Collection, Development and Delivery of Forest Integrated Pest Management Images Via CD-ROM

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ABSTRACT

Evolving multimedia computer technology including the World Wide Web (WWW) provides exciting possibilities for information transfer and delivery. However, current communication capabilities can limit effective transfer of information via the WWW, particularly materials that contain high-quality, large file size color images. Limitations on image transfer is of particular concern when dealing with the numerous and complex assemblage of insects and pathogenic organisms present in forested environments. The small size and varied impact of insects and pathogens on trees require extensive knowledge and the availability of high-quality, high resolution pictures and drawings for proper identification. Unfortunately, forest workers often receive limited insect and pathology training. Additionally, due to shrinking budgets, publications containing high-quality, color photographs are becoming increasingly scarce or are, practically speaking, unavailable. This paper will report on a project dealing with the collection and dissemination of images pertinent to national (U.S.) Forest Integrated Pest Management via CD ROM.

http://www.ces.uga.edu/Agriculture/forest/www_cdad.html

Keywords: Forest IPM, forest insects, forest pathogens, multimedia, digital images

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INTRODUCTION

Forestry is an important component of U.S. and world-wide agriculture. Trees and forests are dominant components of our landscape providing vital products and amenities to society. Large numbers of plant and animal species are present in forested environments, most of which are beneficial or are non-intrusive to man's use and management of forests. However, other species sometimes become pests and can degrade individual trees and forest stands, increase management costs, decrease stand growth, and mar aesthetics. Forest pests impact the beauty of, as well as kill, high-value trees in home, commercial and recreational landscapes, and annually cause untold economic losses.

Integrated Pest Management (IPM) holds great promise in forestry to promote forest and tree health and is a component of the Forest Health Initiative now being endorsed by The U.S. Forest Service and other U.S. agencies. IPM can be defined as the intelligent use of pest control action that will insure favorable economic, ecological and social consequences (Metcalf and Luckman 1975). IPM is part of a management system that integrates all appropriate disciplines and available technologies to manage pest populations so that their negative impact(s) are reduced or eliminated. Although significant amounts of both private and governmental funds are expended on research, suppression and management of selected forest pests (e.g. gypsy moth, southern pine beetle, etc.), there are currently relatively few forest IPM educational specialists. Consequently, the ability to disseminate comprehensive forest IPM information and education to the wide array of audiences is limited. Although the U.S. Forest Service produced a number of high-quality, color Forest IPM training materials in the late 1970's and 1980's, relatively few have been updated since then, and quantities are now limited or the publications are out-of-stock. With the general downsizing in personnel and reduced budgets currently on-going in U.S. public institutions and agencies, the prospect of an increase in availability of traditional published guides containing IPM color visuals is dim.

Some exciting aspects of the current state of computers and communications systems are the ability to deliver information that integrates text, graphics, video and audio into multimedia applications. These evolving computer technologies provide authors and educators with the ability to incorporate graphics and sound into presentations, whether on stand-alone desktop systems, or through systems connected to the Internet and the World Wide Web (WWW). However, for educators, there are still difficulties with the process: Graphics, video and sound must be digitized prior to incorporation. Authors and users must have appropriate software and specifically equipped hardware to develop, observe and experience and hear the information. Authors and program designers must be functionally versed in graphics design and proficient in utilization of appropriate computer software and hardware systems, as well as being knowledgeable in the scientific discipline(s) that are the subject of the presentations. Consequently, it is often necessary to form a project design and application team comprised of individuals with the necessary broad-based experience and capabilities. Additionally, high resolution digital graphics images can be several megabytes in size and can take-up large amounts of disk storage space. Large graphics files may require several minutes to retrieve via

communications access speeds now available to many users. Consequently, developers need to carefully evaluate trade-offs between image file size and the quality and resolution of the graphic necessary for the application, that also allows reasonable access time-frames for user downloads. And very importantly, the author must have suitable images available in appropriate digitized format before they can be included in a presentation.

The authors will report on a Forest Integrated Pest Management project funded by USDA Cooperative State Research, Education, and Extension Service that provides users with a repertoire of easily accessible digital images for subsequent Forest IPM uses and applications. Project objectives included: collection, digitization and dissemination of a comprehensive set of forest pest graphic images (principally photographs) in computer accessible form via CD ROM. Users and authors will be able to retrieve images that can be used to develop and deliver customized IPM products to varying audiences using print and electronic technology.

The authors did not propose to photograph the images themselves, rather the intent was to retrieve original slides and photographs from agency archives that were used to produce the many excellent USDA Forest Service and other U.S. and State agency publications, published principally, in the 1970's and 1980's. Unfortunately, the authors soon determined that in most cases, the original images were returned to the individual or location from which they were obtained after printing of the publication, often with no record of the source of the image. In most cases, no centralized archival of images occurred. Consequently, the authors/project coordinators had to make extensive contacts and requests of the many individuals and agencies to locate and obtain the desired images.

IMAGE ACQUISITION

Among the problems encountered by the authors in obtaining images were:

1. determining which images should be included. Also, what life stage, damage manifestation, etc. should be included?

2. selecting images from those available. It takes exceptional originals to provide good digitized images, particularly at high resolutions. The more removed from the original slide, the poorer the quality of the digital image.

3. it was often not possible to determine who had provided the image for the publication.

4. the person who had taken/submitted the desired image has retired, transferred or has taken another job. In many cases, their slides/images have been dispersed or lost.

5. only copies of the desired images were available, resulting in relatively poor quality digital images.

6. convincing the individuals who possessed the images to allow us to "borrow" them. The process we used to digitize, archive the images, and return the slides required several weeks.

Images were obtained in one of several ways. The authors:

1. made trips to agency and institutional offices known to have extensive slide collections to select and obtain slides from agency and individual scientist's slide collections.

2. attended regional and national meetings, conferences and workshops to make contact with scientists and solicit contributions of images. The authors followed-up on the contacts made at these meetings to obtain images.

3. contacted scientists and agency work units directly via telephone and/or letter to solicit images appropriate to their particular area of the country. It was necessary to provide details of the project and the processes that we were using to convince the contributor to send us their "original" and in many cases, their only copy of the images.

Great care was exercised by the authors during the image selection process concerning the photographic quality, composition and subject matter of each image. The authors insured that appropriate labeling of the image (slide) was accomplished so that both the subject and source of the image were known.

IMAGE PROCESSING AND ARCHIVAL

As the slides (images) were obtained at our work unit, we:

1. logged the source, number of images and date received, and assigned a "job number" for tracking purposes.

2. placed the slides in notebook-format poly slide sleeves (capable of holding 20 35mm slides each) with any writing on the slides in the up-position. Each slide sleeve was labeled with the job number and then photocopied to document the job prior to further processing.

3. the slides were sent to a photography shop for duplication. The duplicate slide was used as a reference of the image and to guide later computer editing of the digitized image.

4. after duplicate slides were received, the originals were sent to a commercial image processing facility for digitization and creation of our digital archive copy.

We used an image facility licensed by Kodak for digitizing images even though we have the in-house ability to digitize slides using a Polaroid SprintScan slide scanner attached to a Windows-based 486 66Mhz computer [equipped with 20 megabytes of RAM, a one gigabyte internal hard drive and a 270 megabyte removable storage drive (Syquest SQ270)] for the following reasons:

1. high resolution scanning is necessary to insure details and colors are captured from the original image. For low resolution applications, high resolution scanning may not be

necessary, but if the digitized image is to be used for printing of large photographs, slides or offset publication prints, a high definition image is required.

2. high resolution scans at over 2000 pixels are very large files (typically > 12 megabytes each). Scanning of large numbers of images requires very large storage capacity.

3. slide scans at high resolution on our in-house slide scanner take about 15 minutes to complete, including naming and saving of each computer file. Since our jobs consisted of dozens to sometimes hundreds of images, the scanning process could take hours to several days.

4. including shipping time, the Kodak Service Provider was usually able to provide a job turnaround time of less than one week.

5. by freeing us of having to scan the slides, we were able to work on other tasks.

Our Kodak Provider digitized the slides relatively inexpensively (generally < $ 3.00 U.S. per image) at high resolution (up to 2048 x 3072 pixels) and provided an archive of each image in Kodak Photo CD format on a Photo CD disc. Each Photo CD disc is labeled with a unique Kodak Photo CD serial number, and each of the 100 images on the Photo CD is uniquely numbered (1 - 100). We combined the disk serial number and the image number to create a unique, permanent image reference number.

See Gosney, et al. (1995) and Kodak (1994) for a detailed discussion, documentation, uses and advantages of the Kodak Photo CD process. See Rice and Wintersteen (1995), and Douce, et al. (1995) for entomological applications of Kodak Photo CDs.

6. the permanent archival reference number was written on duplicate slides, in our image database, and in all documentation and references to that image.

7. identification, credits and appropriate notes for each image were entered into the image database (see details of database below).

8. the original slides were returned to the contributor accompanied by a print-out of our database information requesting the contributor to correct and verify the textual and credits information.

PROJECT DATABASES

It is essential that appropriate information accompany any image that will be used by audiences other than the original photographer. The authors decided that it was necessary to maintain a computerized database containing (at a minimum) the following information for each image:

1. our project permanent image archival reference number

2. group—e.g. Insect, disease, wildlife, etc.

3. host

4. geographic area of occurrence (if appropriate)

5. category—defoliators, foliage diseases, boring insects, etc.

6. scientific name, or if not appropriate, as much name classification as possible, such as Family, etc.

7. appropriate common name, if there is one

8. a brief description about the image (e.g. adult spruce bark beetle, aerial view of damage, etc.)

9. photographers name, or other photographic credit

10. affiliation and location of the photographer or photographic source

11. a free-form textual description of the image, available if needed (optional).

The authors wanted to avoid developing codes and categories unique only to this specific project. We also wanted to provide opportunities to coordinate products of the Forest IPM Image project with other applications and projects. It was decided to use codes, categories and conventions already developed and in use by the USDA Forest Service Pest Trend-Impact Plot System: PTIPS (USDA, 1994) rather than develop ones specific to the Forest IPM Image project.

The authors felt it was important to not only catalog the above information for each image, but also to have the ability to enact customized database searches so that both information and images could be retrieved on specific topics. For example, we may want to locate all images in our project database for a particular insect, or all photos taken by a particular person. After evaluating several commercial multimedia database software packages, we determined that we would have to develop a customized project database for our application. We finally settled on using Paradox For Windows (Borland International, Inc., part of Novell's PerfectOffice Suite) to build our project database. Our initial Paradox database included both the textual and graphic image representation in one database. However, this database quickly became very large and unmanageable and we subsequently split the database into two. The first database contains the textual information listed above, while the second contains grey-scale image representations to reduce files size (which are still approximately 40 kilobytes each) and our image archival reference number. Using Paradox, we are able to enact a search on each element or any combination of elements contained in the textual database to find the desired image references and descriptions. From the textual database search, we can create a subset of image numbers for which we wish to select images from, and then link to the database containing image facsimiles to view the corresponding graphical image(s), thus greatly strengthening and simplifying our image retrieval capabilities.

PACKAGING AND DELIVERY

The intent of this project was several fold. Among the reasons for undertaking the project were:

1. to provide users with access to a large number of quality images on Forest Integrated Pest Management that can be used as a repertoire of images for specific application(s). The authors had previously found that it was a difficult, time-consuming and an expensive process to acquire a comprehensive set of images on forest insects, diseases and management practices.

2. to provide users with quality Forest IPM images in electronic format(s) that would allow the users or authors of electronic publications and applications to have quick and effective access to a wide array of images. The authors wanted to provide a repertoire of quality images to potential users rather than to embed those images within a pre-designed and pre-packaged application or publication. See Cranshaw, et al. (1995) and CSU (1995) for an excellent entomological application with color graphics that utilize both traditional printed materials and electronic ("pre-packaged") documents.

3. to provide users who need a large number of images at any given time, ready access to images on their local system without having to search through many servers on the World Wide Web, download those images, and then resequence and/or edit them for their specific need. Targeted uses include: University faculty making electronic-assisted lecture(s) to students; authors of training programs that may be designed and packaged by one person or group, and played back by another person in a training session; a Vocational Agriculture Instructor teaching Future Farmers of America high school students about pests in the forest environment; or an Extension Service County Agent working with students preparing for the National Forestry Competition.

4. by providing images on CD ROM, the amount of hard disk storage required on the user's system will be greatly reduced by not having to copy, download and store graphical images on the user's personal computer system. A full-screen, uncompressed 640 x 480 pixel graphic is roughly 900 kilobytes in size. Should the user require several dozen images for the presentation, massive amounts of on-line storage space would be required. By packaging the images on a CD ROM capable of holding 650 megabytes of data, users can access the images directly from the CD, thereby greatly decreasing the amount of hard disk space required. Additionally, these images would likely be of higher resolution and quality than may be downloaded from WWW sites. See Lynch (1996) for a discussion of publication and use of graphics on WWW applications.

5. the images on a CD ROM are permanent. Unlike 35mm slides which must be physically removed from the file and placed in the slide tray to be projected, only copies of the images on the CD ROM are used. Therefore images on a CD ROM cannot be lost or misplaced.

6. since the software application is dealing with copies of images, or is only calling up files from the CD ROM, the sequencing and playback of images can be easily and quickly changed.

7. copies of digital images retrieved from the CD ROM can be edited, cropped, color corrected, customized, labeled, etc. using any commercial photo editing software system without destroying the original image.

ADDITIONAL CONCERNS AND LEGAL ISSUES

The process of acquisition, digitization and archival of images from conventional slides and photographs is only a portion of the overall project concerns that had to be addressed. Other pertinent issues are listed below.

1. Legal issues: The original photographer/author of the graphic image and/or their employing agency, hold the rights to that image. The usage of any copy of that image must be carried out under the legal constraints in effect for that image. Issues such as educational use, commercial use and copyrights must be identified and accompany every delivery of an image. We obtained guidance and advice from The University of Georgia, Office Of Legal Affairs on the necessary processes to follow, the releases necessary, and the mode(s) and actual verbiage that must accompany delivery of each image to insure appropriate legal credits and identification for each image.

2. There may be legal constraints associated with the technology used to deliver the images and products, and any copies thereof. This includes not only the actual technology process used on the CD ROM such as Kodak Photo CD, but also any compression algorithms that may be used with the images themselves, such as TIFF, GIF, JPEG, etc. Use of some technologies require royalty charges and licensing fees.

3. Since it is imperative to maintain credits, copyright and identification information along with each image, the mechanisms of delivery and insuring accompaniment of this information with the digital images must be considered. The ultimate delivery process and application for any image may be very different than the hardware platform and delivery mechanism provided by the authors. Since these images will be digital in form, one must assume that copying of the original digital image will occur. Additionally, editing and conversion of the original image should be expected. The terminal application for which the image will be used will determine the image file format, file size and delivery process ultimately used. For that reason, we:

   a. electronically affix our permanent Forest IPM Project Archival Reference number on each image that we deliver via our project. This will, at minimum, alert the potential user that there is identifying and credit information that should accompany each use of the image.

b. provide the credits and project archival reference numbers in a traditional printed format document rather than in a proprietary electronic format. This will eliminate problems that the user could face by using an incompatible operating system, or not having applicable software to read and use the documentation.

c. maintain a permanent reference database system at our project site. Should copies of the images be disseminated without the accompanying credits and identification information, users could contact our project office to acquire the missing information.

PRODUCTION AND PACKAGING CONSIDERATIONS

The production, duplication and packaging process associated with quantity, large-scale releases of CD ROMs is at least as complicated as publication of traditional printed materials. It is not only what you know, but also who you know. The authors found that University of Georgia personnel had only minimal experience with the process of production, release and distribution of CD ROMs as they were producing the *Forest Insects and Their Damage* Photo CD set (Douce, et al., 1995). In the Photo CD project, the authors had to develop functional, working relationships with many individuals in many fields of expertise. There were entomologists, pathologists, foresters, computer specialists, lithographers, printers, software engineers, digital image setters, legal affairs personnel, compact disc duplicators and packagers, digital imaging professionals, agency administrators, and agency procurement and purchasing officers involved in this project.

At the time of the writing of this paper, the authors have not completed the Forest IPM CD ROM project. Issues such as the final file format, images to be included, etc. have yet to be determined. It is anticipated that the CD ROM will contain several hundred images in (probably) 640 x 480 on-screen (probably compressed) format. Processes and procedures learned, and contacts made in the production of the *Forest Insects and Their Damage* Photo CD set will guide the development and production of this Forest IPM CD ROM.

The Forest IPM CD ROM will provide a wide array of users with an easily accessible, comprehensive repertoire of quality Forest Integrated Pest Management digital images that can be efficiently and effectively used in printed materials (requiring moderate to low resolution) as well as in electronic applications. The standardization of file sizes and formats, ready access, permanency of storage and ease of retrieval on a local computer system will greatly enhance the delivery of educational efforts in Forest Integrated Pest Management. Users will be able to quickly retrieve and customize desired images and integrate them into their particular application or presentation using standard, commercial software without tying-up valuable disk space. The CD will be available to users at a relatively low cost (approximately $30 U.S.) from The University of Georgia through the senior author.

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