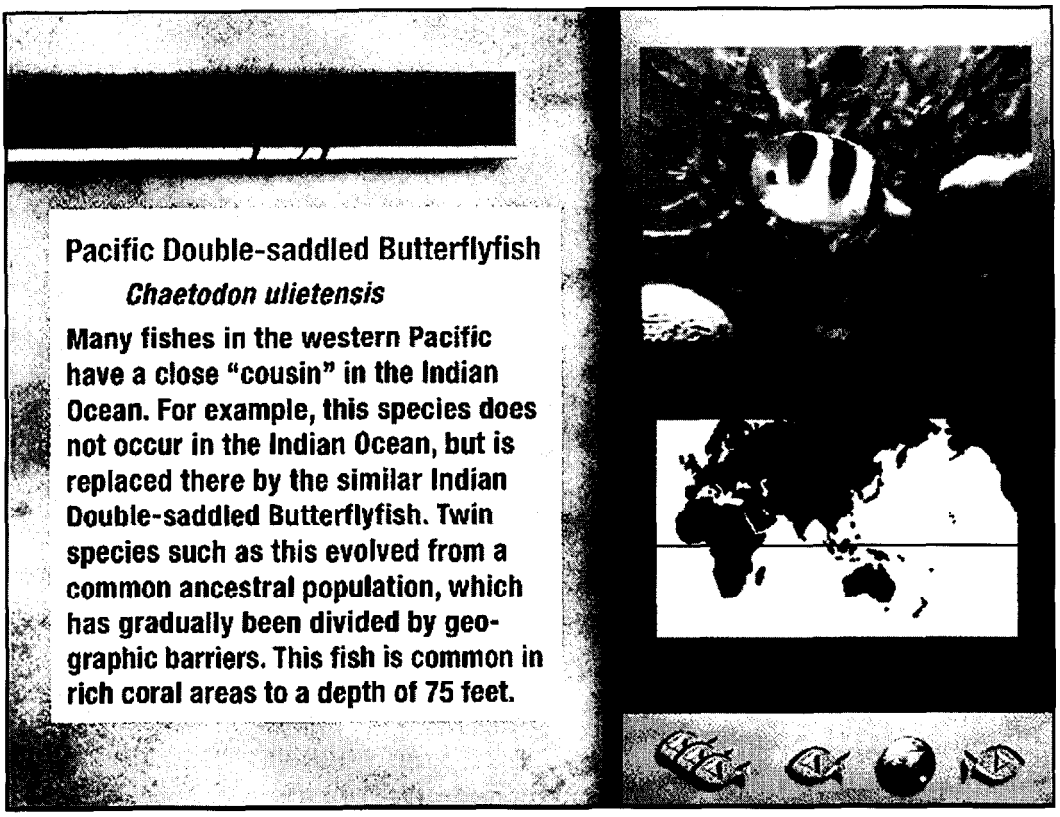

Fig. 4b.

marine biota. Volumes 1–4 include: The Southwestern Pacific, Micronesia, Hawaii and the Great Barrier Reef. Music and narration complement descriptions of hundreds of fish species, including behavior, distribution range, and taxonomy (Fig. 4). Contents also include (very) basic external anatomy as well as interactive maps and illustrated habitat ecology. A text search mechanism and the ability to browse by photo, movie, name or key word serves to cross-reference the media elements. This meritorious application is authored in *Director*, and may be of appeal to anyone interested in learning about marine life in general. Another boon for Sumeria's programs is that text and movies may be exported into other user applications for teaching. A fifth *OceanLife* volume on the Caribbean is soon expected which incorporates an expanded morphology section including internal anatomy.

The World of Sharks, *Fishes of the Red Sea* and *Fishes of the Caribbean* are three interactive applications on CD-ROM (Sea-D Publishing, P.O. Box 30076, Seven Mile Beach, Grand Canyon, BWI, 809–949–8327, Windows versions, $34.90 each). Each of these digital adventures allows exploration of a variety of underwater habitats with a myriad of color photographs and movies of the regional fishes. A nice user interface (Fig. 5) allows users to learn about fish alphabetically and by group, and extract information on fish ecology and home aquarium tips. Clicking on photos brings up full-screen enlargements, and a morphing tool allows viewers to see transitions of fishes "changing" from juvenile to adult or to see changes in color adaptation. Hypertext allows the user to click on green or blue words to offer

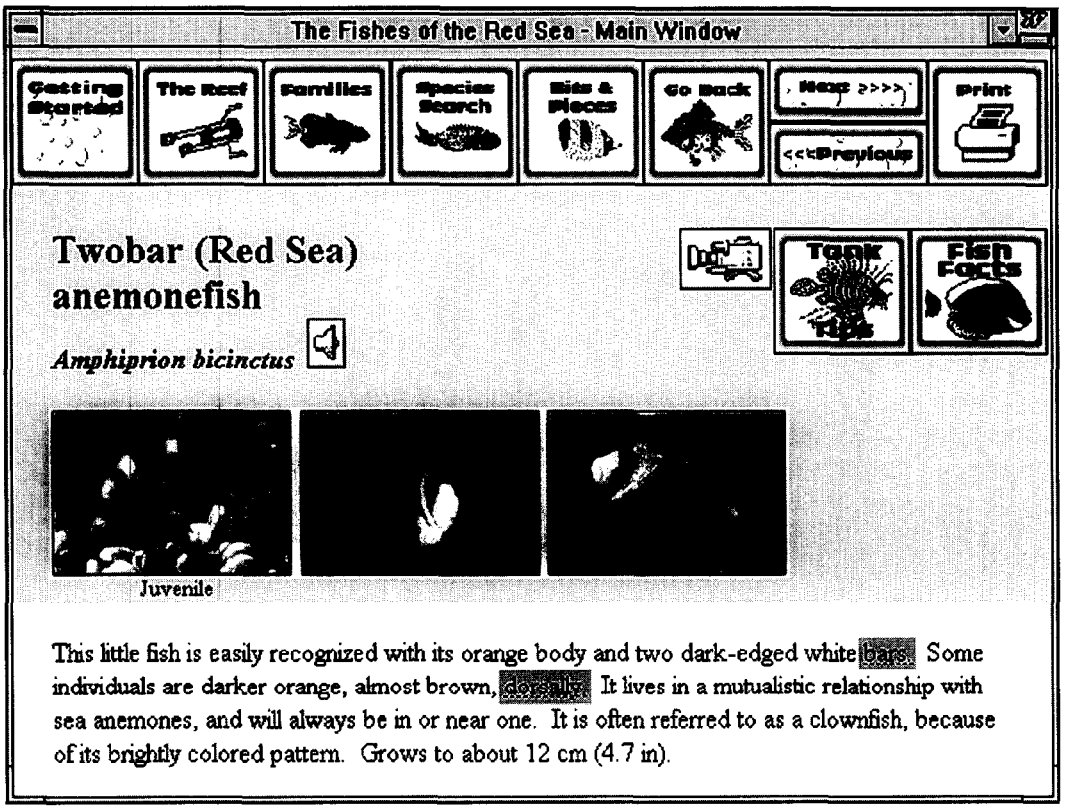

Fig. 5. *Fishes of the Red Sea* offers a graphic interface which links the user to information on taxonomy, aquarium maintenance and species-specific trivia. Users are also able to access the (shaded) hypertext definitions, browse for information on other species, and hear pronunciation of the scientific names. A help and print function are also available.

definitions or take you to other portions of the program. Clicking on a speaker icon gives pronunciation of genus and species. The depth of information offered in these programs is moderate, but there is lots of it. The design of these applications is splendid and the programs are enjoyable to explore.

AQUAZONE is a computer simulation which allows the user to design their own digital aquarium. Developed in Japan and distributed in North America by 9003inc. (P.O. Box 45009, 2482 Yonge St., Toronto, Ontario, Canada, 416-487-1777, Macintosh/Windows hybrid CD-ROM, $39.99), this program installs from floppy disks and re-creates a real home aquarium experience. The digital aquarium requires heating, filtration and water conditioning, and the addition of fish, plants, gravel and (sometimes surreal) props and backdrops (Fig. 6a). Users take control over feeding, medication, water change and filter cleaning regimes. Water quality parameters (temperature, pH, hardness, dissolved oxygen, nitric acid, ammonia, chlorine, magnesium and calcium) may be measured at any time and reflect tank manipulations (feeding, stocking density, medications, change in temperature, etc.) (Fig. 6b). Aquarium events (pregnancy, sickness, mortality, alterations in water quality) take place in real (or excelerated) time, whether the program is running or not. Although the number and kinds of fish which can be

Fig. 6a. *AQUAZONE* allows users to set up (a) personalized aquaria by positioning different plants and backdrops, and adding fish. User-activated information windows (b) offer information on each tank inhabitant, presence of disease and water quality status.

placed in the aquarium are limited, the program is well executed and documented, and is fun to play with.

For those interested in exploring the undersea via SCUBA diving, *Oceans Below*™ simulates the experience (Mindscape, 60 Leveroni Court, Novato, CA, 94949, 415–883–3000, Macintosh, DOS or Windows, $49.95). Users are able to visit seventeen dive sites worldwide including the Caribbean, California coast, Red Sea, Hawaii, South Pacific, Australia, Sea of Cortez and the Galapogos. At each site users learn about the area above and below the water. The program contains color photographs and extensive video footage of many fish and other marine life, as well as music, sound, graphics and text (Fig. 7). Insufficient detailed technical facts about the biota may leave a student of marine biology thirsty for more information. However, youngsters, novice divers and armchair marine biologists can gain enjoyment from this adventure title.

For youngsters (age 5–12), *Undersea Adventure* (Knowledge Adventure, 4502 Dyer Street, La Crescenta, CA 91214, 800–542–4240, Macintosh or DOS/Windows, approximately $35) offers a view of marine life with navigable color photographs and narrated QuickTime movies. Users can navigate the program (with balloon help) to play games (Who Am I?, What Do I Eat?, Can You Find Me?), visit an undersea theater and marine animal laboratory, or take an

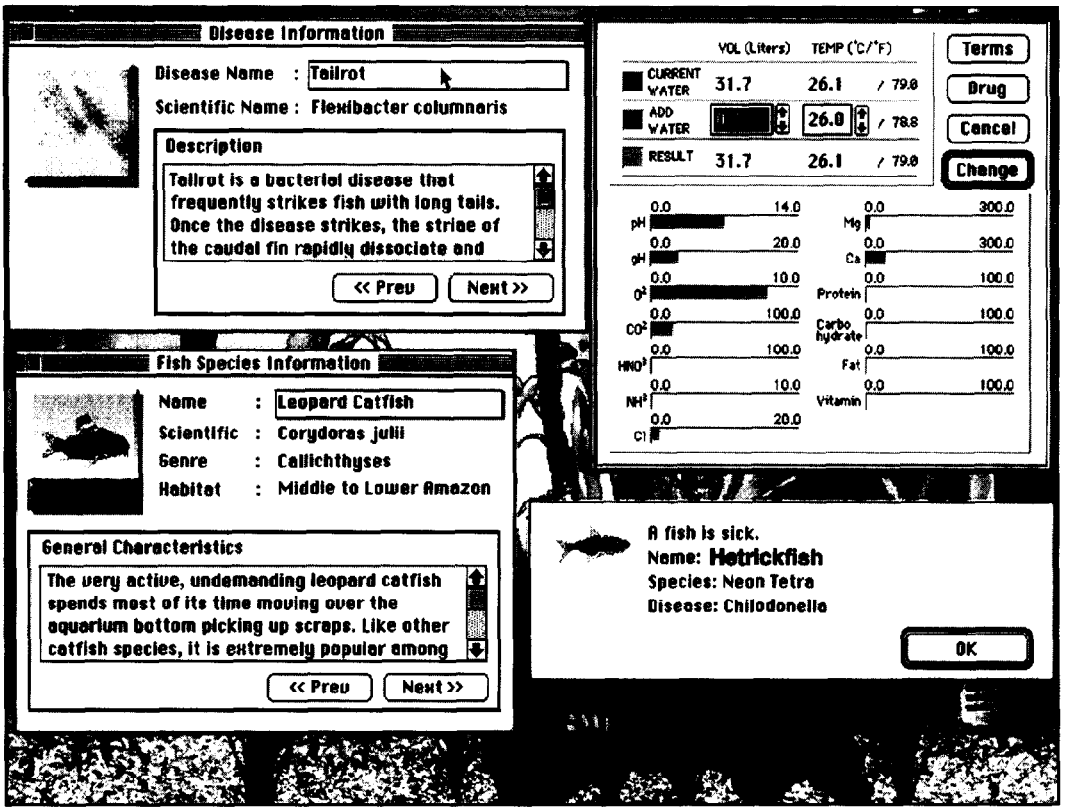

Fig. 6b.

ocean tour. This program is based on the Random House Atlas of the Oceans and features an introduction by (who else?) Jacques Cousteau.

On the other end of the spectrum, and mentioned for purposes of extreme, is *Sakana Hakkei*. This title (translated means "Eight Beautiful Views With Fish"), is soon to be released in Japan by the NEC Corporation, according to an article in Newsweek (June 12, 1995). The program requires a computer-operated laser disk, a high-definition television monitor and a real, water-filled glass tank. Video images of exotic fishes are projected through the tank to create an ultra-realistic effect. It had better be good for $18,000.

CONCLUSIONS

As more colleges, universities, and diagnostic laboratories take advantage of personal computers, development of software for fish health education, management and diagnostics is becoming increasingly appropriate. Development costs and stifling effort may hinder commercial production of some software, since the target audience is relatively small. However, software companies have begun to take the interests of scientists and educators to heart by developing new multimedia authoring packages which are relatively easy to learn (as compared with the "higher-end" authoring software such as *SuperCard, Director, Authorware*, C++, etc.). One such application to create interactive multimedia is *Digital Chisel* (Pierian Spring Software,

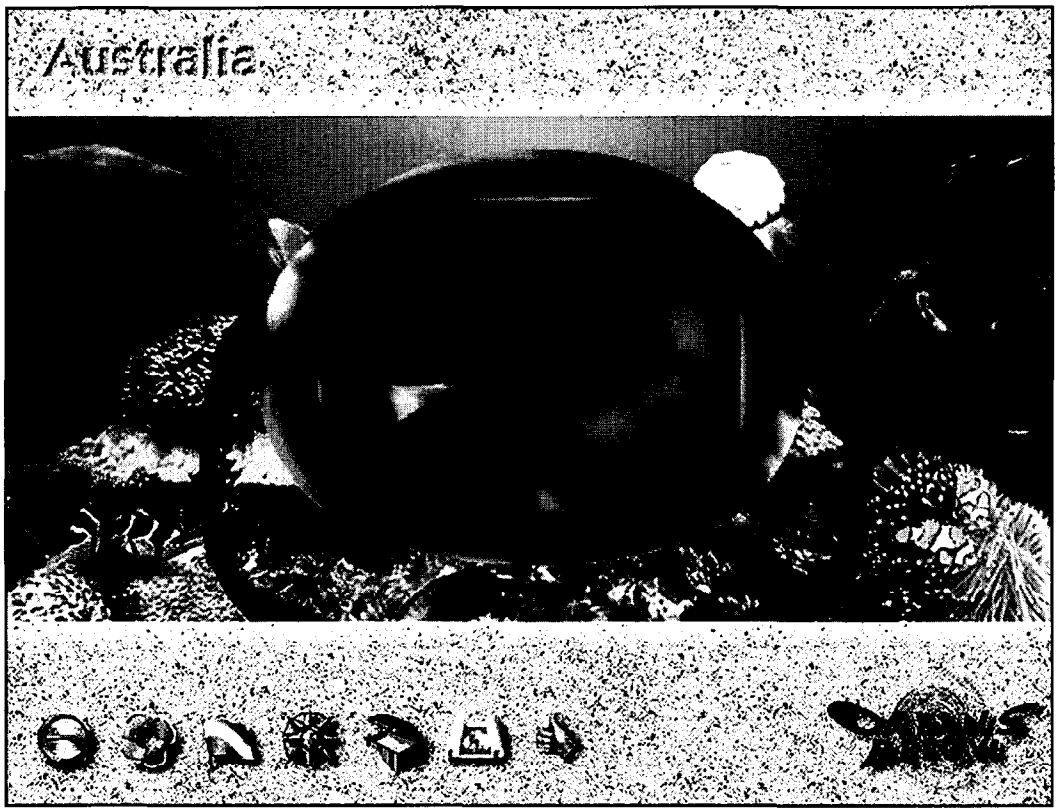

Fig 7. The interface for *Oceans Below* includes information on dive equipment, world-wide dive sites, maps and help. After making a dive descent, users may click on identified fish and other animals to view a movie of them through a dive mask viewer.

5200 SW Macadam Avenue, Suite 250, Portland OR 97201, 503-222-2044; $120; Macintosh only; soon to be for Windows; reviewed in *MacUser* Jan. 1996). This program contains ready-made templates for navigable buttons, screen layouts, and quizzes (for which the data can be stored). Further, development of multimedia-based outreach modules may serve as impetus for collaboration between fish disease experts and established computer-media divisions within various universities and other institutions. As with most areas in fish health, networking and perserverance will help foster the development of utilitarian multimedia and other software applications.

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