Comparison of Programs Used for FIA Inventory Information Dissemination and Spatial Representation

Roger C. Lowe[1] and Chris J. Cieszewski

Abstract.—Six online applications developed for the interactive display of Forest Inventory and Analysis (FIA) data in which FIA database information and query results can be viewed as or selected from interactive geographic maps are compared. The programs evaluated are the U.S. Department of Agriculture Forest Service's online systems; a SAS server-based mapping system developed by the Cooperative Extension Service at the University of Georgia (UGA); and three online applications developed at the D.B. Warnell School of Forest Resources, UGA: HTML and Java-based ESRI ArcIMS applications, HTML-based hypermaps, and a prototype Macromedia Flash-based application. Our study compared the following features in these Web applications: application scope, data resolution, number of available layers, number of variables, reporting capabilities, user interaction capabilities, and user interaction timing.

Much effort has been put into designing and implementing the nationwide U.S. Department of Agriculture (USDA) Forest Service Forest Inventory and Analysis (FIA) program. Numerous bits of information are collected in the field and later summarized and tabulated. The extensive information contained in the FIA database is a valuable source of forest land estimates to many public and private agencies. To facilitate sharing this data, several online programs have been developed that enable users to query different databases and generate various types of reports and maps.

Applications

Each application compared is briefly described below.

USDA Forest Service's Mapmaker

The USDA Forest Service's Mapmaker (fig. 1) is a server-side Web application that enables users to query, report, and map the most current FIA nationwide data available. Through a series of Web pages, the user enters the geographic area of interest, attribute of interest, query filters, and classification variables to query the FIA database and produce custom tables and maps.

USDA Forest Service's Ramiform

The USDA Forest Service Ramiform program (fig. 2) is a server-side application being developed by the USDA Forest Service at the North Central Research Station to serve nationwide FIA database information through the Web. This application enables users to query information derived from the 2002 Resources Planning Act (RPA) summary database, map the results to hexagon units, generate dot density displays, and tabulate area summaries by USDA Forest Service region for the query.

Georgia Statistics System

The Georgia Statistics System (GSS) (fig. 3) is the server-side Web application developed by the Center for Agribusiness and Economic Development, Cooperative Extension Service at the University of Georgia (UGA). GSS was developed to provide access to Georgia data from the Georgia County Guide (GCG), the multiple Farmgate Value Reports (FVR), and selected FIA database information. This application enables users to perform a cross-sectional, time series, analysis of county information.

Forest Maps Applications

The Fiber Supply Assessment group at the D.B. Warnell School of Forest Resources (WSFR), UGA, developed a set of applications consists of a large suite of Web pages designed for users to view, query, tabulate, and map the most current FIA database information for Georgia.

- The Unique Selected (Uni-select) maps for 13 Southern States (fig. 4) offers fast client-side access to multiback-

[1] GIS Analyst and Corresponding Author, Associate Professor, D.B. Warnell School of Forest Resources, University of Georgia, Athens, GA 30602. E-mail: rcl7820@owl.forestry.uga.edu.

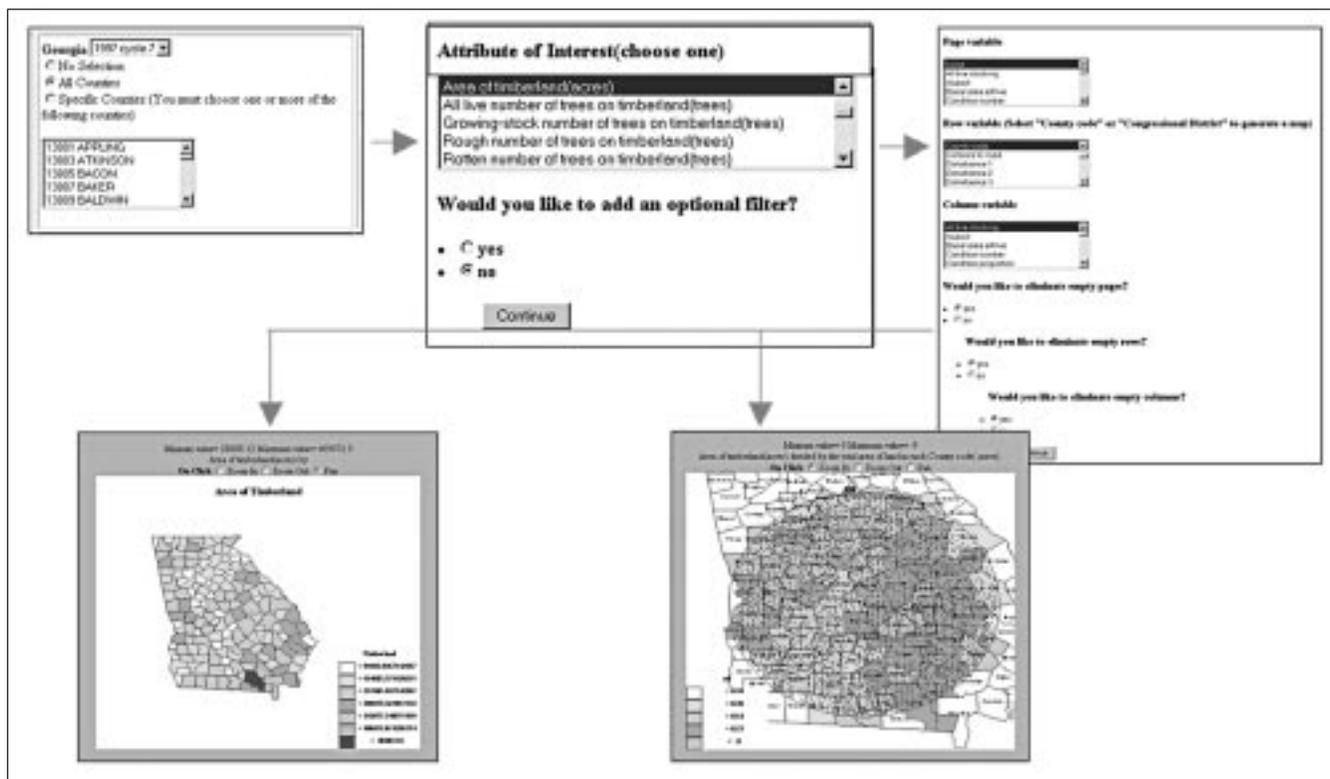Figure 1.—*USDA Forest Service Mapmaker, version 1.0.*
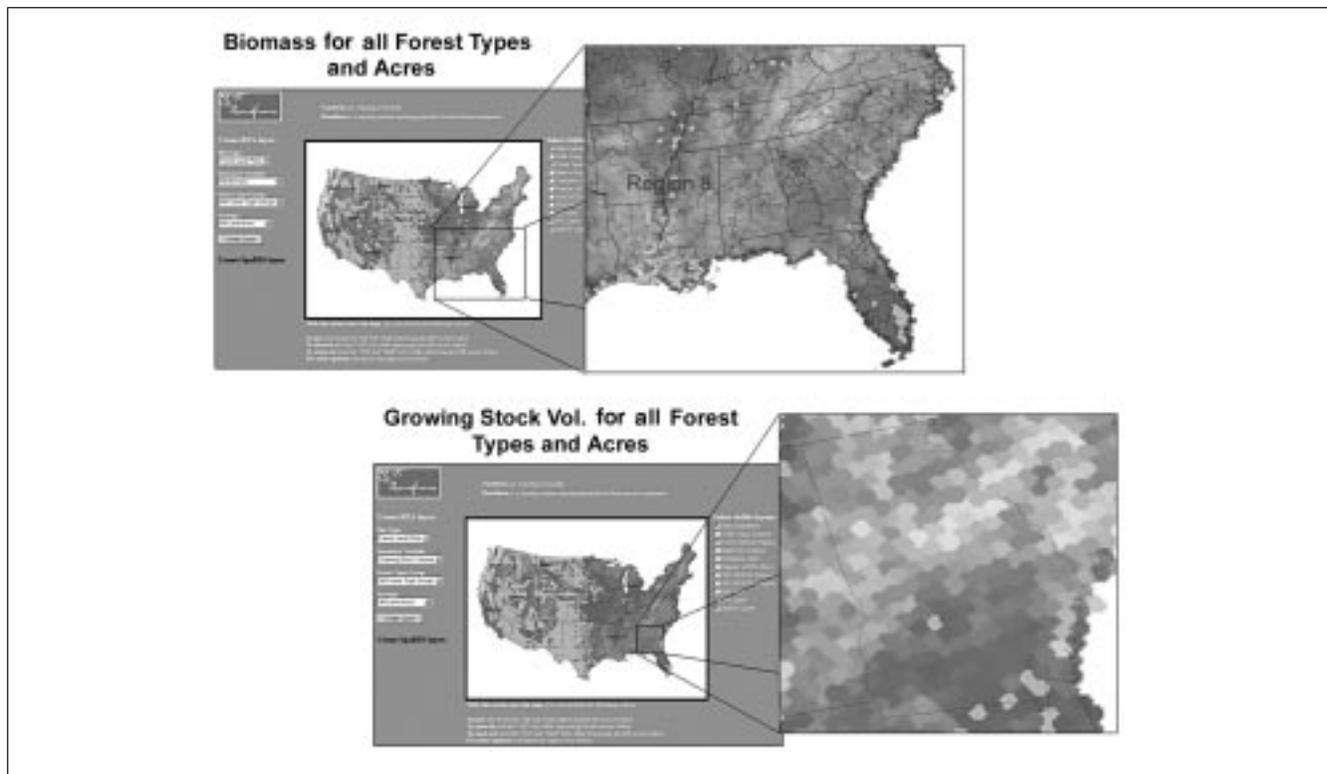

Figure 2.—*USDA Forest Service Ramiform.*

Figure 3.—*Center for Agribusiness and Economic Development, Cooperative Extension Service, University of Georgia, Georgia Statistics System (GSS).*
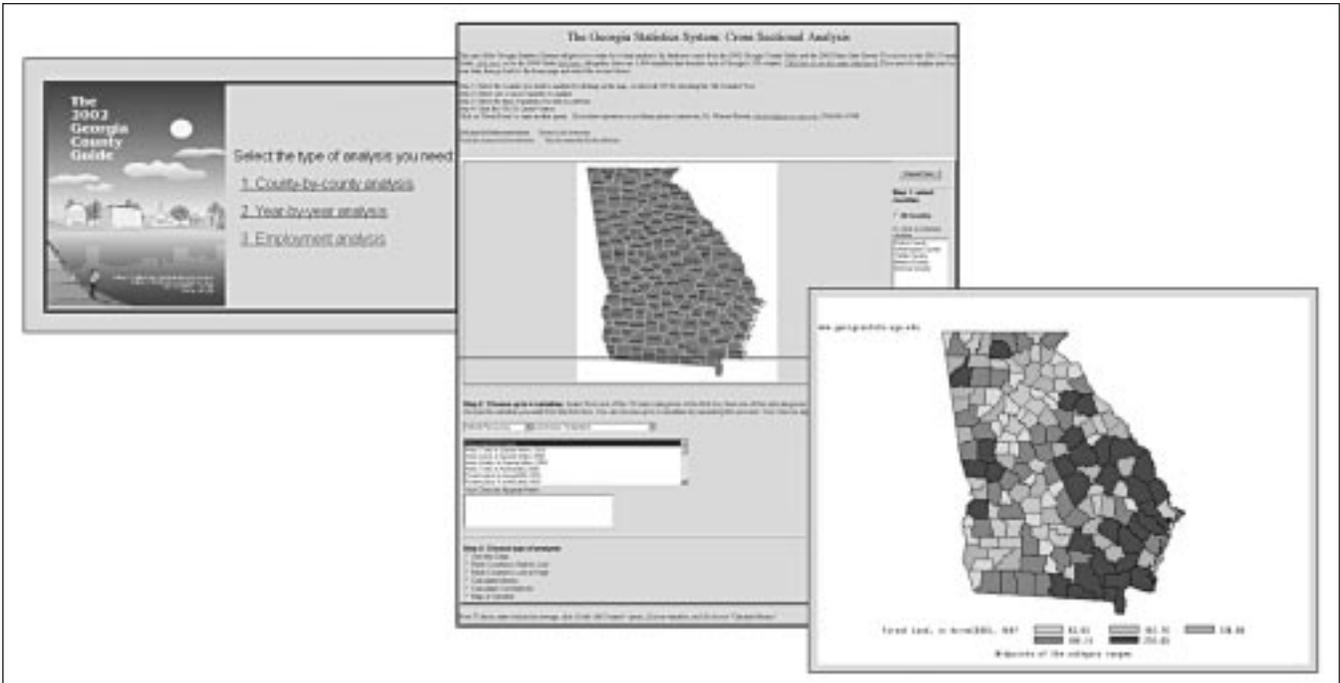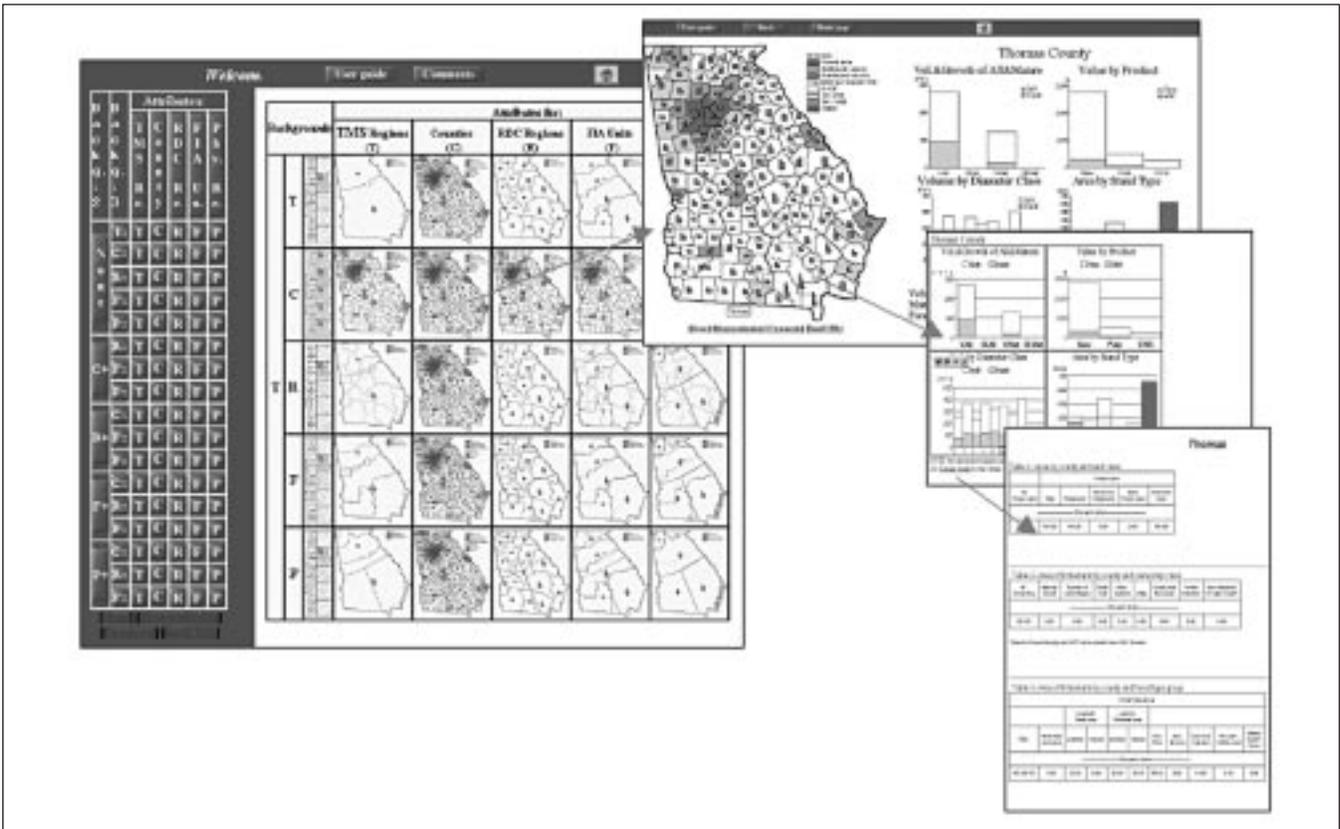

Figure 4.—*D.B. Warnell School of Forest Resources (WSFR), University of Georgia. Uni-select maps.*

ground statistics for cross-sectional selections of Georgia's Rural Development Centers (RDC) regions, FIA units, physiographic regions, Timbermart South regions, and counties.

- HTML- and Java-based Environmental Systems Research Institute, Inc.'s (ESRI's) ArcIMS® server-side platforms provide users with the ability to query and report FIA database information, and geographic information system capabilities such as buffering and subselections (fig. 5).

- The InFORM client-side application (fig. 6) makes available compiled FIA inventory information useful for high-level discussions and Georgia's inventory analyses. Users can display multiple FIA database variables as a choropleth map and tabulate FIA information for single, select, and subse-lections of counties.

Methods

The online applications were compared between November 10 and 15, 2003. Updates applied to the sites after this week may not be represented in the comparisons. All assessments were made from a home computer through a dial-up modem with a 49 kbps connection. Where applicable, at least 15 page loads were timed and averaged. After each page load, the Internet browser was closed and the Internet cache cleared. Note that physical proximity to the application server computer may affect the page load timing. To minimize this effect and mitigate the impact of heavy online traffic, evaluations were conducted between 1:00 a.m. and 5:00 a.m. eastern standard time.

Results

The applications were compared on general features such as scope (geographic extent of analysis), data resolution (the smallest unit that can be mapped), and the number of layers and variables available for viewing and mapping were made (table 1). The two USDA Forest Service applications, Mapmaker and Ramiform, provide analysis capabilities at the national level; the others focus on Georgia. The Ramiform application's data resolution is the hexagon. The other applications use county-level resolution. ArcIMS can display 11 different layers, such as county and RDC boundaries, more than all the other applications. Ramiform makes 10 different layers available; the Uni-select maps have 5 layers that can be displayed on 5 backgrounds; and the remaining programs have single county boundaries. Mapmaker offers the largest number of variables, such as timberland and forestland area, that can be mapped or tabulated, followed by Ramiform, InFORM, Uni-select maps, GSS, and ArcIMS.

Figure 5.—*D.B. Warnell School of Forest Resources (WSFR), University of Georgia, ArcIMS.*
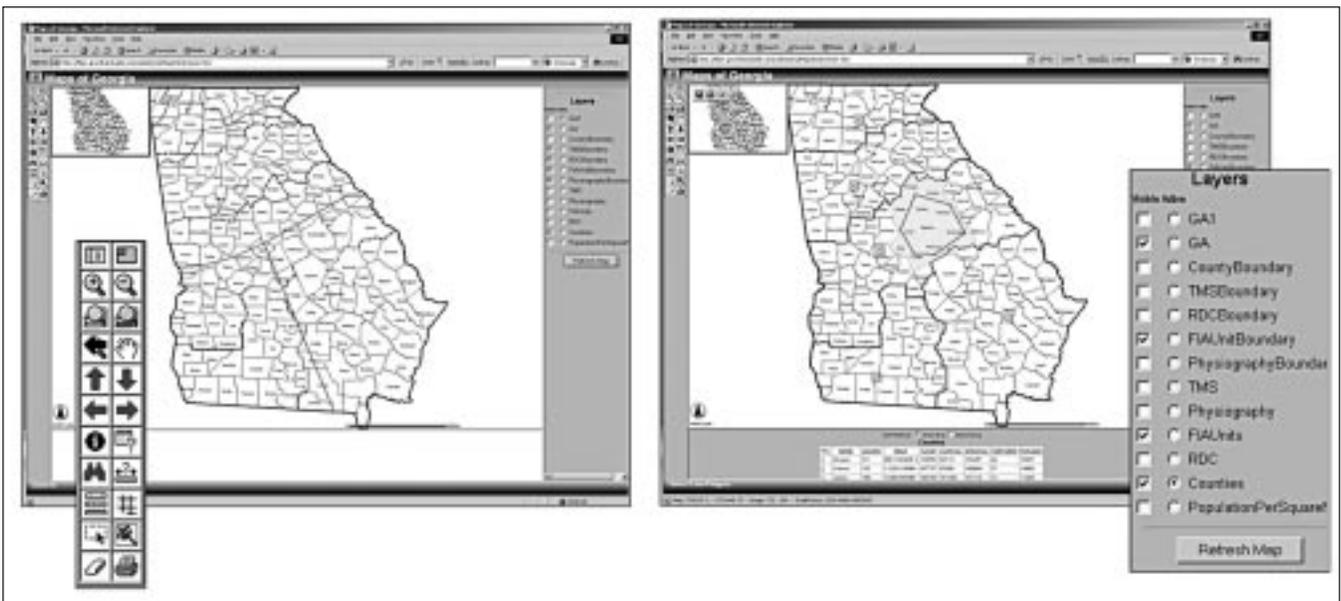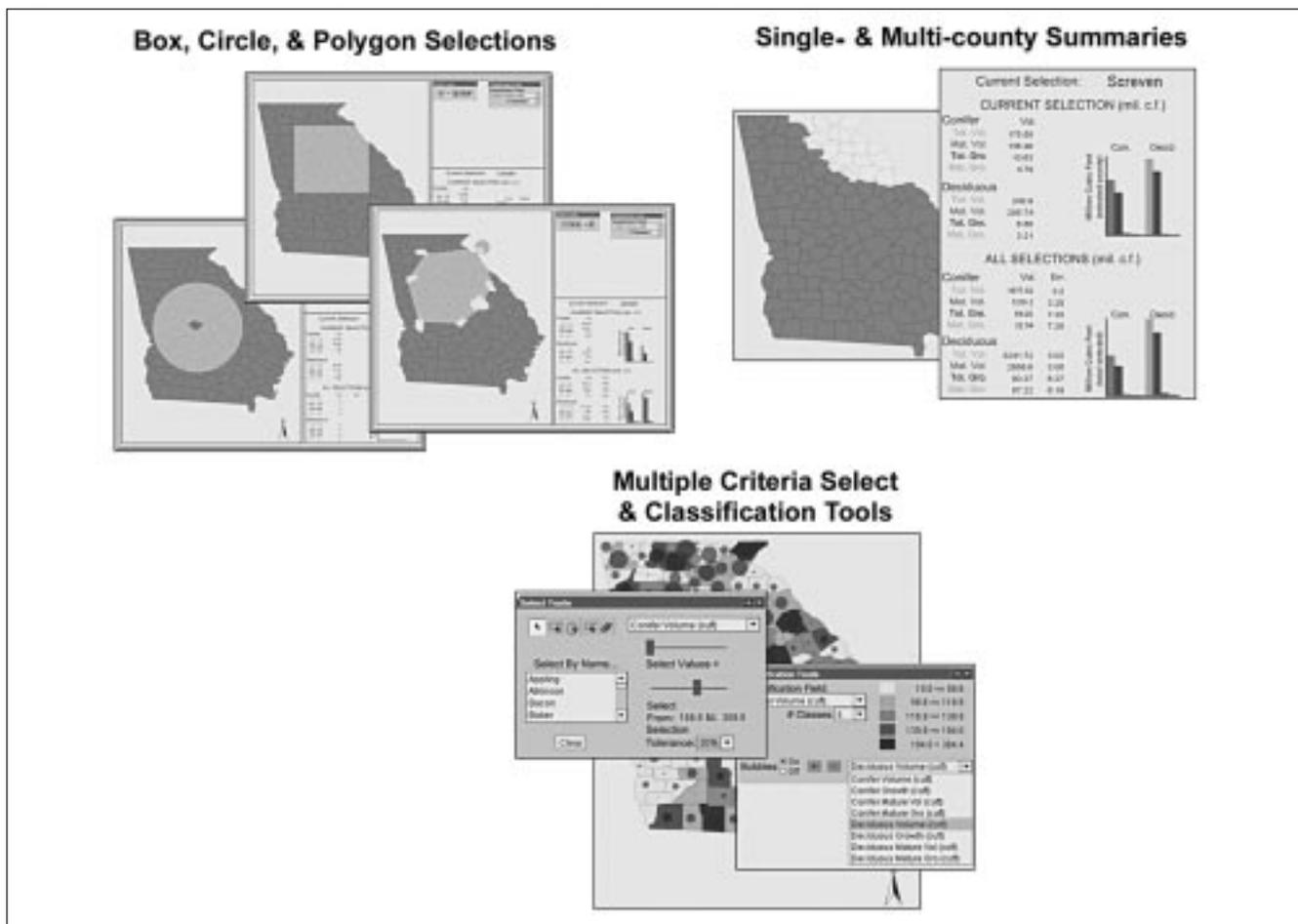
Figure 6.—*D.B. Warnell School of Forest Resources (WSFR), University of Georgia, InFORM.*

The applications were also compared on user interaction functionality, such as reporting, zoom, pan, variable display, and selection (table 1). All except ArcIMS have reporting capabilities. (Although ArcIMS can be programmed to offer reporting, its development team does not consider this functionality to be critical to the application's development path.) Mapmaker, Ramiform, ArcIMS, and InFORM programs provide zoom and pan capabilities; Uni-select maps and GSS do not. ArcIMS site is the only application with buffer capabilities.

Ramiform, ArcIMS, and InFORM enable the user to display more than one variable at a time—for example, to show conifer and deciduous timberland area simultaneously. Users are able to simultaneously select more than one feature, such as a county or region, from a map, in Ramiform, ArcIMS, InFORM Mapmaker, GSS, and the Uni-select maps do not provide this capability. In addition to single click-and-select, InFORM and

ArcIMS enable the user to select multiple features with a user-defined box, circle, and polygon computing in real time summary statistics for the chosen selections. Ramiform had also a capability of selections, though without real time computing. Instead, a link function is used that was supposed to submit the selection to the Mapmaker (we were unsuccessful testing this external to the native application functionality). Furthermore, InFORM is the only application that allows for progressive increase in selections, in which selections of individual units can be added to circle selections by radius, which can be added to rectangle selections, which can be added to arbitrary selections, which can be altered by individual deselecting, and so forth.

Table 1 presents average times, in seconds, from multiple trials conducted with all the applications. The following events were timed: (1) initial load time, (2) layer load time, (3) selection time, and (4) report generation time. Ramiform had the longest

Table 1.—*Internet application comparisons.*

	D.B. Warnell School of Forest Resources (WSFR), University of Georgia (UGA)			USDA Forest Service		Center for Agribusiness and Economic Development, Cooperative Extension Service, UGA
	Uni-select	InFORM[1]	ArcIMS	Ramiform[1]	Mapmaker	Ga. stat.
Scope	Georgia	Georgia	Georgia	Nation	Nation	Georgia
Resolution	County	County	County	FIA Hex.	County	County
No. of layers	5	1	11	10	1	1
Simult. lyrs.	No	Yes	Yes	Yes	No	No
No. of variables	79[2]	90[2]	11	97	Numerous	43
Reports	Yes	Yes	No	Yes	Yes	Yes
User interaction						
Pan	No	Yes	Yes	Yes	Yes	No
Zoom	No	Yes	Yes	Yes	Yes	No
Buffer	No	No	Yes	No	No	No
Interactive selections						
Single	Yes	Yes	Yes	Yes	No	Yes
Box	No	Yes	Yes	Yes	No	No
Polygon	No	Yes	Yes	Yes	No	No
Circle	No	Yes	Yes	Yes	No	No
User-defined	No	Yes	Yes	Yes	No	No
Query	No	Yes	Yes	Yes	Yes	No
Interaction time (seconds)						
Initial load	2	2	10	43	6	2
Vector load	1	na	2	3	na	na
Raster load	na	na	4	17	na	na
Selection	na	1	4	4	na	na
Report	2	2	na	42	nt	7

[1] Applications under continued development.
[2] Includes report variables.
na: not applicable on the date of timing.
nt: event not timed; requires multiple queries.

initial load time for the application to fully load in the Web browser. The other applications loaded in less than 10 seconds. Vector data layers loaded quickly (less than 3 seconds) in those apps that provide that functionality. The raster layers in Ramiform took a bit longer (17 seconds). Selection time—how long it took to graphically display selected features—was relatively short, fewer than 4 seconds for Ramiform, ArcIMS, and InFORM. The time required to generate a tabular report was less than 7 seconds for the Uni-select maps, InFORM, and CAED GSS; it took much longer—42 seconds—for Ramiform to create this type of report.

Summary

Our study evaluated six online systems developed to disseminate forest inventory information based on FIA data for the United States. The systems were assessed on scope, data resolution, simultaneous number of themes that can be displayed, reporting ability, interactivity, and speed in performing simple tasks. The Web applications currently being developed and maintained by the USDA Forest Service—Mapmaker and Ramiform—are national in scope and serve data at the county or RPA hexagon level. Applications based at The University of Georgia are statewide in scope and serve data at the county level. Mapmaker provides access to the largest number of variables for analysis than all the other applications, followed by Ramiform, InFORM, Uni-select maps, the Georgia Statistics System (GSS), and the D.B. Warnell School of Forest Resources (WSFR), University of Georgia's application, ArcIMS. Users can generate tabular output in each application except ArcIMS, although this functionality can be programmed. InFORM, Ramiform, Mapmaker, and ArcIMS provide zoom and pan capabilities: Uni-select maps and GSS do not. ArcIMS is the only one with buffer capabilities. Ramiform, Uni-select maps, and ArcIMS can display multiple layers simultaneously. InFORM, ArcIMS, GSS, and Ramiform provide interactive selection tools to select many features at the same time; the Uni-select maps and GSS provide individual county, FIA region, RDC region, and physiographic region selection functionality. Mapmaker is a query-driven application that does not allow user-driven selections from a map. Based on application event timing, the client-side applications load, select, and report data faster than the server-side applications.

Literature Cited

Center for Agribusiness and Economic Development, Cooperative Extension Service at the University of Georgia. Georgia County Guide. http://www.agecon.uga.edu/%7Ecountyguide. [Date accessed unknown.]

Center for Agribusiness and Economic Development, Cooperative Extension Service at the University of Georgia. Georgia Statistics System. http://www.georgiastats.uga.edu. [Date accessed unknown.]

Center for Agribusiness and Economic Development, Cooperative Extension Service at the University of Georgia. http://www.agecon.uga.edu/~caed/staffreports.html. [Date accessed unknown.]

Fiber Supply Assessment Group, D.B. Warnell School of Forest Resources, University of Georgia. Fiber Supply Assessment about the forestry growth and yield. http://growthandyield.com. [Date accessed unknown.]

Fiber Supply Assessment Group, D.B. Warnell School of Forest Resources, University of Georgia. Unique selected maps for 13 Southern States. http://growthandyield.com/main/maps_uni.htm. [Date accessed unknown.]

Fiber Supply Assessment Group, D.B. Warnell School of Forest Resources, University of Georgia. The Internet Map Service for Forest of Georgia. http://growthandyield.com/main/maps_ims.htm. [Date accessed unknown.]

Fiber Supply Assessment Group, D.B. Warnell School of Forest Resources, University of Georgia. minn_meeting1. http://growthandyield.com/inform/tty/minn_meeting1.html. [Date accessed unknown.]

U.S. Department of Agriculture (USDA) Forest Service. Mapmaker, version 1.0. http://ncrs2.fs.fed.us/4801/FIADB/index.htm. [Date accessed unknown.]

USDA Forest Service. Ramiform. http://ncrs2.fs.fed.us/zope/ramiform. [Date accessed unknown.]