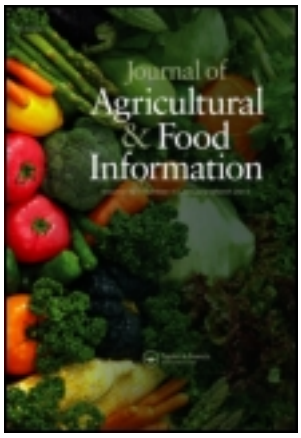

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Partnering for Better Management of Western Rangelands: Using Web Technologies to Get the Word Out

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Partnering for Better Management of Western Rangelands: Using Web Technologies to Get the Word Out

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ABSTRACT. For more than six years, a multidisciplinary team at the University of Arizona, along with a variety of outside partners, have been developing a series of Web sites and Web modules on topics related to the management of western rangelands. This article describes collaborations that have led to the development of the Arizona Rangelands Web site. The site is organized around distinct modules that provide access to data and other information previously only available through agency or other technical specialists. Also described is a companion Web site, which provides a template for storage and retrieval of archived information central to the management of public land grazing allotments.

KEYWORDS. Rangelands, management, collaboration, information dissemination, Web sites, Arizona, western rangelands

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Western rangelands in the United States are a type of land that supports many kinds of vegetation and uses, and encompasses a variety of tenure systems. These lands are often described by their limitations; not enough rainfall or soil, or too hot or too cold (Holechek et al., 2001). Some consider these broad expanses of grasslands, shrublands, and deserts as marginal lands leftover from the western expansion and settlement of the 1800s. Others view them as the country's last great open spaces characterized by distinctive flora and fauna and possessing unparalleled beauty. Much of this land is public land under Federal control by the U.S. Bureau of Land Management (BLM) or the U.S. Forest Service (USFS). Other large areas of rangeland include state land, Indian and military reservations, and privately held acreage. Uses of rangelands are many and include domestic livestock grazing, watersheds, recreation, wildlife habitat, and wilderness. Needless to say, proper management of rangelands that satisfies public desires for commodities and other values within environmental, economic, cultural, and legal constraints is a complex task. Gone are the days when management decisions were made by a few people with little or no public scrutiny. Today, rangeland management can be highly contentious, litigious, and charged with emotion (Raish, 2000). As a result, it is more important than ever for all members of the public, in addition to ranchers and other rangeland managers, to be informed about the issues surrounding rangelands and for there to be greater understanding of appropriate strategies for their management.

This need for access to timely and relevant information by those involved in the management of western rangelands has led to a series of multidisciplinary and cross-organizational collaborations which has resulted in a set of interrelated Web sites on various aspects of the subject. The first and continuing of these collaborations involves a diverse partnership at the University of Arizona (UA) consisting of academic librarians, rangeland specialists, and computer application experts. Beginning in 1995, this group has worked together to organize and develop the first phase of an Arizona Rangelands Web site as part of the Agriculture Network Information Center (AgNIC) (Hutchinson and Ruyle, 2000). Once the initial site was operational, project members began conceptualizing a much broader Web resource, which would eventually involve agency personnel, ranchers, special interest groups, geographic information systems specialists, and programmers in the development of tools for providing access to information and databases that up to that point had been largely unavailable. This vision has become the basis for the ongoing development of the UA Arizona Range-

lands AgNIC Web site, including a number of extensive stand-alone informational and decision-making modules. It also has generated a companion Web site focused on the management of public lands grazing allotments using as a demonstration model the fifty years of data collected on the UA Walker Basin Allotment and V-V ranch. Based on the experience gained through these projects, it has become clear that partnering is an essential element for the successful creation and management of any comprehensive approach to Web-based information dissemination. This is particularly the case in such applied disciplines as agriculture, which requires both a strong scientific foundation, but also a means to put science to practical and immediate use to support basic societal needs (Hutchinson and Greider, 2002).

ARIZONA RANGELANDS AgNIC WEB SITE

As noted above, the Arizona Rangelands Web site was launched as the result of the AgNIC national level initiative first operationalized by the U.S. National Agricultural Library, Iowa State University, Cornell University, the University of Nebraska-Lincoln, and the University of Arizona. As one of the original members, the UA had the opportunity to be involved at the outset in defining the nature of AgNIC as a distributed information system where member institutions and organizations each provide access to information, data, and subject-experts on specific agriculture-related topics. Taking a centers-of-excellence approach, the AgNIC members were to each select a topic in which their institution had particular expertise and resources, and which had relevance to their state-wide clientele. To this end, the UA AgNIC team chose to focus on the management of western rangelands, not only because of its relevance to Arizona, but because it would link more traditional agriculture disciplines with ecological, social, and economic issues related to natural resources (Ruyle et al., 2000).

Throughout the years, the UA effort has involved both daily development and maintenance efforts of the core team and periodic meetings with an expanded group to discuss and critique overall progress. Additionally, the Web site provides an online feedback mechanism for users to make suggestions for additional content or functionality. The team also solicits input directly from clients, in the beginning by establishing a formal Advisory Group and later through formal demonstrations at stakeholder group meetings around the state. Primarily the UA Arid Lands Information Center provides day-to-day development and main-

tenance of the Web site; the Rangeland Extension Specialist determines content directions; and staff from the UA Science-Engineering Library monitor the online reference service. However, there is some overlap between these activities and the entire group makes many decisions about design and features, while certain special components may become the domain of individuals or groups of individuals. For example, faculty from the Science-Engineering and Main Libraries are working with the Society for Range Management to make the back issues of the *Journal of Range Management* easily available and searchable in their full-text form.

Currently, the Arizona Rangelands Web site is divided into five major categories: Rangeland Science and Management; Policy Issues; Economics, Business and Marketing; Education, Teaching, and Careers; and General Resources [http://rangelandswest.org/az/index.html] (see Figure 1). Although the entire site is a continuous work-in-progress, envisioned here is a broad array of material that might commonly be included in typical rangeland management courses, albeit expanded, particularly by the ability to draw on the many resources made available through other related Web sites. Another set of categories focuses on materials that are considered to be of a more practical nature. Here the user will find sections on Practical Tools, Geospatial Tools, and information on Climate and Weather. The majority of the site has been developed by the core team who donate much of their time to the project, sometimes with graduate student assistants hired to work on certain sections as outside funding allows. However, a number of specialized applications have been developed with partners outside the University such as the USDA Natural Resources Conservation Service (NRCS) and NASA.

Each such individual module, created through these various collaborations, has a unique history and targeted audience. They also often provide knowledge and technology previously available to end users only through direct contact with university and agency technicians. The modules described in some detail below include the Practical Tools section, access to NRCS Ecological Site Guides, and a resource on geospatial applications. A fourth Policy Issues section under development is directed at controversial issues such as public land livestock grazing, urbanization, and mining as well as regulatory aspects of rangeland management. This section will be discussed briefly, as will a related Web site on managing public lands grazing allotments.

FIGURE 1. Arizona Rangelands Home Page

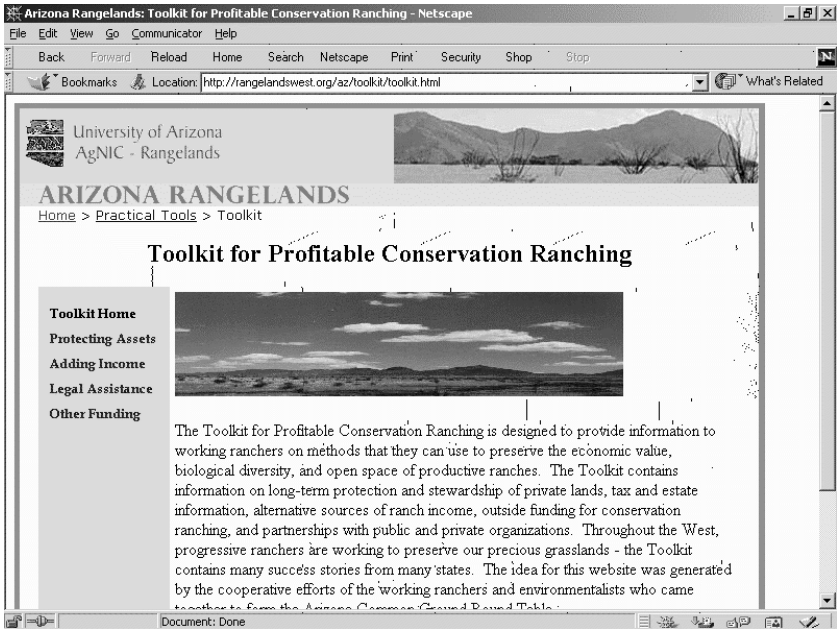
PRACTICAL TOOLS

Following a demonstration of the Arizona Rangelands Web site to several UA project groups studying climate change in the Southwest, members of the team were approached by the Arizona Common Ground Roundtable to help them develop a set of practical tools to support ranchers' efforts to stay on the land. They were interested in tying the tools to the Arizona Rangelands Web site as a vehicle for more widely disseminating such information. Affiliated with the Udall Center for Studies of Public Policy, the Roundtable is a statewide group of ranchers, environmentalists, researchers, public agency personnel, sportsmen, and other interested citizens who share a concern over the rapidly accelerating loss of open spaces in Arizona. Roundtable participants are seeking to identify tools and policy changes that will conserve the open spaces on which Arizona's flora and fauna, water supply, and scenic beauty depend. After a brainstorming session composed of both Roundtable and UA AgNIC team members, a list of categories was determined for practical information that

could be of use to ranchers and other land managers. Soon after, a graduate student from the Rangelands and Forest Resources Program was hired to identify appropriate Web links and to write summaries for each category. What resulted was the Toolkit for Profitable Conservation Ranching as well as a broader Practical Tools section [http://rangelandswest.org/az/toolkit/toolkit.html] (see Figure 2).

The complete Practical Tools section includes relevant information for end-users, including ranchers and other rangeland managers. It covers such topics as conservation strategies for small farms and ranchettes, technical advice for the management of noxious weeds, and ranch management guides. The distinctive Toolkit contains information on conservation easements and estate planning, where legal assistance can be obtained, alternative income generating ideas, and information on grant programs and potential partnerships. The intent of this section is to provide basic, hands-on information for commonly encountered range management problems and serves as part of a larger effort to identify and elucidate issues related to sustainable ranching.

FIGURE 2. Toolkit for Conservation Ranching



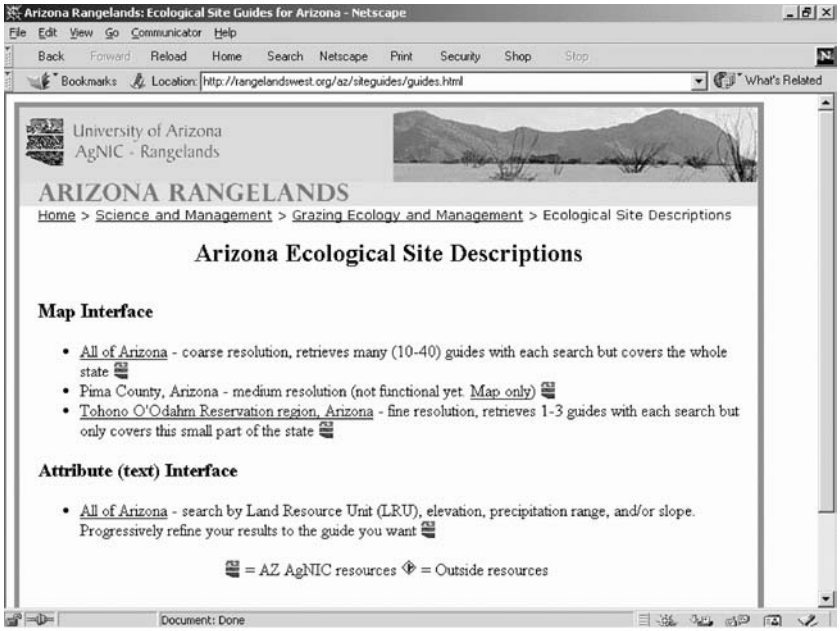
ECOLOGICAL SITE GUIDES

One of the most frequently used technical applications is a tool that was developed to provide access to NRCS Ecological Site Guides. Ecological sites are the primary mapping units for conservation planning on all non-federal rangeland, and are also used by the BLM. Site Guides characterize land resources in terms of soils, plant communities, hydrologic features, climate, and interpretations of wildlife, recreation, and grazing. In essence, they provide an overview of the production potential for specific land types. The tool developed for the Arizona Rangelands site enables ranchers and others to identify specific Site Guides for particular grazing allotments or properties in Arizona, providing them with descriptive information that had only been available to agency personnel in the past.

The idea to create a Web-based system for accessing the Site Guides via the Arizona Rangelands site was conceived by members of the project team. To this end, a small proposal was compiled and submitted to Cooperative Extension to develop a prototype for the system. At the same time, a key person in the Arizona state office of the NRCS was contacted to determine if there was a way to obtain an electronic version of the Site Guides. In a serendipitous, but extremely fortunate moment, it happened that the State Range Conservationist at NRCS was nearing completion of an individual three-year effort to put the Arizona Site Guides into a database format and he was willing to turn it over to the UA for loading on the Web and for developing suitable interfaces. Similarly, through another NRCS contact, digitized base soils maps were obtained to provide the foundation on which to build the geospatial interface to the Site Guide data. Thus, with funding received from Cooperative Extension, largely used to hire a programmer and GIS specialist, and the generosity of NRCS in sharing its electronic data, two interfaces to the Site Guide data were developed and made operational [http://rangelandswest.org/az/siteguides/guides.html] (see Figure 3).

The first interface encountered is map-based, while a second interface allows the user to enter specific attributes such as slope, elevation, and precipitation to identify particular Ecological Sites. The popularity of this section is due not solely to the new accessibility of information that previously had very limited distribution, but also to the array of Map-Server products that allow users to target specific localities, obtain relevant Site Guides, as well as a variety of related material. Using the Internet Map Service software developed commercially by ESRI, an application was created where users can select from different layers to create a base map and then overlay it with

FIGURE 3. NRCS Ecological Site Guides for Arizona



such attributes as roads, cities, rivers, township and range, watersheds, or land ownership. The capability to focus the map resolution makes it possible to view selected areas in detail and to retrieve site-specific information such as basin and range coordinates. The results of each land point search are displayed in a right-hand column providing links not only to specific Site Guides, but descriptions of soil series, links to U.S. Geological Survey topographic maps, and county-specific information. Although the greatest functionality for the geospatial interface is only available at this time for the Tohono O'odham Reservation in Arizona, funding is being pursued to build a similar system for the entire state as well as neighboring states.

GEOSPATIAL TOOLS

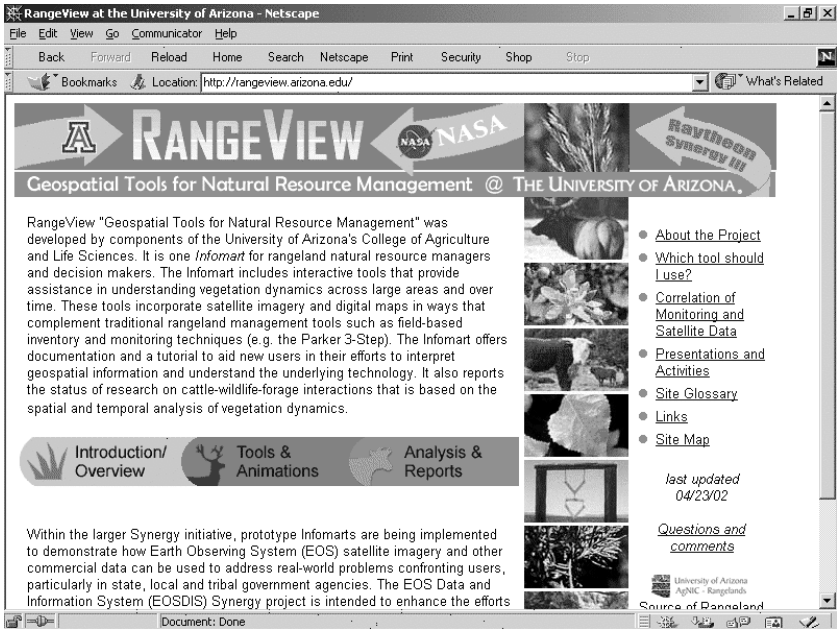
The high visibility of the UA involvement with the national level AgNIC initiative, coupled with the development and outreach activities of the Arizona Rangelands team, led to an important collaboration with the UA-based Arizona Remote Sensing Center. The Center had been working on a project called Synergy which was funded with NASA monies fun-

neled through the Raytheon Company and was looking for ways to expand its applications of satellite remote sensing to natural resource management, particularly rangeland management. There also was interest at the outset to attach the remote sensing applications to an already well-known and viable Web-based system to make the products more accessible to the public and presented in a real-life context. This led to partnering on a successful Synergy II, now called RangeView, proposal and the beginning of an extensive set of user-driven remote sensing and GIS tools to assist ranchers and agency land managers in vegetation monitoring and land use planning activities. These tools elaborate on user interest in Map-Server applications, using available satellite images as the basis for analysis.

Selecting the Geospatial Applications button on the Arizona Rangelands home page takes the user to an interim page describing geospatial technology [http://rangelandswest.org/az/geospatial.html]. This page links to the RangeView site as well as to other related geospatial projects and educational programs available on the Web (see Figure 4). The RangeView home page provides an overview of the project and links to the interactive tools that contribute to an understanding of vegetation patterns over time and between land areas. These tools incorporate satellite imagery and digital maps in a way that complement traditional rangeland management such as field-based inventory and monitoring techniques. The site also offers a tutorial to aid new users in their efforts to interpret geospatial information and understand the underlying technology. Specific tools include animations of weekly vegetation conditions for the U.S., Southwest, and Arizona. These tools measure vegetation greenness from a variety of perspectives including difference from normal or from the previous week or year, in comparison to annual precipitation, and based on a ten-year average. Map-Server applications are also available as demonstration modules for analyzing vegetation conditions along with other spatial information for participating ranches.

One of the most unique aspects of the RangeView project has been the direct involvement of ranchers in the initial development stages of the tools. Feedback has been obtained through workshops, one-on-one interviews, and hands-on activities. Central to the rancher's interface with the tools has been the four graduate students who are directly involved in creating the tools and conducting training in their use. This unusual collaboration is one of the most interesting and innovative characteristics of the project. Recently, a third year of funding was obtained which is helping to solidify this partnership and to develop even more powerful, user-oriented geospatial products.

FIGURE 4. Geospatial Applications for Rangeland Management



POLICY ISSUES

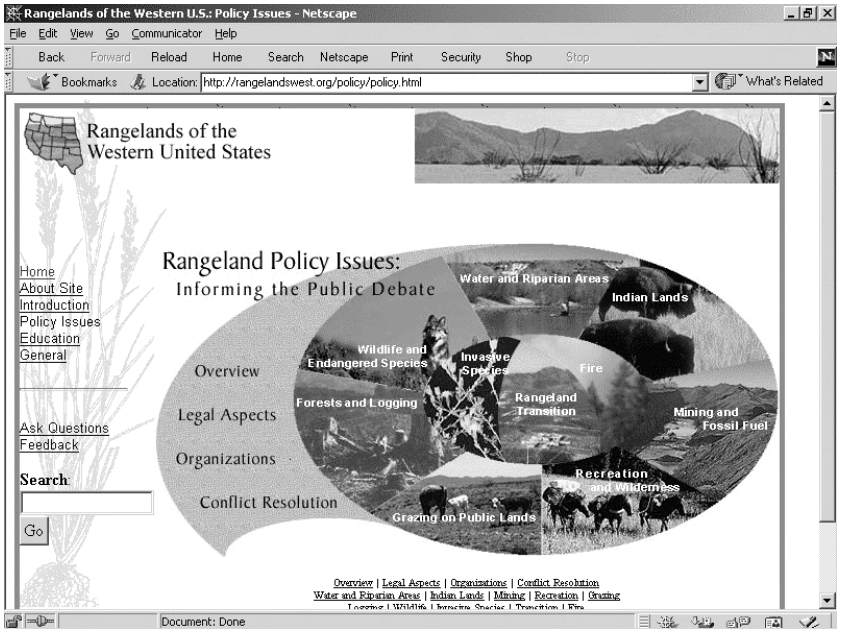
Periodically, the Arizona Rangelands team has demonstrated the progress made on both the UA and national-level AgNIC activities to the administrators of the UA College of Agriculture and Life Sciences and Main Library. These presentations are undertaken not only to inform, but to remind administrators of the need to maintain support for these efforts not only in terms of faculty time, but with financial commitments whenever possible. At one such event held in early 2001, one particular section of the Arizona Rangelands site sparked the interest of the agriculture administrators. This was the Policy Issues section that focuses on the most contentious aspects of rangeland management and those topics most often appearing in the news.

What these administrators are well aware of is that much of the vast areas called rangeland in the western U.S. are public lands and most aspects of public land management can be described as public policy issues. Public land grazing issues, as well as issues surrounding other public land

uses, are a combination of social, economic, and policy influences, constrained by ecological processes. These issues are often controversial and divisive. The Arizona Rangelands Policy Issues section is generally aimed at informing the public policy debate, but also specifically oriented to help rangeland managers better understand the application of complex laws which regulate land use [http://rangelandswest.org/policy/policy.html] (see Figure 5). The intent of this section is to provide enough information to clarify particular issues, analyze management alternatives and their consequences, and allow viewers to stay abreast of legislation and legal decisions. Additionally, this section provides links to the organizations most involved in these policy debates as well as a resource on conflict resolution. Key federal legislation also is featured including the Clean Water Act and the National Environmental Policy Act (NEPA) as related to rangeland management.

Largely due to the difficulties in keeping this section up-to-date and the request from the team for financial assistance particularly for this section, the UA College of Agriculture Dean and Associate Dean suggested

FIGURE 5. Rangeland Policy Issues: Informing the Public Debate



the team make contact with a related program initiated by the Western Land-Grant Colleges of Agriculture administrators. The administrators had created the Policy Center for the Analysis of Western Public Lands in 2000 to address public land issues through science-based information and analysis on the social, economic, and ecological impacts of public land policies in the West. At the time of this writing, members of the team had recently made a presentation to the Center's Board demonstrating the Arizona Rangelands Web site and particularly outlining opportunities for using the Policy Issues section as a means to disseminate the results of the Center's research and activities. In discussion is a formal collaboration between the Center and the Arizona Rangelands team for further developing, expanding, and maintaining the section as a means to frame important issues for public consumption.

PUBLIC LANDS GRAZING: THE WALKER BASIN ALLOTMENT WEB SITE

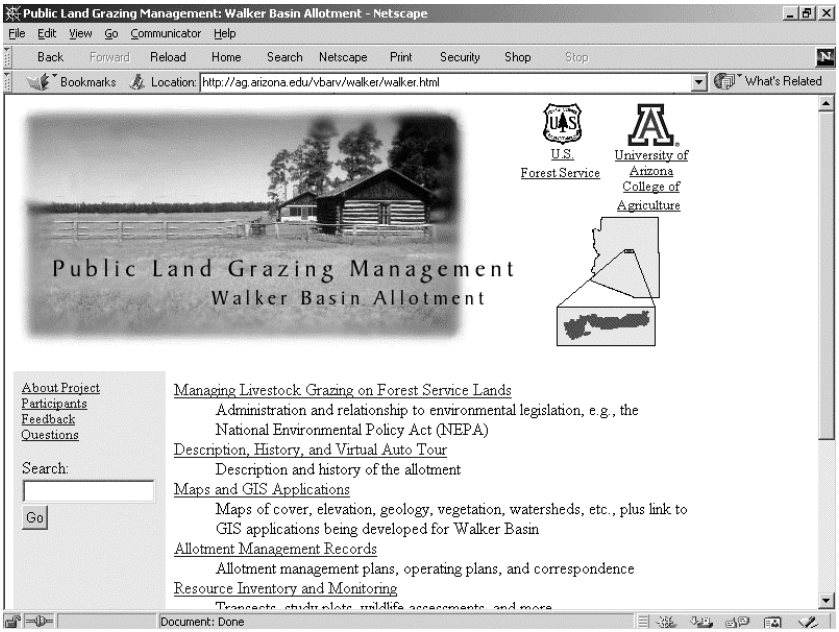
Building on the initial work of the Arizona Rangelands Web site, a proposal was developed to bring 50 years of data and administrative records from the UA V barV Ranch and Walker Basin Allotment to the Web. Funded by the International Arid Lands Consortium, the project is a collaboration of the UA and the USFS, the agency that administers the allotment. Three objectives were defined in the original proposal: (a) to provide electronic access to elusive public lands information; (b) to create a model database for vegetation monitoring records and imagery; and (c) to increase knowledge of Federal regulations on public lands. The ultimate goal is to provide agency personnel and ranchers with an example and template for record-keeping and management planning that will facilitate compliance with Federal regulations and lead to improvements in land capabilities.

To date, the sections on the Public Land Grazing Management Web site include an historical overview of grazing on Forest Service lands and the Federal regulations that impact such utilization activities as well as a description of the demonstration site for the project [http://ag.arizona.edu/vbarv/walker/walker.html] (see Figure 6). A description and history of the UA Walker Basin Allotment is supported by many years of management and financial records such as operating plans, grazing schedules, and cash flow spreadsheets which are available in full-text. Digitized maps of the Allotment compiled by the USFS Long Valley Ranger Station provide base maps of the area showing pasture names,

cover, elevation, geology, landforms, shaded relief, vegetation, and watersheds among others. Vegetation monitoring sites are identified on the maps and linked to soils and vegetation data collected over a 50-year period and to the photographs taken at each location and repeated during each monitoring session. Reports on range improvement projects and wildlife assessments also are being added in their entirety.

One of the most extensive sections developed as a result of this project is the in-depth description of NEPA, which is housed within the Policy Issues section on the Arizona Rangelands site and directly links the two sites. The section focuses on agency implementation of the NEPA process in the course of grazing permit transfers and renewals on public land grazing allotments, the procedure the agencies are using to reevaluate permit numbers, management requirements, and the affects of grazing on endangered species. Due to the backlog in permit renewals, the agency has looked for ways to streamline allotment analysis procedures. In support of this effort, part of the section on NEPA describes the basics about grazing permits and allotment management plans as

FIGURE 6. Walker Basin Allotment Home Page



well as the specific steps in the NEPA process for grazing authorization by the Forest Service.

The Public Land Grazing Management Web site provides an overview of the regulatory processes and specific examples of information and data needs from an active USFS livestock grazing allotment. When complete the site will describe the wide variety of activities that are involved in the management of an allotment and of the various people who participate in devising allotment management strategies.

CONCLUSION

The ongoing challenge of providing relevant information via the Web for the wide variety of client-groups involved in rangeland management issues requires the combined creativity, energy, and expertise of a multidisciplinary team. Experts in range management, library science, Web site design, computer programming, remote sensing, GIS, and Map-Server technologies as well as agency personnel and interest groups have become essential ingredients in the development of the Arizona Rangelands AgNIC Web site and its companion sites. To fully realize the potential of the Web as a means to increase knowledge and understanding of the issues of the day, such diverse capabilities must be drawn on and integrated. Through a collaborative Web-based approach, strategic information, data, and tools can be brought to the public and made available on a 24/7 basis. Recognizing the important legacy of western rangelands to society, the University of Arizona's AgNIC team hopes to contribute to a greater understanding and appreciation of their unique qualities, characteristics, and values through its Web site initiatives.

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