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Digital Preservation and Access of Natural Resources Documents

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Abstract
Digitization and preservation of natural resource documents were reviewed and the current status of digitization presented for a North American university. It is important to present the status of the digitation process for natural resources and to advocate for increased collections of digital material for ease of reference and exchange of information. Digital collections need to include both published documents and ancillary material for research projects and data for future use and interpretation. The methods in this paper can be applied to other natural resource collections increasing their use and distribution. The process of decision making for documents and their preservation and inclusion in ScholarWorks is presented as a part of the Forest Sciences Commons as a subset of the Life Sciences Commons of the Digital Commons Open Network launched and maintained by bepress. Digitization has increased the roles and skillsets needed for librarians and from libraries. This creates new challenges and opportunities for the library as publisher and as an advocate for open access. Digital curation melds together digitization and knowledge management and enhances community engagement. Digitization of collections are reviewed and natural resource documentation presented for faculty publications, Research Projects and Centers, eBooks, Journals, Galleries and electronic Theses and Dissertations (ETDs). Recommendations are made to increase the digital curation of the collection by encouraging community participation and use. Digital archives are important to natural resource professionals as society-ready natural resource graduates need to deal effectively with complex ecological, economic and social issues of current natural resources management. Natural resource research for the future needs to ensure that professionals have a greater breath of knowledge as they interpret and apply new knowledge, understanding, and technology to complex, transdisciplinary social and biological issues and challenges.
Keywords: Digitization, ScholarWorks, Preservation, Natural Resources, Digital Curation, Institutional Repository.

1. Introduction

Digital preservation of documents has increased in university libraries. This increase revealed the need for stable, sustainable platforms for archiving documents and to increase the use and impact of research material produced by the university (Gracy and Kahn 2012). The need for digital library material for natural resources is to enable users to make informed decisions, and to provide information to policy makers, educators, community groups, citizens, and other scientists. Decision-making and environmental stewardship, planners and academicians need access to high quality timely information on natural resources (Salwasser and Murray-Rust 2002). The Arthur Temple College of Forestry and Agriculture (ATCOFA) has made a significant contribution to the body of knowledge freely available by its enthusiastic participation in the institutional repository at the Stephen F. Austin State University (SFASU) ScholarWorks. Like many university libraries the Ralph W. Steen Library at SFASU provides mediated deposit into the institutional repository (IR) as a service. The Center for Digital Scholarship (CDS) in Steen Library handles the uploading of articles for faculty, applying metadata for these deposits, and when appropriate adding links to other locations. Sustainability of the archives is essential for a successful repository. While the cost of updating the repository's platform is a major consideration, the sustainability of the program is also dependent on the successful participation and buy-in of the university's faculty. Institutional repositories can serve to quantify research output of the university and provide a platform for publishing faculty driven academic journals (Erway 2012). Part of the resources of the library are used to assist students in becoming information literate and teaching them how to find and access library materials including digital archives. With the demands of electronic learning, universities need to embrace information and communication technology to guarantee quality of learning (Pinto and Doucet 2007).

To facilitate the digital preservation of and expand access to the scholarship at SFASU, articles were scanned and deposited into SFASU ScholarWorks. This resulted in the inclusion of ATCOFA's scholarship and research as a part of the Forest Sciences Commons™ http://network.bepress.com/life-sciences/forest-sciences/ and Other Forestry and Forest Sciences Commons™ http://network.bepress.com/life-sciences/forest-

sciences/other-forestry-and-forest-sciences/ .These are subsets of the Life Sciences Commons™ from the Digital Commons Network™ (DCN) launched by bepress. The Digital Commons Network™ is created by universities and includes full-text scholarly articles from faculty. bepress views DCN as an extension of the Digital Commons software service used to build institutional repositories and publish peer-reviewed journals thereby increasing the visibility of an institution and its research (Enis 2013).

Currently 105 universities contribute to the Forest Sciences Commons on the DCN. Of the 105 universities ATCOFA at SFASU contributes the second largest collection of forest sciences research to the DCN. SFASU consistently ranks as one of the top ten universities for research in the Forest Sciences. Additionally authors from SFASU appear multiple times in the ten most popular researchers list in the monthly usage reports from the DCN.

Digitization of library material can help preserve older and more fragile material. Digitization facilitates greater access to the content of these materials while reducing the need to use and handle the original item. It also increases the discoverability of these materials in the online environment. Initial grant funded digitization projects often enhances technical infrastructure and skillsets in an institution. This includes the use of metadata articulating the provenance of a document and its publication record (Pandey and Misra 2014). Digitization has increased the scope of librarians' work, adding new challenges and opportunities driven by the continuous changes in technology. This includes the increasing demand for qualifications in digital technology, management and communication skills (Choi and Rasmussen 2009). Current digital librarians often need web page design experience, internet searching expertise, and effective communication skills.

1.1 Challenges to Digitization

Challenges to digitization include collecting and selecting material for inclusion in the digital collection. Acquiring the necessary rights or permissions to store and disseminate the material electronically is a time consuming process. The ability to get or not get these permissions often determines whether or not an item is included in the repository and its level of access to prospective users. The success of ScholarWorks and the repository program is largely due to the library's willingness to devote the necessary resources in dedicated staff to the institutional repository, and to cover the costs of implementing, sustaining and growing the program. This includes the resources needed for storing and retrieving information, and for employing best practices and standards for digitizing library materials (Liu 2004, Lopatin 2006). The role of the library and librarians in institutional repositories is constantly changing as methods of procuring electronic resources rapidly increase (Newton et al. 2010). Boock (2008) details the organization of digital material for both preservation and use including the digitization process, and for the approval and prioritization of digitization projects. Librarians must have or develop the knowledge and skills needed for the acquisition of the necessary copyright and intellectual property permissions to include an item in the repository. Additional skills needed for a repository include the understanding and application of appropriate metadata, understanding the principles of effective web design, and the selection of materials. One of the most important skills that a librarian must possess for the success of an IR is not in technology but in their ability to generate enthusiasm and buy in from faculty. Faculty participation and especially the participation of the faculty in ATCOFA is the cornerstone of the current and future success of ScholarWorks.

Other repositories of digital collections for natural resources do not have breath of use of ScholarWorks. DSpace, an open source program used for creating digital archives/digital material for library repositories (Madalli et al. 2012) is not as widely available as the Digital Commons Network™ for use in natural resource digital preservation. The Digital Commons Network™ is supported primarily by universities and expanding into journal publication (Daly and Organ 2009). DSpace is supported by open source software and this can be used to build digital libraries and digital archives (Madalli et al. 2012). Tramboo et al. (2012) review open source digital library software including DSpace, EPrints and Greenstone for use as institutional repositories. The Digital Commons Network™ developed through bepress originally founded in 1999 and now hosts a suite of tools and services for institutions to manage, display and publish and disseminate scholarly works with open access institutional software (http://digitalcommons.bepress.com/about/).

Digital curation is used to describe digital preservation and knowledge management melding together both digital asset management and community engagement (Kunda and Anderson-Wilk (2011). The concern is that digital preservation without directed use will not be sustainable. The value-added function of facilitating user understanding and use of the preserved digital resources with the metadata is essential for user experience, reflection and learning (Beagrie 2006).

1.2 Natural Resources Digital Library, Oregon Explorer™

Salwasser and Murray-Rust (2002) evaluated the need for a natural resources digital library that included a sustainable and powerful search capability; access to full-text documents and reports; immediate accessibility; access to spatial data; and access to synthesized material. The goal was to find, retrieve, integrate and geo-

reference documents, maps, spatial data, audio clips, video clips and reports across spatial and temporal environments, and to retrieve, store and access existing information. Salwasser and Avery (2010, 2014) continued the Natural Resources Digital Library for Oregonians termed the Oregon Explorer™ with search access supported by the Oregon State University Libraries and Open Source Lab. Development of four digital library areas included: development, content, funding and usability. The purpose was to have a single web-access point for information on Oregon's natural resources and environment. Sustainability includes adding content and a business plan for the Oregon Explorer™. It can be accessed at http://oregonexplorer.info/, and the Natural Resources Digital Resources, Oregon State University Special Collections and Archives Research Center http://scarc.library.oregonstate.edu/digitalresources/naturalresources/.

1.3 Southern Methodist University

The case study of digital strategies to manage data at Southern Methodist University (SMU) (McCombs 2013) was similar to the archival work in natural resources at SFASU. In 2010, SMU began implementation of an instance of bepress's Digital Commons platform. This included uploading of material and dealing with copyright issues. The plan was to generate a familiarity and comfort with the process and gradually move faculty to include digital material and to provide an open access digital repository for that material. SMU promoted engaged learning with its Quality Enhancement Plan. This increased the emphasis on the appropriate digital infrastructure leading to global access to the library collection (McCombs 2013). Currently the SMU collection is part of the Greater Western Library Alliance to promote scholarly communication (GWLA 2012 http://www.gwla.org). Salo (2010) emphasizes that with digital archives of data, there is an increase in associated metadata. Digital quality and the data scanned for entry need to be prioritized.

1.4 Nigeria

Abdusalami et al. (2015) presented a case study on the importance of digitizing and preserving information in university libraries. In their questionnaire respondents indicated the need for high level of access to materials (91 percent of respondents); the need to preserve theses and dissertations, and the desire for digitization of books in high demand. Digitization was seen as highly beneficial (53 percent) or beneficial (47 percent); and 84 percent indicated digitization is highly relevant. Access to material online was deemed the most important (65 percent). This study indicated the importance of access of digital material from a library including the condition of the material and how users are guided to the information. The most efficient approach to digitization is through scanners. Needs for Nigeria libraries include funding, acquisition of skills and staff training, infrastructure updates, scanning and scanning technology, and adherence to digitization standards (Abdulsalami and Achebe 2013, Margoi and Gani 2014). Currently only theses and dissertations are being scanned and entered into the digital repository at Kashim Ibrahim library, and needs for further updates include increased scanners and proper copyright (Dorcas 2012).

2. Results

To develop the ScholarWorks database for natural resources within ATCOFA at SFASU meetings were held with ATCOFA and librarians in Steen Library. Concerted efforts were made to build an electronic database that was accessible, discoverable and mirrored the production of the college. In ATCOFA, a digital process was begun in Steen Library by the Center for Digital Scholarship (CDS). CDS supports scholarly activities, intellectual output, and in the teaching, research and service of the university community. Journals and articles were scanned and included in the ScholarWorks repository. In turn, these materials were added to the Forest Sciences section of the Digital Commons Network™. Publishers and professional societies were contacted by the librarians for the needed permissions to upload and store material in a retrievable database. Once the database was created, additional efforts were taken to locate material and have it scanned for upload into ScholarWorks. At SFASU, eight referred journals have been launched and are hosted in ScholarWorks including the Journal of Geospatial Applications in Natural Resources with the aim and scope of applied geospatial research on natural resources http://scholarworks.sfasu.edu/j_of_geospatial_applications_in_natural_resources/. For the ATCOFA documents, published articles were included with associated metadata. At the current time, grey literature, and working papers are not included.

The mission of ATCOFA is to maintain excellence in teaching research and outreach to enhance the health and vitality of the environment through sustainable management, conservation, and protection of natural resources. Society-ready natural resource managers need to deal effectively with complex ecological, economic and social issues of current natural resources (Bullard et al. 2014). Natural resource research for the future needs to ensure that professionals have a greater breadth of knowledge as they interpret and apply new knowledge, understanding, and technology to complex, transdisciplinary social and biological issues and challenges (National Research Council 2009). The development of the natural resources repository at SFASU paralleled the

evaluation of the curriculum for the B. S. Forestry degree. The need for graduates to integrate population growth, climate change, growing and changing timber and fiber markets, and the dramatic increase in invasive species is woven across the forestry curriculum (NAUFRP 2007). As information increases, the need to both chronicle and access this information is increasing. New technologies are available to acquire knowledge for online resources, communication and training and the pace of change of these technologies has accelerated (Bullard et al. 2014).

The SFASU repository for natural resources reflects faculty research interests, and aligns closely with their teaching expertise. For fire management, examples of fuel loading in The Netherlands reflect needs and methods that can be adapted and used in other locations. For pest management, articles produced reflect the major pests in the southeastern United States and become source material for both teaching and research on topics including the southern pine beetle, *Dendroctonus frontalis*; the Nantucket pine tip moth, *Rhyacionia frustrana*; the Texas leaf-cutting ant, *Atta texana*; and the interactive of bark beetles, the endangered red-cockaded woodpecker, *Picoides borealis*, and habitat modification. The ease of use of ScholarWorks increases its use and access to published material in the discipline. Forest economics is featured in the database and information garnered from a search indicates a broad range of publications. Hands-on measurements for spatial science includes the use of Pictometry® hyperspatial imagery for tree and forest object heights (Unger et al. 2015, Kulhavy et al. 2015); and use of GPS (Global Positioning Satellites) training for undergraduates in spatial science and forestry (Unger et al. 2014).

The discovery and application of new knowledge, at a rapidly increasing rate, is an important part of natural resource management. Well-designed programs are needed to continue professional education (Bullard and Straka 1986). Much of the material produced for foresters for research, teaching and service was funded by the McIntire Stennis Cooperative Forestry Research Program (Bullard et al. 2011).

The development of ScholarWorks as the institutional repository for SFASU, documents these contributions. Important features of ScholarWorks include a permanent link (URL) for the materials deposited, increased access and visibility of research for the public and the use of Creative Commons licensing of content. ScholarWorks provides increased discoverability and greater ease of access to research. ScholarWorks is supported and maintained by Steen Library. It provides the software to search articles within the institutional repository at SFASU and increases both the visibility of the work and gathers university scholarly output into a single location. ScholarWorks was designed as a platform to archive and showcase the creative and intellectual output of the university. The importance of the expanding role of libraries and librarians in scholarly communication is that research and other scholarly writings can be disseminated to a wider scholarly community on an open access basis and be preserved for the future (Association of College and Research Libraries, 2000). Integral to this process is the need to access material effectively and efficiently. Librarians must understand the economic, legal and social issues surrounding the use of the information. This understanding contributes to the information literacy instruction of the library. This instruction is crucial to student success both during and after college. "Gaining skills in information literacy multiplies the opportunities for students' self-directed learning…woven into the curriculum's content, structure and sequence…furthering the influence and impact of…problem-based learning, evidence-based learning, and inquiry learning." (Association of College and Research Libraries, 2000, p. 5).

Material available through ScholarWorks for natural resources includes Research Projects and Centers. These include the East Texas Pine Plantation Research Project (ETPPRP); the National Center for Pharmaceutical Crops (NCPC); the SFASU Gardens; and the SFASU Weather Station.

2.1 Faculty Publications

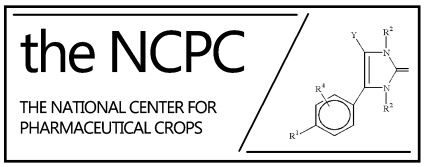
Between 400 and 700 full-text articles by ATCOFA faculty are downloaded every week. In the past year research by the ATCOFA faculty was downloaded over 20,000 times. Providing their research published in peer reviewed academic journals on an open access basis results in the wider use and greater impact of faculty research in addition to the traditional avenues of publication.

2.2 East Texas Pine Plantation Research Project

The ETPPRP is conducted in conjunction with Timber Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs) in eastern Texas and western Louisiana (ETPPRP, 2007, 2012). There were a total of 256 permanent monumental plots established in 1982-1984 with 175 in loblolly (*Pinus taeda*) and plantations and 8l in slash pine (*Pinus elliotti*) plantations. Six integrated forest product companies, Temple-Inland, International Paper, Louisiana Pacific, Champion International, St. Regis Paper Co. and Owens-Illinois, Inc., were initial participants prior to merging with other companies and/or selling their land base in East Texas. At present, the ownership is fragmented with mostly TIMOs and REITs managing the properties. In 2012, 126

new plots were established in intensively managed loblolly pine stands in Texas and Louisiana on Temple-Inland, International Paper, Rayonier, Hancock and The Campbell Global TIMO. The ETPPRP is a long-term, comprehensive research program investigating the factors affecting loblolly and slash pine plantation management in eastern Texas. By 2012, 67 reports, 5 dissertations, 15 theses and 33 publications had been produced on timber measurements and forest stand growth and yield models available through ScholarWorks (ETPPRP 2012). The ETPPRP was initiated by Dr. J. David Lehnart (1982-1999), and continued by Dr. Dean Coble (1999-2015) and Dr. Yuhui Weng (2015-present).

2.3 National Center for Pharmaceutical Crops



The National Center for Pharmaceutical Crops (NCPC), located in ATCOFA, was established in 2004. The mission of the NCPC is to improve human health by discovering novel anti-tumor and antiviral agents from native and invasive plant species with the purpose of the center is the extraction or preparation of therapeutic substances including drugs, active pharmaceutical ingredients, vaccines and antibodies, and other therapeutic solutions. There is a database of 950 samples of 720 species from 138 families http://faculty.sfasu.edu/yuanw/plants/stat.asp. ScholarWorks displays NCPC specimens http://scholarworks.sfasu.edu/ncpc_specimens/. Of special interest is the development of endocides (endogenous biocides), a new approach to invasive plant control, especially against giant salvinia, *Salvinia molesta* (Li, et al. 2014). Li and Adair (1994) documented the importance of camptothecins as a secondary metabolite with anti-tumor and anti-viral applications from Chinese happy tree, *Camptotheca acuminata* (Table 1), as an antifungal agent (Li et al. 2005), and as a pharmaceutical crop (Li 2014). Links can be followed to ScholarWorks for a total of 60 articles and patents from the NCPC 2001-2014 with 7544 downloads. http://scholarworks.sfasu.edu/ncpc_articles/ Data for 10,000 tree species pools in eastern Asia and North America were analyzed by Li and Adair (1997).

2.4 SFASU Gardens

Occupying over 128 acres of space on the SFASU campus and the city of Nacogdoches, the SFASU Gardens host a diverse selection of plant life. Five distinct gardens include the SFASU Mast Arboretum, the Ruby M. Mize Azalea Garden, the Pineywoods Native Plant Center and the Gayla Mize Garden and the Kingham Children's Garden. The SFASU Gardens hosts the Sculpture for All competition and exhibition, a nationally juried display of outdoor art. http://scholarworks.sfasu.edu/sculpture_for_all/ The SFASU Gardens is a teaching center with the Ina Brundrett Conservation Education Center at the Piney Woods Native Plant Center (PNPC), a 40 acre area for environmental and forestry education. The SFASU Gardens publishes the SFASU Gardens Newsletter since the 1980s on past festivals, workshops and lectures. Six Lone Star Regional Conference proceedings held at the PNPC, are published on ScholarWorks http://scholarworks.sfasu.edu/sfa_gardens_lonestar/?utm_source=scholarworks.sfasu.edu%2Fsfa_gardens_lonestar%2F5&utm_medium=PDF&utm_campaign=PDFCoverPages. SFASU Gardens Newsletters on the garden from 1986 to 2014 that chronicle the events in the garden. http://scholarworks.sfasu.edu/sfa_gardens_newsletters/index.5.html

2.5 SFASU and National Weather Service Weather Station

The weather station maintained by ATCOFA at Pecan Park, Nacogdoches, is part of the weather observation network of the National Weather Service (NWS) since 1989 and data collected are reported to the NWS and the Texas Water Development Board. Daily rainfall and air temperature data for Nacogdoches are available since 1901. The SFASU Observatory, Lat: 31° 45' 36" N, Lon: 94° 39' 39" W, Elevation, 490 feet, 10 miles north of Nacogdoches operated by the Department of Physics, Engineering and Astronomy; and Wafflelow Creek Station, Lat: 31° 41' 54" N, Lon: 94° 31' 25" W, Elevation: 360 feet, supplies daily weather for the area including fire danger, wind, rainfall, humidity and barometric pressure and ultraviolet index. Monthly weather data (2007-2016) are on ScholarWorks. http://scholarworks.sfasu.edu/weather_station_data/

2.6 Forestry Bulletins and Forestry Papers

Forestry Bulletins 1-25 from 1957 to 1972 were scanned and accessed in ScholarWorks

http://scholarworks.sfasu.edu/forestrybulletins/?utm_source=scholarworks.sfasu.edu%2Fforestrybulletins%2F10&utm_medium=PDF&utm_campaign=PDFCoverPages. Important in the bulletin series are silviculture of southern forest tree species including longleaf pine (Walker and Wiant 1966a) and shortleaf pine (Walker and Wiant 1996b); bottomland hardwoods (Walker and Watterston 1972) and upland hardwoods (Walker 1972). Texas Forestry Papers 1-29 were published between 1970 and 1976 over topics of timber inventory, and volume estimates, site index curves for loblolly pine, *Pinus taeda*, and southern silviculture http://scholarworks.sfasu.edu/texas_forestry_papers/.

2.7 eBooks, eJournals and Theses and Dissertations

Proceedings from ATCOFA conferences are now online as eBooks increasing the availability of the articles. http://scholarworks.sfasu.edu/ebooks/ Electronic theses and dissertations are being added to ScholarWorks and a total of about 400 will be added for ATCOFA http://scholarworks.sfasu.edu/etds/. As part of ScholarWorks for natural resources, a total of 24 books and conference proceedings produced by ATCOFA were scanned and uploaded. This provides online access to these volumes and expands the availability and impact of these resources.

3. Discussion

Natural resource documents from the Arthur Temple College of Forestry and Agriculture were scanned by the Center for Digital Scholarship and uploaded into ScholarWorks for both electronic preservation and access. Area topics included Faculty Publications in Forestry, Spatial Science, Environmental Science and Agriculture, eBooks, Research Projects and Centers (East Texas Pine Plantation Research, National Center for Pharmaceutical Crops, SFASU Gardens, SFASU Weather Station); eJournals (Journal of Geospatial Applications in Natural Resources), Archived Journals (ATCOFA Monograph Series; Forestry Bulletins No. 1-25, 1957-1972, Texas Forestry Papers, No. 1-29, 1970-1975); Galleries (National Center for Pharmaceutical Crops Specimens), and electronic theses and dissertations.

ScholarWorks acts as digital archives to preserve the documents and have them available for digital curation for public and academic engagement. It is essential that digitized material be available for policy makers, educators, community groups, citizens; and other scientists. Institutional repositories facilitate open access to traditional scholarship broader support of emerging technology in the digital age (Chen 2004). Liaisons in libraries both advocate and consult with an emphasis on campus engagement speaking on trends in higher education, providing information to stakeholders and promoting the repository holdings (Jaguszewski and Williams 2013). Digital access to high quality and timely information on natural resources provides updates to trends and current research in the field and increases the material available to students, researchers and PR actioners. Sustainability of the archives is essential and institutional resources need to be allocated to both the archive and to the collection of scholarship and research produced at SFASU. One of the greatest difficulties with the collection of materials included locating copies of the documents for scanning and preservation. Future plans include increasing the thesis and dissertation uploads for natural resources and to expand the database for digital images of presentations and journals. Material and presentations for conferences directed will be uploaded to ScholarWorks as an institutional repository. As additional centers are developed, these will be included in ScholarWorks increasing both the institutional repository and information for users and stakeholders.

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