

Electronic Guide to Wildflowers: Maintaining an Online Database for Natural Areas

RICHARD S. WACHA¹ and KELLY ULRICK²

¹Biology Department, Drake University, Des Moines, Iowa 50312

²United States Army Corps of Engineers, Saylorville Lake, Johnston, Iowa 50131

An online guide to wildflowers of the Saylorville Lake Recreation Area, Des Moines River Basin, Polk Co., Iowa, is maintained as a public information project in cooperation with the U. S. Army Corps of Engineers. Each wildflower is represented by a digital image and scientific description. Digitally created diagrams of leaf and flower structure are also included. Issues associated with maintenance of the online guide are discussed. These include: (a) collection of data and online delivery methods, (b) features of a traditional guide compared to those of an electronic guide delivered online, (c) an electronic guide as a database, (d) incorporating online data in CD-ROM and PDF formats, and (e) publishing online data through the peer review process.

INDEX DESCRIPTORS: electronic publishing, Iowa wildflowers, electronic wildflower guide, flower databases, online wildflower guide, website publishing.

An online visual-guide to the wildflowers of the Saylorville Lake Recreation Area, Des Moines River Basin, Polk Co., Iowa, is maintained as a public information project in cooperation with the U. S. Army Corps of Engineers, Rock Island District, Illinois (Wacha 2001a). The principal goals of this web-based guide are (1) to maintain an online database that features descriptions of local wildflowers as an informational resource for use by the public, and (2) to produce a CD-ROM of this resource which will be available to the public at the Saylorville Lake Visitor Center through a kiosk operated by the Iowa Academy of Science. The CD-ROM (Wacha 2001b) provides information similar to that presented in the online guide and contains a Portable Document File (PDF) from which printed copies of the guide can be generated for use in the field.

In this paper we discuss issues that may be useful in developing and managing a website directed toward public awareness of native and restored natural areas. The paper is divided into four sections. The first provides background information describing: (a) the Saylorville area, (b) the rationale for serving the guide on the World Wide Web, and (c) the methods used in collecting the data and placing it online. The second section compares the differences between a traditional field guide and an electronic guide as a means of understanding the limitations and advantages of their competing formats. Section three examines the management of online databases (or websites) with particular reference to the Saylorville website. The final section discusses online databases as publications. We hope these discussions will provide some insight into the theory and operation of a web-oriented database and, perhaps, inspire the development of other online sites as public links to our natural areas.

BACKGROUND

The Online Guide

The online guide presently contains 45 taxa, including prairie and woodland species, within the families Asteraceae, Ranunculaceae, and Rosaceae. The guide is being expanded to include additional species in other families. Each taxon in the guide is represented by a digital image and a scientific description based on specimens found and collected at the Saylorville site (Fig. 1). Family descriptions, a gloss-

sary, and digitally-created diagrams of leaf arrangement and flower structure (Fig. 2) are also included. Taxa presented in the website are grouped by family. Within families, species are grouped by flower color and arranged alphabetically by common name.

The Saylorville Area

The Saylorville Lake Project in Polk Co., Iowa (Fig. 3) is administered by the U. S. Army Corps of Engineers. It hosts many visitors and has numerous recreational facilities for water sports, camping, picnicking, hiking, and bicycling. Still, much of the Saylorville Project remains an undeveloped non-recreational area. Two major vegetation zones are associated with the area: (1) bottom-land forest which lies along the Ding Darling Greenway (Des Moines River corridor) south of Saylorville Lake and below Saylorville Dam, and (2) upland forest, which borders Saylorville Lake above the Dam, north to Big Creek Lake. These wooded landscapes are periodically interrupted by ponds, oxbows, streams, fields, savannas, parcels of planted and native prairie, and the park-like camping and picnic sites within the 10,500 ha Saylorville Project. These diverse habitats provide the area with a variety of wildflowers throughout the growing season. A multipurpose, bicycle-hiking trail extends along the entire east side of the Ding Darling Greenway, Saylorville Lake, and Big Creek Lake. A journey along this trail provides access to those habitats in which the wildflowers presented in this guide have been observed.

Rationale for an Electronic Guide

The U. S. Army Corps of Engineers at Saylorville Lake strives to promote stewardship of its natural resources for its visitors. Increased knowledge among resource users not only leads to increased enjoyment but also can influence environmental attitudes and behavior (Gigliotti 1990). If visitors and adjacent landowners of Saylorville Lake become more knowledgeable about the wildflowers around them, they may develop an even greater interest in the area. Promoting educational media is an effective way of improving knowledge and favorable attitudes among recreational users and neighboring citizens (Marynowski and Jacobson 1999). A fundamental reason

Fig.

for
app
Proj
com
achi

P
Sayl
stan
wer
age
scar
slid

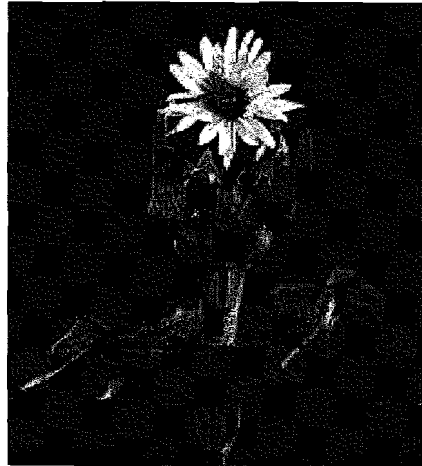
A Guide to Common Wildflowers of the Aster Family in the Saylorville Lake Area
of Central Iowa

Compass Plant
Silphium laciniatum



Flowering heads have from 15 to 30 yellow ray flowers surrounding a central cluster of yellow disc flowers. Involucral bracts are hairy, large, and broadly ovate, with pronounced recurved-tips that taper to a long, narrow point. Flowering heads are distributed sparsely along the upper stem, which has a "zig-zag" appearance. Upper stem may bear clear drops of resin. Leaves are highly lobed, almost to the point of being compound, and are larger and more densely clustered at the base of the stem. Leaves attach individually by a petiole that bears small wings. Leaf edges may be aligned in a north-south direction, hence the name compass plant. Areas where compass plants are found are assumed to be remnants of native prairie. However, compass plants may also occur in prairie plantings or reconstructed sites, such as Red Feather Prairie at Saylorville Lake. Blooms from July into September. Native to N. A.

Cup Plant
Silphium perfoliatum



Flowering heads have from 20 to 30 ray flowers surrounding a central cluster of conspicuous, yellow, disc flowers. Involucral bracts are few in number, broadly ovate, and prominent. Leaves are broadly ovate and arranged in pairs. The paired leaves are fused to each other at their bases so that they surround the stem, forming a distinctive "cup," which may hold rain water. Margins of the upper leaves have shallow teeth of rather uniform size. Lower leaves have large, prominent teeth, that are lobe-like and not uniform. The stem is square rather than round. This is a tall plant, growing shoulder high or higher. Blooms from July through September, in prairies and prairie plantings, where soil is damp. Native to N. A.

Fig. 1. Species descriptions of two wildflowers from the "Electronic Guide" as displayed in PDF format in the CD-ROM (Wacha 2001b).

for developing the online guide is to create a public awareness and appreciation of the wildflowers found within the Saylorville Lake Project and on adjacent public lands. It is hoped that the guide will contribute to this realization. How effective the website will be in achieving this goal, however, remains to be evaluated.

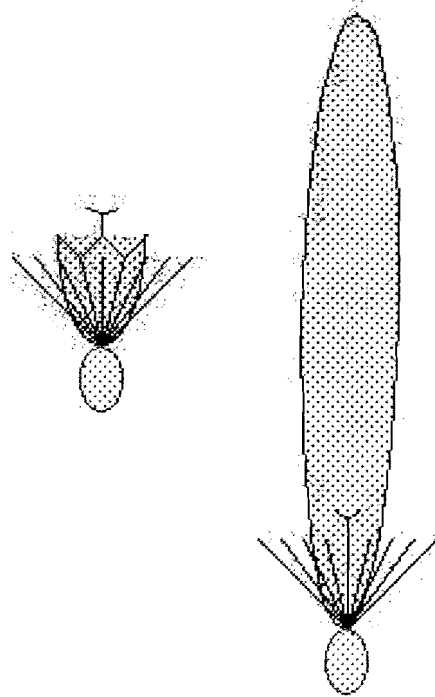
METHODS

Photographs of wildflowers were taken *in situ*, in the field, at the Saylorville Lake recreation site with the aid of a 35 mm camera using standard photographic methods. Bracketed exposures of wildflowers were made using *Kodachrome* or *Ektachrome* color-positive films. Images, selected from the resulting pool of photographic slides, were scanned into a *Macintosh* computer with the aid of a *Nikon Coolscan* slide scanner. Captured images were refined using *Adobe Photoshop*

3.0 software. These images were stored in JPEG format and imported into *Adobe PageMill* 3.0 for preparation of the web pages. All photographs constitute original work. Line diagrams of flowering parts (e.g., Fig. 2) were made using the graphics component of *Adobe FrameMaker* 5.0. The diagrams were converted to JPEG images in *Photoshop* prior to importing them into the *PageMill* program. The server is an *iMAC* (MHz 350; RAM 64) running *Quid Pro Quo* server-software by Social Engineering [commercially unavailable at this writing]. A CD-ROM containing the Aster Family component of the online site was produced for publication (Wacha 2001b) using a *La Cie* 4 × 2 × 6 CD-RW writer. The Aster Family contents were copied to the CD-ROM from the online source in the *PageMill* program, which, when viewed on the CD-ROM, resembles the website in appearance and operation. A PDF document of the Aster Family

A Guide to Common wildflowers of the Aster Family in Central Iowa

Disc and Ray Flowers



Disc Flower (left). Ray Flower (Right)

Note: Disc flowers have 5 petals fused together to form a tube (blue). Ray flowers have 5 petals fused together, but they do not form a tube. Instead, the would be tube is "unfurled" to form a conspicuous, long, ribbon-like ray (blue). Below the petals is the ovary (green), which, upon fertilization, becomes a fruit, or "seed," called an achene. Positioned above the ovary is the pappus, a cluster of bristle-like filaments that facilitates wind blown dispersion of the achene. The stamens, or male parts of the flower, are contained within the tube of petals. They are not illustrated here. The stigma of the pistil, however, is illustrated, in red. The stigma is divided into two segments, and appears forked. It is connected to the ovary by a "style," which is not shown.

Fig. 2. Computer generated diagram of disc and ray flower of the Aster Family (with text legend as it appears in the "Electronic Guide" and in the PDF document from the CD-ROM (Wacha 2001b).

content was also prepared for inclusion in the CD-ROM. This document, which is arranged in a condensed two-column format including images and text, can be printed with a standard ink-jet printer on letter-size paper for use in the field (Fig. 1). The PDF document was created using the *FrameMaker* application and was converted to PDF with *Acrobat Writer* (Adobe). Descriptions of the wildflowers contained in the guide are based on flower specimens collected from within the Saylorville Lake Project area during the

course of the study. Specimens were collected with the permission of the U. S. Army Corps of Engineers and prepared according to standard herbarium methods (Woodland 1997). However, pressed specimens were not attached to herbarium sheets in order to facilitate their optimal arrangement for digital photography. Species identifications were determined in part with the aid of the following references: Barkley et al. (1987), Eilers and Roosa (1994), Gleason (1968), Steyermark (1963), and Van Bruggen (1958).

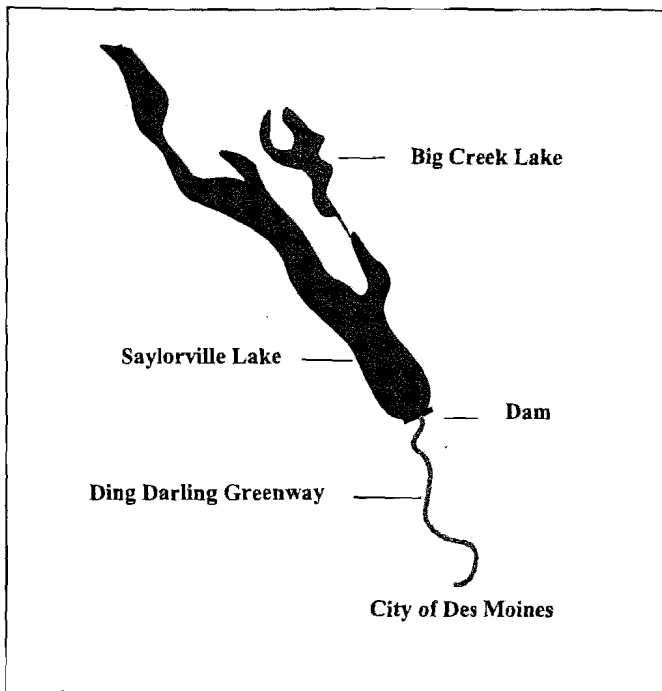


Fig. 3. Computer generated map showing the relationship between Saylorville Lake, Big Creek Lake, and the Ding Darling Greenway. The Ding Darling Greenway as shown extends 9 km south of Saylorville Dam and terminates within the city of Des Moines.

TRADITIONAL VS. ELECTRONIC GUIDE: A COMPARISON

Wildflower guides constitute a unique genre of information available to those interested in wildflower identification. Guides are typically directed toward identifying showy, herbaceous species (wildflowers) that have an aesthetic appeal and are characteristic of a particular habitat (e.g., prairies or woodlands) or a particular region or locality such as the Midwest or Saylorville Lake. An electronic guide represents a technological departure from the traditional guide. In this section, both types of guides are compared to illustrate their features.

The Traditional Guide

Traditional field guides are intended to facilitate the identification of wildflowers in their natural setting and to enhance an appreciation for wildflowers by the general public. The use of field guides by students and naturalists also points to their function as an educational resource for learning about flora. Field guides contain varying amounts of information that may include images of flowers, descriptive features, flowering periods, geographic distribution, ethnobotanical information, family characteristics, a glossary, a key to species, and references. This information varies in degree of complexity depending on the guide (compare: Edsall 1985, Grimm and Kartesz 1993). The contents are usually moderately complex and of a general nature, describing a limited number of showy species within a defined geographic location. This is in contrast to either a floristic study or a flora (e.g., Barkley et al. 1987), which are more detailed in content and concerned mainly with a systematic evaluation of all plants in a given taxon or geographic region for scientific rather than public purposes. Because the traditional field guide is distributed as

a book or manual, it is highly portable, and because it is printed on paper, it is relatively permanent in archival quality.

The Electronic Guide

An electronic guide, served online, is similar to a traditional guide in that it contains images and descriptions of wildflowers along with related information such as distribution of species, etc. However, the electronic guide differs in several ways:

Electronic guide as an open-ended database. One difference inherent in an electronic guide is the capacity to modify the data within the guide. In the traditional guide, the data are fixed and cannot be modified without creating a new edition because the contents are printed in book form. In the electronic guide, the data are not fixed and can be modified at any time because there is continuous access to the html editor, from which the guide is being electronically served. Thus, data can be expanded or changed as needed to include additional species, images, descriptions, diagrams, or corrections and enhancements. Because of this capacity to modify data, the online guide may be thought of as an "open-ended" database (Moffett 1996). Conversely, due to its "fixed" or indelible format, the traditional guide may be considered as a "closed" database in the context of its currently published edition.

Portability. A second distinction is portability. A traditional guide can be transported effortlessly into the field. An electronic guide, however, is tied to a computer screen and can be accessed in the field only through a remote connection (e.g., via a cell phone connected to a laptop computer). Direct use of an online data source in the field, therefore, is complicated by the technological requirements of the system. But, with the "wireless-web" features of small-screen "palmtops," it should become increasingly handy to have direct access. However, "indirect" access to online information is available, either by CD-ROM used with a laptop computer, or by a printed PDF document that can be used in the field with the same convenience and effectiveness as a traditional guide.

Access to the medium by which the information is delivered. Although the content and purpose of both the traditional and online guides may be somewhat similar, use of the online guide requires a working knowledge of computers and access to the internet that a traditional guide does not. If computer-use were to become universal, however, the traditional guide might still retain its value through its practicality in the field and self-contained format.

Format by which the information is presented. Traditional guides are printed in book form. Their format is restricted mainly to pictures, diagrams, and text. With an online guide, the electronic format is unrestricted and, along with standard images and text, can accommodate video information and direct links to other sites. Therefore, it has multimedia capability. Online information can also be transferred to a CD-ROM or a magnetic disc for offline use.

Archival qualities. As stated by Hedstrom (1998), "The purpose of preservation is to protect information of endearing value for access by present and future generations." Printed media are relatively long-lasting. For example, acid-neutral paper may last a century and more (Hedstrom 1998). This quality of "permanence" is an advantage for traditional guides printed on paper. Electronic media are more labile. Magnetic media are subject to binder degradation, particle instability, and substrate degradation (Hedstrom 1998). These media (floppy disks, 100 MB disks, etc.) have life spans of 10–30 yrs if properly stored (Hedstrom 1998). Optical disk media (CD-ROMs, DVDs) are subject to high humidity, extreme temperature fluctuation, and contamination by airborne particulates, but if properly stored they may reach a lifespan of up to 100 yrs (Hedstrom 1998). These considerations are important not only when backing-up online databases to guard against loss or damage, but also in preserving data for

archival reasons. Archival considerations are relevant, because the ultimate fate of an open-ended database (website) is either termination and withdrawal to storage or replacement with a new database (Moffett 1996).

Apart from the purely archival value of storing online data on magnetic or optical media, preserving or backing-up the database provides an electronic library of stored images, diagrams, and text that may be accessed later for use in other applications or in new databases. Hence, archived data not only become a matter of record, but also may have value for future use.

ISSUES ASSOCIATED WITH MAINTAINING AN ONLINE DATABASE

Several considerations are important in maintaining an online database, not the least of which are those relating to the expense and time involved in collecting, organizing, and maintaining information online. But, of additional importance, assuming these preliminary conditions have been satisfied, are management issues related to software and hardware upgrades, image enhancement, serving the data electronically, linking with other internet sites, and perhaps, incorporating video images. These are some of the routine issues of maintaining an online database presented here.

Upgrading Software and Hardware

As an electronic database ages, so too do the tools of electronic acquisition and delivery, which periodically require updating to maintain their effectiveness in the presence of newly-marketed tools. With the online guide, a different HTML editor, *Go Live* (www.adobe.com), is scheduled to replace the existing editor *PageMill*. Also photographic images are now being captured with a digital camera rather than a traditional one (Wacha 2000). Upgraded versions of *Adobe Photoshop* (v. 5.0) and *FrameMaker* (v. 5.5) have also been incorporated. With such changes, added costs may be expected to occur, especially for software upgrades. But, to improve effectiveness of online delivery, change may be necessary. Some expenses, however, may decline. In terms of hardware upgrades, for example, the cost of a digital camera may be less than that of a 35 mm slide scanner which it replaces, and operating costs for a digital camera may be lower than those of a traditional camera because neither film nor film-processing are required for image acquisition.

Image Enhancement

In preparing images for online use, an image editor (e.g., *Adobe Photoshop*) is especially helpful for enhancing contrast and brightness and for sharpening images. Sharpness is best achieved with the aid of the "unsharp" mask filter, which allows for graduated degrees of sharpness or "unsharpness" to be selected. The quality of images captured by digital camera or with the aid of a digital scanner can almost always be improved with these tools. The image editor is useful also for resizing and cropping images and for adjusting color quality. An advanced imaging editor, like *Adobe Photoshop*, is of primary importance for website development because it allows for the highest quality image outcome within the limitations of the medium. A comprehensive reference on digital imaging is that by Greenberg (1999).

Desktop and Distant Servers as Web-Hosting Sources

Use of a desktop computer as a server, from which to broadcast a database over the internet, is an advantage in that information delivered in this way can be modified as the need arises for immediate delivery on the WWW. Information to be added to a database can be conveniently typed into the HTML editor of one's desktop com-

puter/server and instantly sent online. This feature offers comprehensive control over data delivery because both website and server are managed by the same operator. A desktop server software program that can be used to this advantage with *Macintosh* operating systems is *WebStar* by *Star 9* (www.star9.com) and, with *Windows*, *Windows 2000 Server* (www.microsoft.com).

The alternative to hosting a website on one's own server is having it hosted by an internet service provider or by an independent web-hosting site. This approach to website delivery transfers some of the responsibilities of hosting (e.g., server maintenance) to an external or distant server. An advantage of using a web-hosting site is that it may also provide additional, interactive features, such as e-mail, message boards, and forums. Information for delivery to the WWW by a distant server can be conveniently uploaded from a desktop computer to the server site by using File Transfer Protocol (FTP) software, [e.g., *Fetch* (<http://fetchsoftware.com>) for *Macintosh* systems or *CuteFTP* (www.cuteftp.com) for *Windows*]. Multimedia files, including video and audio tracks, can also be uploaded to a distant server by using FTP procedures. Although web-hosting sites may offer online web-page templates that preclude the need for specialized desktop software, a desktop HTML editor is usually preferred for preparing data for delivery to the WWW. When the desktop prepared file is ready for uploading, it can be conveniently sent, via FTP, to the specified website on a distant server. Common HTML editors include *Go Live* (*Adobe*) for *Macintosh* systems and *FrontPage* for *Windows*. See Sawyer and Greeley (1999) for a discussion of distant servers and Tauber and Kienan (1997) for hosting and managing websites.

Links to External Sites

Adding internet links to connect external websites to an online database serves to expand the overall database for users. These links may be thought of as electronic analogs to the bibliographic references listed by traditional guides. Linked, external sites are helpful, too, in that they may serve as models for data formatting or site navigation. One such model for an online wildflower database is that maintained by the California Academy of Sciences (2001).

Video Images

One reason for presenting wildflowers in video format is to demonstrate them in realistic perspective as viable objects in their natural setting moving with the wind in concert with nature. This reason may not replace the advantage of the static image for taxonomic identification, but it does provide a realistic impression of a plant that may help to interpret it for the viewer. In essence, the video image takes the viewer into the field.

Video images of wildflowers can be captured with either an analog or digital video camera. Video clips can be prepared for online delivery by using video editing software (e.g., *Adobe Premiere*). Analog images must first be converted to digital ones. A program capable of achieving this conversion for the *Macintosh* platform is *Interview* by *XLR8* (www.xlr8.com). A video editor that is packaged with *Interview*, or available separately, is *Videoshop* by *Strata* (www.strata.com). Online videos are commonly viewed with *Quick Time Player* (www.apple.com), a cross-platform program for *Macintosh* and *Windows*. A principal consideration in broadcasting videos online is file size, which must be kept small to facilitate realistic downloading times for viewing. However, file size is less of a consideration if video clips are to be incorporated into a database on CD-ROM, where they can be viewed directly without having to wait for downloading. For an account of video editing see Stern and Lettieri (1999).

ISSUES RELATED TO PUBLICATION OF ONLINE DATA

Websites as Publications

The term "publication" may have different meanings to different people. One implied meaning is that of making information public or publicizing it (Abate 1997). Placing information on the internet would be an example. Thus, any website containing information could, by the definition given, be interpreted as a "publication" or more specifically, perhaps, an "electronic" publication to denote the medium of delivery. However, the term publication, in the academic sense, is more restrictive and applies mainly to scholarly works disseminated for educational reasons, which might range from scientific to artistic. One criterion of scientific publications that distinguishes them from the general definition given above is that they are expected to undergo a peer review process of evaluation as a prerequisite for publication. As stated by Deegan (1996) "A publication is an academic measure of output . . . a paper in a monograph published by a reputable press, with peer review, or in a refereed journal." Thus, scholarly scientific publications, whether delivered to their "public" audience in traditional book form or placed online in an electronic journal, are a distinct kind. But, in the absence of peer review, simply placing information on the internet as a website does not qualify as a scientific publication in the scholarly sense: "Websites are not recognized as [scholarly] publications." (Deegan 1996). A CD-ROM of online data that has been submitted to an editor for peer review, however, may qualify: "CD-ROMs are of the same interest to scholars as books, and may be accessible in the same areas of a library." (Deegan 1996).

This is not to suggest that scientific information presented online does not meet publication standards. It may or it may not. But in the absence of peer review, it cannot be guaranteed that a website is maintaining the standards expected of a peer-reviewed publication.

CD-ROMs and PDFs as Publications

One way that an author of a website may meet publication standards is by submitting the online database, in parallel fashion, for publication as an "offline," peer-reviewed CD-ROM or as a peer-reviewed PDF file which can be delivered "online." Both the CD-ROM and PDF documents can serve as closed databases, the content of which, like that of a traditional guide, will remain unchanged until resubmitted to a publisher for revision. This method of achieving publication standards for electronically-served information retains, for the electronic medium, the publication value of the "closed" database.

CD-ROMs have further value in their capacity to serve an archival function. As reservoirs of stored data, the information they contain may be retrieved as needed for use in other applications. Production of CD-ROMs appears to be increasing each year in multiple areas of interest, including academic (Brown 1996).

Modes of Electronic Publication

Two distinct approaches (modes) for presenting electronic data seem apparent: one is the open-ended, non-reviewed database and the other, the closed, but reviewed database. Eysenbach (2000) categorized these two approaches to publication as being either a "Type 1" publication (the open-ended, non-reviewed category) or a "Type 2" (the closed and reviewed category). Delivery of the wildflower guide online, as a website, represents a Type 1 publication; the published CD-ROM of the Aster Family, taken from the website, represents a Type 2. Eysenbach's (2000) review of the impact of electronic publishing on biomedical research provides insight into the value of both types of publication. In his paper, it is also interesting

to note the similarities between his definitions of publication and that which we present.

FURTHER STUDY

With increasing use of the internet as an information system, focusing internet resources on our natural areas would appear to be a positive way to connect the public with local lands that we as environmental stewards hope to preserve and restore. The informational value in offering website access to our natural areas for aesthetic and environmental reasons seems self-evident. However, the extent to which delivery of electronic information does, in fact, fulfill this objective for our website remains obscure. For example, the online guide to wildflowers has a population of visitors who "log-on" to the website daily. But the demographic structure of this population remains unknown. This kind of information would be of value for measuring how effective we may be in realizing our perceived informational goals. Assessing this information through studies that focus on the educational value of our website is a logical extension of this work that we hope to pursue.

SUMMARY

With the access available to internet service providers and the ease of using HTML editors to create websites, the opportunity to develop an online database is becoming increasingly practicable. Through a review of some of the issues related to online delivery, perhaps this paper can provide information of value for establishing and maintaining an online system that will focus on our natural areas. Hopefully, recreation users with access to this kind of information will develop a deeper awareness and appreciation for our natural areas and the work of conservation organizations and managers.

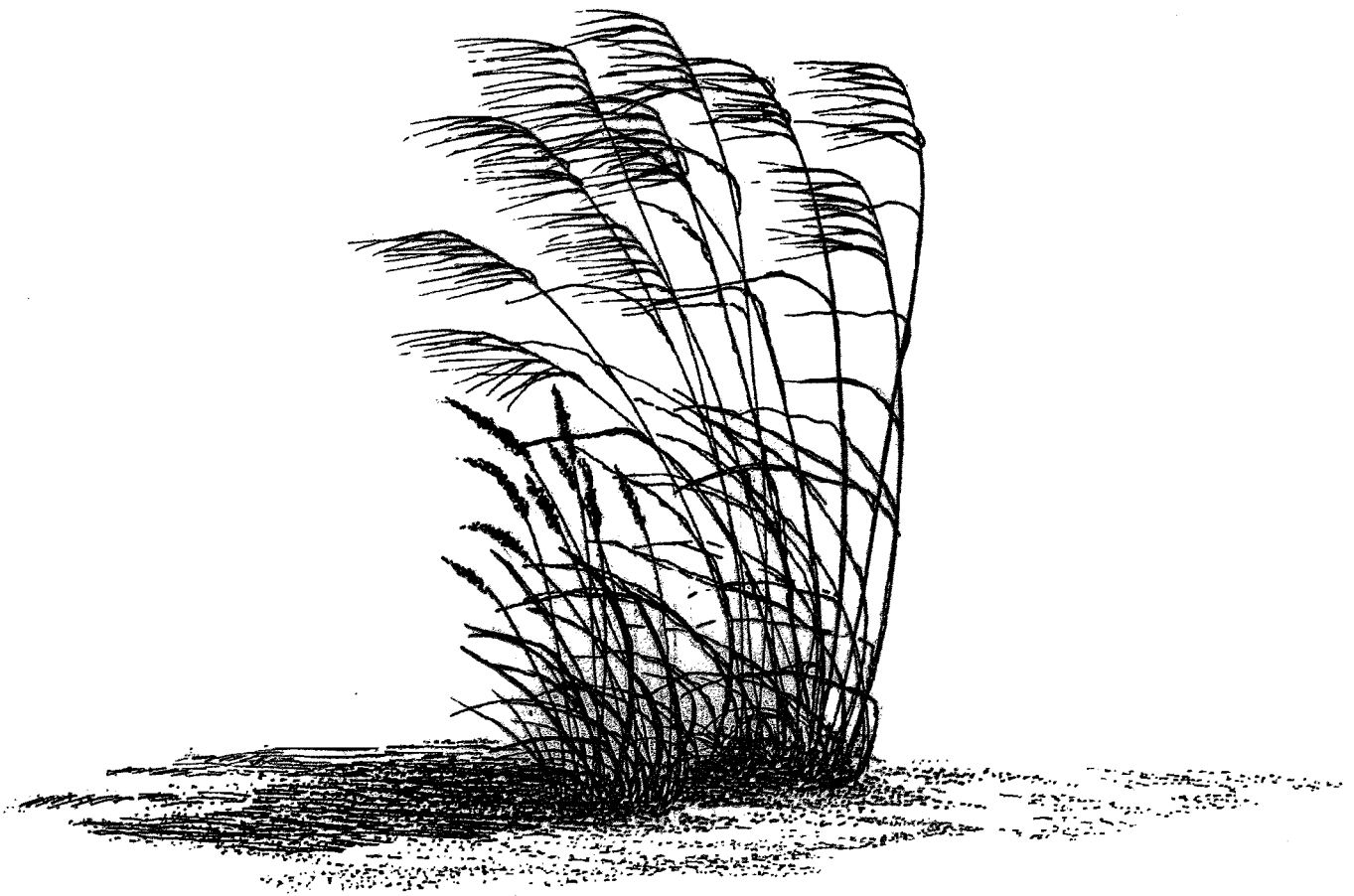
ACKNOWLEDGEMENTS

Foremost, we wish to thank Jerry Honts, Associate Professor of Biology, Drake University, for his mentorship in the area of computer graphics and website development. We also thank Rod Henshaw, Director, Cowles Library, Drake University, and Bruce Gilbert, Systems Director, for their unselfish assistance toward the production of a CD-ROM. I especially appreciate the cooperation received both from Jerry DeMarce, Operations Manager for the Saylorville Lake Project, and the U. S. Army Corps of Engineers for providing office space at the Saylorville site for work on this project during my sabbatical leave (RSW). Our appreciation is extended also to Holly Ford, Graduate Assistant in Education at Drake University, for her work in curating the herbarium collection. Funding received from a Drake University Faculty Research Grant and from the Department of Biology toward this project is gratefully acknowledged.

LITERATURE CITED

- ABATE, F. R. (ed.). 1997. Oxford Desk Dictionary and Thesaurus, American Edition. Oxford University Press. New York, New York.
- BARKLEY, T. M., R. E. BROOKS, and E. K. SCHOFIELD (eds.). R. L. MCGREGOR, Coordinator. 1987. Flora of the Great Plains. University of Kansas Press, Lawrence.
- BROWN, D. J. 1996. Electronic Publishing and Libraries: Planning for Impact and Growth to 2003. Bowker-Saur: Reed Elsevier, Ltd. U.K.
- CALIFORNIA ACADEMY OF SCIENCES. 2001. Retrieved May 2001. California Wildflowers: <http://www.calacademy.org/research/botany/wildflow/index.html>
- DEEGAN, M. 1996. Electronic publishing. Pages 408-425. In *New Technologies for the Humanities*. C. Mullings, M. Deegan, S. Ross, and S. Kenna (eds.) Bowker-Saur: Reed Elsevier, Ltd. U.K.
- EDSALL, M. S. 1985. *Roadside Plants and Flowers: A Traveler's Guide to*

- the Midwest and Great Lakes Area. The University of Wisconsin Press, Madison.
- EILERS, L. J., and D. M. ROOSA. 1994. *The Vascular Plants of Iowa: An Annotated Checklist and Natural History*. University of Iowa Press, Iowa City.
- EYSENBACH, G. 2000. The impact of preprint servers and electronic publishing on biomedical research. *Current Opinion in Immunology* 12: 499-503.
- GLEASON, H. A. 1968. *The New Britton & Brown Illustrated Flora of the Northeastern United States and Adjacent Canada*. 3 Vols. Hafner Publishing Company, New York, New York.
- GIGLIOTTI, L. M. 1990. Environmental Education: What went wrong? What can be done? *Journal of Environmental Education* 22:9-12.
- GREENBERG, S. 1999. *The Complete Idiot's Guide to Digital Photography*. Que Corporation: Macmillan Computer Publishing. Indianapolis, Indiana.
- GRIMM, W. C., and J. T. KARTESZ. 1993. *The Illustrated Book of Wildflowers and Shrubs [Eastern North America]*. Revised Ed. Stackpole Books. Harrisburg, Pennsylvania.
- HEDSTROM, M. 1998. Digital Preservation: a time bomb for digital libraries. *Computers and the Humanities* 31:189-202.
- MARYNOWSKI, S. B., and S. K. JACOBSON. 1999. Ecosystem Management Education for Public Lands. *Wildlife Society Bulletin* 27:134-145.
- MOFFETT, J. 1996. Databases in the Humanities. Pages 29-46. *In New Technologies for the Humanities*. C. Mullings, M. Deegan, S. Ross, and S. Kenna (eds.). Bowker-Saur: Reed Elsevier, Ltd. U.K.
- SAWYER, B., and D. GREELEY. 1999. *Creating GeoCities Websites*. Muska & Lipman, Cincinnati, Ohio.
- STERN, J., and R. LETTIERI. 1999. *QuickTime Pro 4 for Macintosh and Windows*. Peachpit Press: Addison Wesley Longman. Berkeley, California.
- STEYERMARK, J. A. 1963. *Flora of Missouri*. Iowa State University Press, Ames.
- TAUBER, D. A. and B. KIENAN. 1997. *Webmastering for Dummies*. IDG Books Worldwide, Inc. New York, New York.
- VAN BRUGGEN, T. 1958. *The Flora of South Central Iowa*. Ph. D. Dissertation in Botany, University of Iowa. University Microfilms, Ann Arbor, Michigan.
- WACHA, R. S. 2000. *Some Common Wildflowers of the Badlands Area of North Dakota*. Retrieved May 2001: http://www.voyageur.drake.edu/Photo_Gallery/north_dakota_wildflowers.html
- WACHA, R. S. 2001a. *Wildflowers of the Saylorville Lake Recreation Area and Ding Darling Greenway*. Retrieved May 2001 from: http://www.voyageur.drake.edu/Wacha/guide_to_wildflowers.html
- WACHA, R. S. 2001b. *Wildflowers of Saylorville Lake: A Visual Guide to Wildflowers of the Aster Family in Central Iowa*. CD-ROM. Cowles Library, Electronic Publications, Drake University, Des Moines, Iowa (In Press).
- WOODLAND, D. W. 1997. *Contemporary Plant Systematics*. 2nd Ed. Andrews University Press, Berrien Springs, Michigan.



ap
pr:
ac:
re:
ac:
of
ou
to
cr:
co:
se:
co:
ba
to
st:

ca
ac
a

sp
fa:
ex:
sc:
U

N
a