Extension Education Methods

The Hawaiian Native Plant Propagation Web Site: Developing a Web-based Information Resource

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Additional index words. database, endangered plants, endemic plants, Hawaii, indigenous plants, Internet

Summary. The Hawaiian Native Plant Propagation Web Site (**http://pdcs.ctahr.hawaii.edu:591/hawnprop**) is a collection of organized propagation information for selected Hawaiian indigenous and endemic plants. It was designed to provide easy access to this information for university extension personnel, researchers, students, conservationists, and nursery and landscape professionals. Journals and newsletters published in Hawaii provided the most relevant data for this Web site. The first prototype was a database-driven Web site that provided sophisticated search capability and dynamically generated Web pages for each plant record. Subsequent testing of the prototype identified a number of usability problems. These problems were corrected by redesigning the Web site using a hybrid database–static Web page approach. The database software search features are retained, but each database record is linked to a static Web page containing the propagation information for a specific plant.

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The Hawaiian Native Plant Propagation Web site was developed in partial fulfillment of the MS requirements for Eileen Herring from the Tropical Plant and Soil Sciences Department, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa.

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The Hawaiian island chain consists of 132 islands, reefs, and shoals stretching across the Pacific Ocean and contains many unique ecosystems (Juvik and Juvik, 1998). This ecosystem diversity, coupled with Hawaii's isolation from other landmasses, has resulted in "degrees of endemism...unmatched anywhere else in the world" (Scott, 1995). The Hawaiian Islands also have one of the highest species extinction rates in the world; 75% of all recorded extinctions in the U.S. have been in Hawaii, even though Hawaii represents only 0.2% of the U.S. landmass (Mlot, 1995; Scott, 1995). Today, the U.S. Fish and Wildlife Service (USFWS) lists 273 Hawaiian plants as threatened or endangered (USFWS, 2001).

Act 73, passed by the Hawaii State Legislature in 1992, requires that, where feasible, indigenous plant materials be included in landscapes of public projects. Part of the purpose of this legislation is to encourage the propagation of Hawaii's indigenous flora. In 1997, the State of Hawaii Department of Land and Natural Resources (HDLNR) Title 13, Subtitle 5, Chapter 107, was adopted. Chapter 107 provides an administrative procedure allowing the legal propagation of endangered plants from cultivated stock (HDLNR, 1997). These governmental actions have increased the interest of Hawaii's landscape industry in producing native plants. There has also been a statewide increase in participation in traditional Hawaiian cultural practices, such as hula, which involve collection of plant material from the native forests. Some members of this cultural community are interested in developing alternatives that decrease collecting pressures on the diminishing tracts of native ecosystems (Josephson, 1998). Successful propagation of Hawaii's native plants is also important in efforts to reintroduce these plants where suitable habitat still exists, and for *ex situ* conservation where necessary.

Many of Hawaii's native plants are difficult to propagate, and information is limited regarding the details of propagation attempts. Some of the information that has been developed on propagation of these plants is difficult to retrieve because it was published before the creation of electronic databases. Other important propagation information was published in literature such as society newsletters that is outside of the scope of these electronic databases. Some of this information has never been published and exists only in the memories and notes of amateur and professional native plant enthusiasts. The Hawaiian Native Plant Propagation Web Site at http://pdcs.ctahr.hawaii.edu:591/hawnprop (Herring, 2001) was created to collect and organize this information on the propagation of some of Hawaii's indigenous and endemic plants. A further objective was to provide easy access to this information for university extension personnel, researchers, students, conservationists, and nursery and landscape professionals.

Procedures

A preliminary list was developed that contained 100 plants with proven or potential uses as edible or medicinal plants, landscape plants, lumber or fiber sources, or lei materials. Many resources were consulted in the selection process (Abbott, 1992; Bornhorst, 1996; Bornhorst and Rauch, 1994; Jenkins, 1989; McDonald, 1985; National Tropical Botanical Garden, 1996; Weissich, 1995).

Format. Ease of access was a primary criterion in selecting the delivery format. Traditionally, print has been the primary medium for information delivery. Recently, however, electronic media such as CD-ROM and the World Wide Web (Web) have assumed greater roles in information dissemination. CD-ROM is generally used when an information product is developed for sale, controlled

distribution is required, software is provided to access the information, or the target audience does not have access to the infrastructure needed for Internet access. The disadvantages of print and CD-ROM publishing include relatively high production costs, the length of time required to produce a corrected or updated product, and possession of the physical object, either book or CD-ROM, is required to access the information.

The Web, on the other hand, provides a low-cost publishing option that allows quick and easy correcting and updating. It provides a vehicle for remote access by researchers and professionals on all the islands of Hawaii and throughout the world (Feiler, 1999; Heid, 1997; Peer, 1998). The interactive nature of the medium facilitates two-way communication between the information provider and the user. In addition, Web delivery of the Hawaiian Native Plant Propagation Web Site allows solicitation via electronic mail of additional research-based or anecdotal information from researchers, scholars, and other amateur and professional plant enthusiasts.

SOFTWARE SELECTION. There are currently two approaches to presenting large amounts of information on the Web. The first is to create static Web pages using hypertext markup language (HTML) for each block of information; e.g., each page would contain all of the propagation information for a particular plant species. An alphabetical list of hypertext-linked plant names could be used to allow browsing for specific plant pages. In this approach, the Web pages are easily developed, and the only software required is an HTML editor. However, studies have shown that in addition to browsing for information, users often need to use a search function to find specific information in a Web site (Rosenfeld and Morville, 1998; Spool, 1997). This requires selection and use of a separate search engine. Maintaining a set of individual, static Web pages could require considerable time because, when the content of a page needs to be changed, the HTML code must be edited by hand. In addition, changes and additions to the Web site may alter page interrelationships necessitating manual updating of numerous hypertext links. These static Web pages have stable URLs (uniform resource locators), or Internet addresses, which is a significant advantage because it makes these pages accessible to Web indexes and search engines such as Google (Mountain View, Calif.) and Yahoo (Sunnyvale, Calif.). People who use these search engines to locate information on the Web can more easily find these Web sites.

The alternative approach is to use Web-enabled database software to organize the textual information and provide Web access. Creating this type of database-driven Web site requires the purchase and use of additional database creation software. This approach is a more expensive, and potentially more difficult, way to provide access to data. Using database software, Web page content is stored in the database, but the Web pages for the database records are not created until a user selects a link for one of these records. The database software then creates the Web page by combining information from a customized template and information from the database record (Feiler, 1999). This type of Web page is dynamic in contrast to simple HTML-coded pages, which are static. Because a dynamic Web page is a temporary page created on demand, it does not have a permanent, stable Internet address. The main advantage of a database-driven Web site is that changes in format or design need only be made to the template rather than to each individual record. The database software also includes search routines that contain advanced features such as field searching (Feiler, 1999; Heid, 1997). A disadvantage of using a database-driven Web site is that since the pages are only created in response to a search query, there is no permanent Internet address for each record. This means that Web search engines cannot locate the individual Web pages, and it may also be more difficult to find the Web site using search engines.

Textual databases, such as the one created in this project, have unique characteristics that require specialized database software. Most significant for this project are variable length fields containing large blocks of text and fields containing repeating values, such as multiple common names for a single species (Feiler, 1999; Jacso and Lancaster, 1999). FileMaker Pro 4 (FileMaker, Inc., Santa Clara, Calif.) software was selected to organize the plant propagation information into a textual database for this Web site. FileMaker Pro 4 allows many large text fields in each record, accommodates repeating values in fields, can incorporate graphics into the database records, and has a built-in Web interface with a flexible search engine.

DATABASE DESIGN. The selection of the database fields can greatly affect the usability of databases since it determines the ease with which records can be retrieved. A number of plant propagation publications, including books and journal articles, were reviewed to identify the types of information that should be included in the plant records for this Web site. *The Reference Manual of Woody Plant Propagation* (Dirr and Heuser, 1987) was chosen as the most appropriate model. Each plant in the Hawaiian Native Plant Propagation Web Site has its own record, and each record includes fields for information on propagation by seeds, cuttings, division, air layering, grafting, tissue culture, immature seed culture, and embryo culture.

In addition to the plant propagation fields, each plant record contains fields with current botanical name, alternative and superceded botanical names, common names, and family. *The Manual of the Flowering Plants of Hawai'i* (Wagner et al., 1990) and *Ferns of Hawai'i* (Valier, 1995) were used as authorities for this taxonomic information. Each plant record also contains a brief nontechnical description of the plant, its original habitat, and a bibliography of the information resources consulted for the plant.

INFORMATION COLLECTION. Published information provided the bulk of the data included in the database. The most easily identifiable sources were journal articles and other publications indexed in electronic bibliographic databases including Agricola (National Agricultural Library, Beltsville, Md.), CAB Abstracts (CABI Publishing, Wallinford, U.K.), AGRIS (Food and Agriculture Organization of the United Nations, Rome Italy), and Biological Abstracts (BIOSIS, Philadelphia, Pa.). The Univ. of Hawaii College of Tropical Agriculture and Human Resources Web-accessible databases of extension and other college publications were searched to identify additional publications. The Univ. of Hawaii Library catalog and Dissertation Abstracts (University Microfilms, Ann Arbor, Mich.) also provided citations for relevant books, dissertations, and theses.

The most useful published sources of information were journals and newsletters published in Hawaii. These

contain propagation notes from many researchers and enthusiasts. Most of these publications have limited distribution or are published for a short time. Because of this, they are not included in, or are covered incompletely by, electronic journal article databases. They are examples of a large body of difficult-to-access scientific information often referred to as gray literature. The significant titles for this Web site were the *Bulletin of the Pacific Tropical Botanical Garden* (1971–89) which became the *Bulletin of the National Tropical Botanical Garden* (1989–93) (Lawai, Hawaii); *Hawaii Horticulture* (1998–2001) (Honolulu, Hawaii); *Horticulture Digest* (1970–96) (Honolulu, Hawaii); the *Newsletter of the Hawaiian Botanical Society* (1962–present) (Honolulu, Hawaii); and *Notes from Waimea Arboretum* (1974–93) (Waimea, Hawaii).

In addition to published information, the Hawaiian Native Plant Propagation Web Site contains significant data collected from unpublished sources. These sources include papers obtained from faculty and students of the Univ. of Hawaii, and internal institutional documents from the National Tropical Botanical Garden, Nature Conservancy (Honolulu, Hawaii), and Hawaii Volcanoes National Park (Hawaii National Park, Hawaii). The National Tropical Botanical Garden on Kauai and the Waimea Arboretum on Oahu provided access to very useful propagation notes and records. The Internet proved to be a rich source of anecdotal information. Hawaiian native plant researchers and enthusiasts from around the world have submitted unpublished propagation information by e-mail. There is also a very active listserv (hiplants-l) that shares Hawaii native plant propagation information. This has also made a significant contribution to the data contained in the Web site.

USABILITY TESTING. Poor interface design can be detrimental to a Web site and may prevent the target audience from obtaining the information they seek. Observation studies of Web site users show that they find the item they are searching for less than 50% of the time (Nielsen, 1999). Therefore, after the prototype of the database-driven version of this Web site was developed, user tests were conducted to evaluate the Web site organization and content.

Web site usability testing is based on the theories developed for testing software interfaces, but there are still many opinions about what constitutes usable Web site design. The usability study conducted on the Hawaiian Native Plant Propagation Web Site employed Nielsen's testing methodology (Nielsen,1993,1994), as modified by Instone (1997) for testing Web sites. This methodology includes pre- and posttest questionnaires and observations of users doing assigned tasks. During the performance of such tasks, users were asked to think out loud and their comments were tape-recorded. In addition, during the testing of the Hawaiian Native Plant Propagation Web Site, the participants' routes as they navigated through the Web site were recorded. This usability testing methodology calls for an iterative design process in which prototypes are developed, modified, and then retested.

Usability tests are not designed to yield quantitative results, but do provide information that improves interface usability (Krug, 2000; Nielsen, 1994). Nielsen (1994) showed that "one learns the most from the first few users" and recommends testing with three to five users. Three participants, representing various segments of the Hawaiian Native Plant Propagation Web Site target population, tested this Web site and identified a number of problems with the usability of the original Web site prototype.

Results and discussion

A significant problem identified in this usability study was the difficulty that participants encountered in using some of the search tools. The search screen was subsequently modified resulting in significant improvements in the ease of use of the search page. Usability testing also confirmed the need for both a browse function and a search function for this Web site. Limitations of the database software and problems inherent in the plant name data made it difficult to automatically generate functional browse screens for common names and alternative scientific names. Plant name data are complex, and names are generally not unique to a particular plant. Some common names may refer to many different plants. Futhermore, one botanical name may have been used at various times for one or more plants that are currently considered to be distinct species. The diacritical marks for Hawaiian plant names were omitted from the Web site since the software could not accommodate them.

These problems were resolved by the use of a hybrid database/HTML design for the Web site. The database records were reduced to searchable index fields: current botanical name, alternative and superceded botanical names, common Hawaiian and English names, family, and uses. This database was then linked to a set of static Web pages, one for each plant record. This allowed the retention of the useful database software search features. The browsing requirement was fulfilled by the generation of static Web pages with alphabetical lists of hypertext-linked botanical and common names. This linkage was possible because each plant record page has a stable Internet address.

There are several advantages to this solution. The search capability of the database software is retained, and search results pages are dynamically generated in response to each query. Manual coding of the static plant information pages allows more flexibility in formatting page parts. It also allows the inclusion of plant names in the title and metadata tags of the pages. This makes each individual page visible to Web search engines and allows potential users to more easily locate the site. A disadvantage of this approach is the increased time and effort required to create individual plant records and alphabetical lists. The alphabetical lists must be updated manually whenever a plant is added to the database or a botanical name is changed, which may introduce errors and inconsistencies.

The Web site was launched in Aug. 1999, but it was not publicly announced until Feb. 2000 after major revisions had been completed. At that time, it was also submitted to several Web search engines for inclusion in their indexing. From May 2000 through March 2002, the number of page views (hits) on the search and browse pages averaged 300 to 350 hits per month. A number of Univ. of Hawaii at Manoa College of Tropical Agriculture and Human Resource Web sites and some state of Hawaii government sites established permanent links to the Hawaiian Native Plant Propagation Web Site.

The Hawaiian Native Plant Propagation Web Site demonstrates that the Web can be a viable medium for providing access to complex information by a large and diverse community of users. The information contained in this Web site has been collected and integrated from a wide variety of relatively inaccessible sources. The Web site

presently contains propagation information pages for over 70 plants, which was gathered from 150 resources including books, journal articles, Web sites, and unpublished notes and manuscripts. A complete bibliography is available on the Web site.

The Hawaiian Native Plant Propagation Web Site provides easy access to this information for anyone with access to the Internet. Extension agents, landscape architects, and nursery personnel can use this information to increase the use of native plants in public and private landscapes. Practitioners of traditional Hawaiian cultural practices can use this information to grow native plants as an alternative to harvesting from native ecosystems, and it can assist conservationists in protecting endangered plant species. Researchers and students can use it to identify those plants for which propagation information is lacking and for which further research would be useful. This Web site realizes the web's potential as an international forum for sharing, organizing, and accessing specialized or difficult to obtain information.

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Computer and Internet Use Among Oregon Master Gardeners

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ADDITIONAL INDEX WORDS. survey, Internet and computer use, extension, volunteer, volunteer demographics

SUMMARY. The Internet has become a tool used in business, education, and leisure pursuits. Extension has used the Internet in a variety of ways including the training of extension staff and volunteers and the dissemination of information. In 2001, a survey was developed to determine the comfort level, familiarity, and use of computers and the Internet by active Oregon Master Gardeners (MGs). Basic demographic data was also collected. We found that 85% of respondents use computers and are very comfortable with computers and the Internet. This extensive use and comfort level suggests that the Internet may be an acceptable alternative to the traditional face-to-face training method for some Oregon MGs.

When the Master Gardener Program started in 1972 in Washington state, the original focus was training volunteers to diagnose and offer solutions to plant problems (Bobbitt, 1997). In the 30 years since the inception of the Master Gardener (MG) program, the services provided have expanded to include community enhancement projects, youth outreach, and a variety of educational projects.

To increase the impact of the MG program beyond personal contact, various types of media are used, including print publications, radio, and television (Meyer, 1997). The intent of using multiple educational methods is to provide consistent, high

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