Why Are We Still Producing Paper Floras?

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WHY ARE WE STILL PRODUCING PAPER FLORAS?1

Anthony R. Brach2 and David E. Boufford3

ABSTRACT

Advances in online resources and electronic publication provide the sciences with tools to revolutionize education and research (e.g., cataloging, data archiving and access, and identification). Older journals and monographs are being scanned and increasingly posted online quickly by book scanning projects, although even for new issues, there can be a “moving wall” or lag time (e.g., BioOne and JSTOR). Some scientific disciplines are providing the public with pre-print access to articles in digital libraries, while manuscript availability in other disciplines, such as nomenclatural botany, is often delayed until the time of print publication. Within botany, taxonomic treatments should be provided online at all stages of preparation and revision (in certain cases following initial editing). Now, many published floras can be browsed and searched online (e.g., Flora of North America, Jepson Manual, Flora of Australia). The Flora of China Project provides treatments at all stages, online, prior to printing of volumes. Because of this visibility, the Flora of China Web site regularly receives questions from the general public and helpful review comments from botanists worldwide. With pressing issues of cataloging biodiversity, conservation, and sustainable use of resources, botanists are challenged to prepare and revise online treatments, including interactive identification keys and images, for a worldwide audience of students and researchers.

Key words: digital floras, digital libraries, electronic publication, Flora of China, interactive identification keys, species-id.net.

With the pressing issues of conservation and naming and describing the world’s species (Wheeler et al., 2004), electronic publishing (Lancaster, 1995) provides the tools to revolutionize education and research (e.g., cataloging, data archiving and access, and identification; also see Rosatti & Duncan, 1995). Today, older books, journals, and monographs are being scanned and posted quickly by Google Books

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DIGITAL FLORAS

When paper publications are digitized, previously unavailable functions, such as full text searching and hyperlinking, become possible (Rosatti & Duncan, 1995; Heidorn, 2004; Kirkup et al., 2005; Kress & Krupnick, 2006). Online floras are now providing multiple-field searches into the data (see Brach & Song, 2006), which allow searching by taxon name or distributional fields, such as elevation, province, and country, as well as searches through free text (<http://www.efloras.org/search_page.aspx?flora_id=2>) and linking treatments to related information, photos and illustrations, maps, databases, checklists, and other floras (Funk, 2006). In addition to full text or “context searching,” digital floras also allow for updating with new revised treatments as they become available instead of having to wait for the next paper flora to be published. Data extractions of florulas for geographical areas of special interest, e.g., at a country, state/
province, or county level, are facilitated by digitization (see Kartesz, 2011).


**AN EXAMPLE: THE FLORA OF CHINA**

The Flora of China Project (FOC; <http://www.foc.org>) provides online treatments for vascular plants at all manuscript stages (<http://flora.huh.harvard.edu/china/mss/alphabetical_families.htm>) prior to paper publication of text volumes. Draft manuscripts are noted as such in the header, uploaded to the Web site as HTML files, and replaced with revised versions until considered final for volume publication. Once a particular volume is sent to the printer, the final manuscripts for the volume are then database (<http://www.efloras.org>, see Brach & Song, 2006). Because of this dynamic accessibility, we regularly receive e-mail from the general public asking about plant identification and use, as well as from specialists worldwide, suggesting corrections and inquiries for particular taxa. Also, after printed publication, the project’s editors and coauthors, and specialists outside of the project have the opportunity to submit corrections, which we have routinely incorporated into both the databased, published treatments accessible via an interface on <http://www.efloras.org> and into the project’s database of corrigenda for published volumes. Newly published names not available in the printed version are added to the eFloras database and to the FOC Checklist (<http://www.tropicos.org/Project/FC>), also see Brach & Song, 2006). The checklist is maintained as a project within the Web-accessible Tropicos (<http://www.tropicos.org/>). Because the database is regularly updated with corrections, flora users access a “dynamic” flora via the eFloras interface (while the family PDFs are currently maintained in “static” form so as to provide the original, published treatment). Questions for the future will include how to manage major revisions of families and genera after “print publication” of volumes, alternative treatments by authors differing in their taxonomic opinions, and authorship of revisions to the database years later.

The FOC Project provides interactive identification keys (Brach & Song, 2005) in DELTA Intkey and NaviKey formats (<http://flora.huh.harvard.edu/china/ActKey/>). Electronic keys are available for large genera (generally 50 or more species, but also for some smaller genera). The DELTA data are archived and accessible (<http://www.species-id.net/wiki/Main_Page>) for updates and improvements. The keys can be modified (characters/states and items/taxa) using the DELTA Editor application, and subsequent revised keys posted online.

**DEVELOPMENTS IN DIGITIZING FLORAS**

Existing natural language descriptions can be parsed by software such as MARTT (Markuper of Taxonomic Treatments) (Cui, 2008) into XML language (demonstrated at <http://research.sbs.arizona.edu/~honge/ResearchDemo/MARTTDemo1.html>), thereby providing searchable databases online (<http://research.sbs.arizona.edu/gs/cgi-bin/library>).

For new and revised editions of floras, digital floras should be created starting at the beginning of any new project. Programs such as D’Escription Language for TAXonomy (DELTA, Dallwitz, 1980; Dallwitz et al., 1993 onwards; Brach & Song, 2005) provide tools (cf. the DELTA Editor: <http://delta-intkey.com/www/delta-edi.htm>) for inputting characters, character states, measurements, and counts into data matrices to then output as natural language descriptions (in which natural language descriptions read as a natural language and not as machine-generated) and interactive identification keys that can be linked to related images. Open repositories for interactive key datasets (see <http://www.species-id.net/wiki/Main_Page>) may be used as examples in building new character sets and interactive keys and in creating new data conversion (Structure of Descriptive Data, SDD; DELTA, etc.) and input utilities, and also to provide an archive for the data. Also, digital image libraries of taxa can be implemented as part of the identification process (Agarwal et al., 2006; Hearn, 2009; also Wikispecies, <http://species.wikimedia.org/> and Wikimedia Commons, <http://commons.wikimedia.org/>).

With pressing issues of cataloguing biodiversity, conservation, and sustainable use of resources, botanists are now challenged to routinely prepare and revise online treatments, including interactive identification keys and images for a worldwide audience of students and researchers. As botanists,
we should ask ourselves if it is justifiable to continue to produce printed books on paper while at the same time the world is rapidly digitizing older works, and when it appears that soon an increasing number of new works will be available in digital format. Although advances in book scanning, electronic publication, and digital libraries are providing the tools and resources to accomplish this, one has to ask what continuing role the printed flora plays.