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FEATURES

PEER REVIEWED

DEPARTMENTS

COVER

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Our mission is to advance forest science, technology, practice, education, and a conservation ethic to benefit society.

Cruising the Electronic Highway

You would really need to have your head in the trees not to be aware of the changes taking place in almost every aspect of social and professional life as a result of advanced communication technology. The "information superhighway" is rapidly being accepted not only as part of the vernacular but as a tool for conducting everyday business. Messages are sent to friends and colleagues via e-mail; regular correspondence as well as emergency bulletins are posted around the world by fax; discussion groups on the Internet cover everything from home brewing to forest management; and professional societies (such as SAF) assemble their membership through nationwide videoconferences.

But broad awareness of the possibilities and knowledge of the lingo does not mean that everyone is comfortable with these new communication tools, or knows how they can positively affect life and work. In this issue of the *JOURNAL*, we've brought together a number of authors who regularly use cutting edge communication and information-gathering technology. They show us how it works and how it can be used to advance the practice and communication of forestry.

The Internet is the primary medium for computer network–based communication. Thomas Burk's overview of its history and function will help everyone feel more comfortable with this new technology—which someday will undoubtedly be as commonplace as the telephone. He presents information on basic software tools and explains how to log on to Internet services that may be of particular interest to foresters. Anyone not already in the habit of "surfing the 'net" will undoubtedly want to sign up after reading about the many opportunities for sharing and gathering information.

Perhaps nowhere is advancing computer-based technology more evident than in the classroom. From grade school to graduate school, students rely on computers to complete assignments and conduct research. Multimedia-based instruction, explain Edward Jenson and Jeffry Hino, takes the technology a step further by allowing students to learn in a whole new way. "Learner-directed," "multisensory," and "interactive" describe how students are learning today. During lessons on everything from dendrology to wilderness management, for example, students have the opportunity not only to read pertinent text but also to view photographs; hear the words of forest managers, users, and philosophers; and create maps and display various management scenarios. You may not yet be ready to trade in your dog-eared *Forestry Handbook* for a CD-ROM, but you can be sure that day is coming for the students of tomorrow.

Geographic information systems (GIS) is a technology that has been frequently discussed in the *JOURNAL* and one that is becoming almost commonplace in the world of forest management. As Bruce Kessler explains, GIS on personal computers is changing the way foresters gather, store, manage, and analyze data. He describes how several companies, such as Mead Paper and Westvaco, made the transition to a computer-based GIS that allows foresters to gather information and record it in the field, then easily translate the information to central files at the home office.

As foresters and forest products companies become more familiar with GIS technology, they have sought new ways to use it to enhance forest management. For example, Bob Zybach, Mack Barrington, and Thomas Downey used GIS to describe historic cultural and political patterns in the Douglas-fir region of the United States. This information then became one of the GIS layers of data used to create maps and other tools for displaying relationships between historical, current, and future situations.

The incorporation of such social and cultural data is essential and must not be overlooked as managers begin to rely more and more on GIS mapping, caution Courtland Smith et al. They explain how social- and values-oriented comments and information gathered from environmental and forest industry groups, along with GIS data, can help foresters select the best management alternatives.

Rebecca N. Staebler
Editor

One of the advantages of computer and photographic technologies is that they can visually display the effects of various management scenarios. Three articles in this issue discuss such technological opportunities. Kass Green et al. describe a new GIS application, *FIRE!*, which simulates and represents fire behavior and effects depending on fuel type, weather condition, and topography.

Using a computer application called Photoshop, James Palmer et al. scanned and then digitally edited photographs to visually display the effects of harvesting alternatives in the White Mountain National Forest. They then gathered reactions from forest users in order to analyze scenic value. Paul Sacamano et al. compare several types of film-based urban forest evaluation methods and explain how airborne videography is currently being used in urban settings to better understand the effects of vegetation on the environment. The use of videography allows researchers to quickly gather and adjust images; the resulting data can then be digitized and eventually incorporated into a geographic information system.

There can be no doubt that technology is changing the way we do business. We are certainly aware of that here at the national office, especially in the publications department. Through computer and related technology we can do more in less time and for less money (although the initial outlay to purchase equipment can be a bit staggering). In the next few months the entire national office will be upgrading its computer equipment and network, which will allow us to get up to speed on the information superhighway—soon we'll be able to publish our individual e-mail addresses and communicate with you electronically! In the meantime, many of you are already cruising the superhighway; if you have not already done so, we encourage you to sign onto SAF's e-mail list, SAF-NEWS (see page 54).

Converting Historical Information to GIS

Political Boundaries of the Douglas-Fir Region, 1788 to 1995

GEOGRAPHIC INFORMATION SYSTEMS (GIS) technology and early historical information can be combined to create data—maps, graphs, sketches, photographs, tables, databases, and codified text—for examining changes in the landscape over time. This paper describes the background and methods by which 1780s-era political boundaries within the Douglas-fir region of the United States were identified, named, and bounded using techniques that included GIS processing. It also describes products from the resulting GIS format used to correlate the new information to existing GIS layers of geological, current political, and biological data.

Our objective was to describe the political setting of the Douglas-fir region in 1788, using GIS products. We indicated the importance of prehistoric human populations and activities to the evolution of forest conditions. And we linked the potential of GIS to current ecological theory, ethnological understanding, resource management philosophies, policymaking, and public education. In order to achieve these objectives we transformed early historical information into a spatial and temporal framework that could be used in GIS.

Definitions and Descriptions

Time. The history of the Douglas-fir region can be divided into discrete periods. Prehistoric time refers to the prewriting history of human families in the region. Early historical time is the period in which written descriptions, sketches, maps, and other related artifacts were first introduced. For the Douglas-fir region, early historical time begins in the 1770s. During that decade, a number of Spanish traders, Russian trappers, and the English explorer James Cook became the first Europeans to explore the coastline of the Pacific Northwest—then called New Albion—and left numerous drawings and written accounts (Carey 1971, Howay 1990).

In the period 1788–1792, detailed maps and accounts of local people within the Douglas-fir region of the Pacific Northwest first became available. During those years the voyages of Robert Gray of Boston and George Vancouver of England produced regional records that included maps, sketches, and written descriptions of the Pacific coastline from San Francisco to Alaska, the entire Puget Sound–area shoreline, and inland along the Columbia River nearly 100 miles.

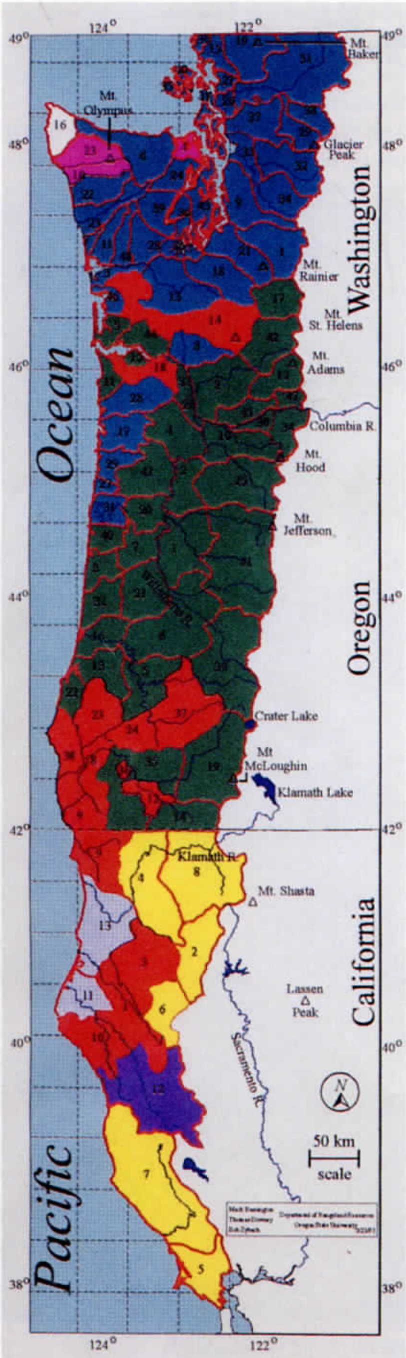
Space. The Douglas-fir region of the United States is defined as west of the crest of the Cascade Mountains in Oregon and Washington, and northwest of the Sacramento River drainage in northern California (Heilman and Anderson 1981). The northern boundary of the region—the Canadian border—is political. The remaining boundaries are biological, determined by an abrupt, nearly complete lack of Douglas-fir *(Pseudotsuga menzeseii)*. These boundaries are the Pacific Ocean to the west, the arid Californian valleys and coastal mountains to the south and southeast, and the high elevation peaks and ridges of the Cascade Mountains to the east.

The region contains the largest, most densely populated, and fastest-growing coniferous forests in the world. The most prevalent and commercially valuable tree of these forests is Douglas-fir.

Political boundaries. Political bound-

By Bob Zybach, Mack Barrington, and Thomas Downey

aries are those established between competing settlements and families to control local resources. Currently in the United States, important political boundaries include public and private land–ownership patterns, city limits, voting districts, school districts, county lines, and state borders. In 1788, primary political boundaries in the Douglas-fir region were directly associated with major river drainages (Zybach 1988). Common native language groups and major geological features formed larger borders *(table 1);* family groups, village locations, and regional trade routes set smaller borders. Families that established these boundaries shared the same languages, bloodlines, and methods of survival (Downey et al. 1995).



Western Washington Nations

01 Buklshuhl
02 Cathlopotle
03 Chehalis
04 Chimakum
05 Chinook
06 Clallam
07 Copalis
08 Cowlitz
09 Duwamish
10 Hoh
11 Humptulips
12 Klickitat
13 Kwaiailk
14 Kwalhioqua
15 Lummi
16 Makah
17 Mical
18 Nisqually
19 Nooksak
20 Nuwaha
21 Puyallup
22 Queets
23 Quileute
24 Quilicene
25 Quinalt
26 Sahewamish
27 Samish
28 Satchap
29 Sauk
30 Semiahmoo
31 Skagit
32 Skykomish
33 Snohomish
34 Snoqualamie
35 Songish
36 Squaxin
37 Stillaguamish
38 Suiattle
39 Suquamish
40 Swallah
41 Swinomish
42 Taitnapam
43 Toando
44 Warciacum
45 Wasoughally
46 Willopah
47 Wooksockwilliacum
48 Wynoochee

Western Oregon Nations

01 Ahalpam
02 Ahantchuyuk
03 Alsea
04 Atfalati
05 Ayankeld
06 Calapooia
07 Chapanafa
08 Chastacosta
09 Chetco
10 Clackamas
11 Clatsop
12 Dakubatede
13 Hanis
14 Kahosadi
15 Kathlamet
16 Kelawatset
17 Killamox
18 Klaskani
19 Latgawa
20 Luckiamute
21 Lumtumbuff
22 Miluk
23 Mishikwutmetunne
24 Miwaleta
25 Molalla
26 Multnomah
27 Nechesne
28 Nehalem
29 Nestucca
30 Shahala
31 Siletz
32 Siuslaw
33 Skilloot
34 Smackshop
35 Takelma
36 Taltushtuntude
37 Targunsan
38 Tututuni
39 Umpqua Molalla
40 Yakona
41 Yalkus Molalla
42 Yamel

Northwestern California Nations

01 Chilula
02 Chimariko
03 Hupa
04 Karok
05 Miwok
06 Nongatl
07 Pomo
08 Shasta
09 Tolowa
10 Wailaki
11 Wyot
12 Yuki
13 Yurok

Language Phyla and Families

Salishan F.
Athapaskan F.
Chimakuan F.
Penutian P.
Algic P.
Yukian F.
Wakashan F.
Hokan P.

(Correction: Area 14 should be yellow)

Figure 1. Indian nations of the Douglas-fir region, circa 1788.

Adjacent river drainages in the 1780s often contained people with similar dialects, ancestry, technologies, and cultural values; although they also frequently contained people with entirely different histories, languages, and subsistence strategies. *Figure 1* illustrates the primary political boundaries that existed in the Douglas-fir region in the late 1700s. Cultural differences and similarities are highlighted by color coding common language groups. These codings are somewhat misleading because they do not always recognize the vast cultural differences that existed between various nations at that time. The physical and cultural differences among people who hunted whales (Makah), lived off shellfish (Yakona), harvested vegetables (Kalapuya), and fished for salmon (Chinook) were strikingly obvious to the European and American explorers of the late 1700s and early 1800s (Howay 1990, Thwaites 1959, Wilkes 1845).

Historical Context

Most information from prehistoric time exists in the forms of fossils (particularly pollen fossils), archaeological sites, tree rings, oral traditions, and persistent patterns of native vegetation. For the time and region considered here, these sources are supplemented by historical artifacts, maps, sketches, and written first-hand accounts (Zybach 1992). Modern historical sources include living memory, oral histories, government records, photographs, movie films, videotapes, and digitized data. Some of these latter forms of documentation are useful for corroborating or interpreting earlier sources (Downey et al. 1995).

Political names. Many rivers today still carry the names of their ancestral owners: the Klamath, the Shasta, the Siletz, the Yaquina, the Quinalt, the Snoqualamie. For rivers that have not retained their native names or that were home to more than one nation (such as the Columbia or Umpqua rivers), the tracing of local names and boundaries is more complex and depends on the journals of overland explorers, beaver trappers, and scientists.

Spellings. Whenever possible during this research, names and boundaries for the nations of 1788 were derived from first-hand accounts of the region between 1788 and 1834. Official journals and reports of 1805–1845 provided standardized spellings (Thwaites 1959, Wilkes 1845). For names and locations that could not be established in this fashion, recognized ethnological sources were consulted (Ruby and Brown 1986, Berreman 1937, Thompson 1991). Suttles and Suttles' map of native northwest languages (1985) served as the model for bounding and coding late-1700s national language groups into families (similar languages) and phyla (similar language families).

Effects of epidemics. Contemporary records of northwest epidemics are often the first and last historical accountings of many late-1700s Native American nations. Evidence of smallpox epidemics were recorded as early as 1788 (Howay 1990); Lewis and Clark described several instances of both smallpox and advanced venereal diseases in 1805 (Thwaites 1959); and the period of time between 1829 and 1834 saw the extinction of thousands of native families in the region, probably because of the introduction of malaria in the late 1820s (Cook 1955). Many entire nations went extinct during those years (1788–1834), often in a matter of weeks (Scott 1928). One result of these plagues is that it is nearly impossible to recover specific details about most native individuals or families that lived in the area before 1835. The small number of survivors and the activities of missionaries and beaver hunters after that time began to result in the identification—and immediate acculturation—of remaining native families.

These epidemics (particularly the 1830–1832 occurrances) are important for their biological and cultural consequences. The near-complete removal of the top of the food chain, for millions of contiguous acres, caused immediate and long-term changes in predator-prey relationships and populations. And vast reduction in cultural practices, such as firewood gathering and seasonal field and forest burnings, caused changes in local and regional forest structures and wildlife habitat.

Ethnographies of native people undertaken between the late 1800s and World War II resulted in final accountings of the names and locations of families and nations before the widespread introduction of malaria, smallpox, syphilis, and measles. Many of the native informants had been born on reservations established in the 1850s. Many likely had Iroquois, white, black, or Hawaiian fathers and/or grandfathers (Thwaites 1959). Such ancestries could have provided a good reason for the survival of these indi-

Table 1. Western Oregon counties, rivers, 1788 Indian nations, and native languages.[1]

County	Map	River	Nation	Language
Benton	07	Marys	Chapanafa	Kalapuyan
Clackamas	10	Clackamas	Clackamas	Chinookan
	30	Columbia	Shahala	Chinookan
	25	Molalla	Molalla	Molallan
	10	Sandy	Clackamas	Chinookan
Clatsop	11	Lewis and Clark	Clatsop	Chinookan
	11	Necanicum	Clatsop	Chinookan
	15	Youngs	Kathlamet	Chinookan
Columbia	18	Clatskanie	Klaskani	Athapascan
	33	Columbia	Skilloot	Chinookan
Coos	22	Coos	Miluk	Kusan
	23	Coquille	Mishikwutmetunne	Athapascan
	13	Millicoma	Hanis	Kusan
Curry	09	Chetco	Chetco	Athapascan
	38	Elk	Tututuni	Athapascan
	38	Pistol	Tututuni	Athapascan
Douglas	16	Smith	Kelawatset	Siuslawan
	05	Umpqua	Ayankeld	Kalapuyan
	24	Umpqua	Miwaleta	Athapascan
	37	Umpqua	Targunsan	Athapascan
	39	Umpqua	Umpqua Molalla	Molallan
Hood River	34	Hood	Smackshop	Chinookan
Jackson	14	Rogue	Kahosadi	Shastan
	19	Rogue	Latgawa	Takilman
Josephine	12	Applegate	Dakubatede	Athapascan
	08	Illinois	Chastacosta	Athapascan
	35	Rogue	Takkelma	Takilman
	36	Rogue	Taltushtuntude	Athapascan
Lane	21	Long Tom	Lumtumbuff	Kalapuyan
	06	McKenzie	Calapooia	Kalapuyan
	32	Siltcoos	Siuslaw	Siuslawan
	32	Siuslaw	Siuslaw	Siuslawan
	06	Willamette	Calapooia	Kalapuyan
Lincoln	03	Alsea	Alsea	Yakonan
	27	Salmon	Nechesne	Salishan
	31	Siletz	Siletz	Salishan
	03	Yachats	Alsea	Yakonan
	40	Yaquina	Yakona	Yakonan
Linn	01	Calapooia	Ahalpam	Kalapuyan
	01	Santiam	Ahalpam	Kalapuyan
Marion	02	Pudding	Ahantchuyuk	Kalapuyan
	41	Santiam	Yalkus Molalla	Molallan
Multnomah	26	Willamette	Multnomah	Chinookan
Polk	19	Luckiamute	Luckiamute	Kalapuyan
Tillamook	28	Nehalem	Nehalem	Salishan
	29	Neskowin	Nestucca	Salishan
	29	Nestucca	Nestucca	Salishan
	17	Tillamook	Killamox	Salishan
	17	Wilson	Killamox	Salishan
Washington	04	Tualatin	Atfalati	Kalapuyan
Yamhill	42	Yamhil	Yamel	Kalapuyan

[1] *After Zybach (1988: E-3).*

viduals after their exposure to new diseases that were usually fatal to other members of local families and villages.

Methodology

Two principal steps must be considered before a GIS product can be generated: planning and processing. The planning step in this project included detailed discussions regarding the types of concepts to be communicated and how these concepts would be represented spatially. First, the team decided on map mechanics, including map projection, coordinate system, and scale. Next, they chose appropriate data layers to depict major exploration routes, trading post and mission sites, political boundaries and names, historical vegetation patterns, and major river locations. The data either existed in various external sources or could be digitized manually. Additional data could be transcribed from historical maps, oral histories, or contemporary texts. Finally, the team decided on the interpretation of historical accounts and the translation of these data to paper maps.

Spatial boundaries were depicted between categories by simply drawing a line between perceived differences. Often this line was only symbolic of a boundary, which may have actually existed as a gradation (Burroughs 1986). Boundaries between categories may be uncertain in some cases. This uncertainty can originate from several sources, which include original observations (historical accounts), interpretations of these accounts, translation of these accounts to a spatial framework, and the accuracy with which they are represented in GIS.

Sources of uncertainty also result from the dynamics between categories, such as temporal fluctuations in boundary locations between language groups or between disturbance patterns on the landscape. Depending on the phenomena, these fluctuations may be great or so small as to be indistinguishable. The scale used to describe changes may influence the perception of the dynamics involved. These dynamics have both spatial and temporal dimensions and are therefore scale responsive (scale in this sense means the amount of data that can be portrayed in the database). Because we were interested in presenting information from a regional perspective, our scale was smaller (reduced detail) compared to larger scales (increased detail) needed for smaller areas.

The processing step used a GIS software package called Idrisi for data entry (digitizing), processing, and file generation. A model 23480 CalComp drawing board was used for digitizing and a 486 PC computer was used for all processing. We chose a 1:500,000 US Geological Survey (USGS) map as our base. Historical information was interpreted and transferred to USGS maps of Washington, Oregon, and northern California. These maps were then registered (georeferenced) to ground control points using the Universal Transverse Mercator (UTM) coordinate system and a Lambert Conformal Conic projection. Depending on the type of information being transcribed, historical account data were then manually digitized as points, lines, or polygons.

Transportation and stream network data were imported from 1:100,000 USGS Digital Line Graph (DLG) files. Because these data are already registered to UTM coordinates, they were directly compatible with our GIS base map. Major landmarks and modern county boundaries were manually digitized from the paper-base maps. Spatial files are often very large and require extensive storage space. Unused files were archived to QIC-80 format cartridges to relieve hard disk space problems.

A paintjet printer was used for paper map and transparency outputs. Slides were produced from the GIS output files and Microsoft PowerPoint software. Vector files were exported from Idrisi to a graphics software package, CorelDraw!, to facilitate the generation of hard copy maps. For these products, data layers from the GIS were managed in separate layers within a single CorelDraw! file. Because all GIS layers were generated under the same base-map criteria (coordinate system and map projection), they could be managed as separate layers in CorelDraw! while maintaining spatial integrity. These layers can be individually activated or deactivated, depending on the requirements of each map.

Currently under study is the utility of managing map files, text, and graphics material within a multimedia system (Multimedia Toolbook-Asymetrix). Multimedia technology allows the integration of these media types within one software/hardware environment and increases information accessibility. Historical data found in diverse formats can be conceptually linked in a multimedia environment. Use of early historical data, because of the limited types and amounts that exist, offers an economical, potentially valuable, and useable test of this concept. In addition, a broader range of users, including rural students, displaced workers, and people with disabilities, can be accommodated through multimedia technology.

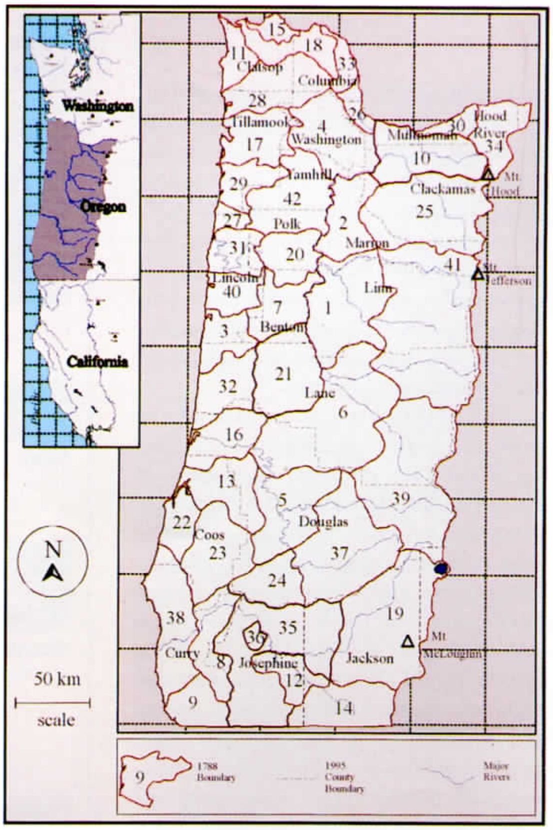


Figure 2. Political boundaries of western Oregon, 1788 and 1995.

Products

Data in digital form can be used to create several types of products. For example, they can be represented as paper maps, tabular summaries, graphs, pictures, recorded words, or annotated text. They can also be converted for use in other GIS packages, exported to graphics or desktop publishing environments, used in multimedia knowledge bases, or used to create 35-mm slides.

Uses

An understanding of the incremental and cumulative biological and cultural effects of humans on the forested river basins of the Douglas-fir region adds another dimension to our understanding of this area. Population numbers, settlement patterns, subsistence strategies, and hunting and gathering technologies have all had effects on native plant and animal populations. Comparisons of prehistoric human effects with modern forest species, structures, and extent; current human populations and settlement patterns; or historical animal extirpation patterns can all be made with available GIS technologies if these types of information are formatted to similar standards.

Forest managers are regulated by a wide array of laws and social concerns regarding esthetics, endangered species, old-growth forests, and game-animal harvests. An increased timeline of understanding regarding the role of humans during the past 200 (or 2,000 or 12,000) years provides a foundation to manage for past conditions or to determine a range of natural variation for possible future conditions. Management actions can therefore be directed to mimic, enhance, or mitigate changes in the environment, depending on desired future conditions.

The political value of this information is inestimable and directly proportional to the consideration given it by the public and political officials. For example, plans have been announced to create a new federal process in the Douglas-fir region intended to implement "ecosystem management" as defined in President Clinton's plan for northwestern forests (Dodge 1994). A first step in this process has been the creation of "provinces" (USDA 1994). Within such boundaries volunteer citizen "advisors" and state and tribal representatives will meet with federal officials to discuss details of the plan. The use of historical data would add another dimension to their discussions.

A correlation of 1788 political boundaries *(fig. 1)* with major river drainages (defined as "ecosystems" in the Clinton plan) *(table 1)* and current political boundaries *(fig. 2)* demonstrates that ecosystem and landscape-scale management systems have been in place for several centuries or longer. Local and county governments, for instance, have been in place in the Douglas-fir region since the 1840s, when they were first used to gather taxes for bounties on wolves and bears. Since that time, counties have been responsible for such forest management–related activities as timber harvesting methods, game management, weed control, river "channelization," public education, rural road construction and maintenance, and forest fire suppression.

This interpretation of historical data in digitized, graphic (map), and tabular formats allows us to better determine whether to support three new federal "provinces" in western Oregon, consider an existing federal boundary (six 60-year-old "study units") (Andrews and Cowlin 1940), or work within the existing 19-county structure of locally selected representatives *(fig. 2)*. Given this perspective—based on historical information in a GIS format—it becomes easier to consider past conditions, current cultural resources and endangered species laws, and future economical and biological consequences of actions.

Other possible uses of forest history data in GIS format include the following:

- Prehistoric settlement patterns and cultural practices can be correlated to early records of forest fires and even-aged stands resulting from such fires to help determine the influence of people on "natural" fire frequencies (Barrett and Arno 1982, Booth 1991);
- Early historical vegetation patterns can be correlated to historical patterns of forest fires, clearcutting, and tree planting to determine the general locations, ages, and structures of old-growth forests at the time of European settlement (Botkin et al. 1994, Agee 1993);
- Early land-use and settlement patterns can be correlated to current land ownership patterns to determine the locations, values, legal responsibilities, and management options for prehistoric and early historical cultural resources (Spoerl 1988, Agee 1993).

Perhaps the most succinct summary of the need for this type of information in GIS format was provided by President Clinton's Forest Ecosystem Management Assessment Team (FEMAT 1993):

> Critical knowledge was either unavailable or not in a readily useable form. We documented how ill-equipped the agencies are to deal with issues such as Native American values, recreation, scenery, special forest products, and subsistence. Information is collected and stored in different forms, even in neighboring units of the same agency. Relatively little information is readily accessible in the geographic information system. Consequently, it was not possible in an easy way to compare the options to some of the values of concern to society. How can we make informed, sensitive, responsible decisions when we lack essential information?

Discussion

Geographic information systems are tools that allow us to visualize phenomena more comprehensively and to travel through scales (or levels) of time and space. The focus of GIS studies should not be on the vehicle, but rather on the message to be communicated. Policy should be based on the most complete, accurate information available, although individuals will always need to make their own evaluation of the information to which they are exposed. JOF

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