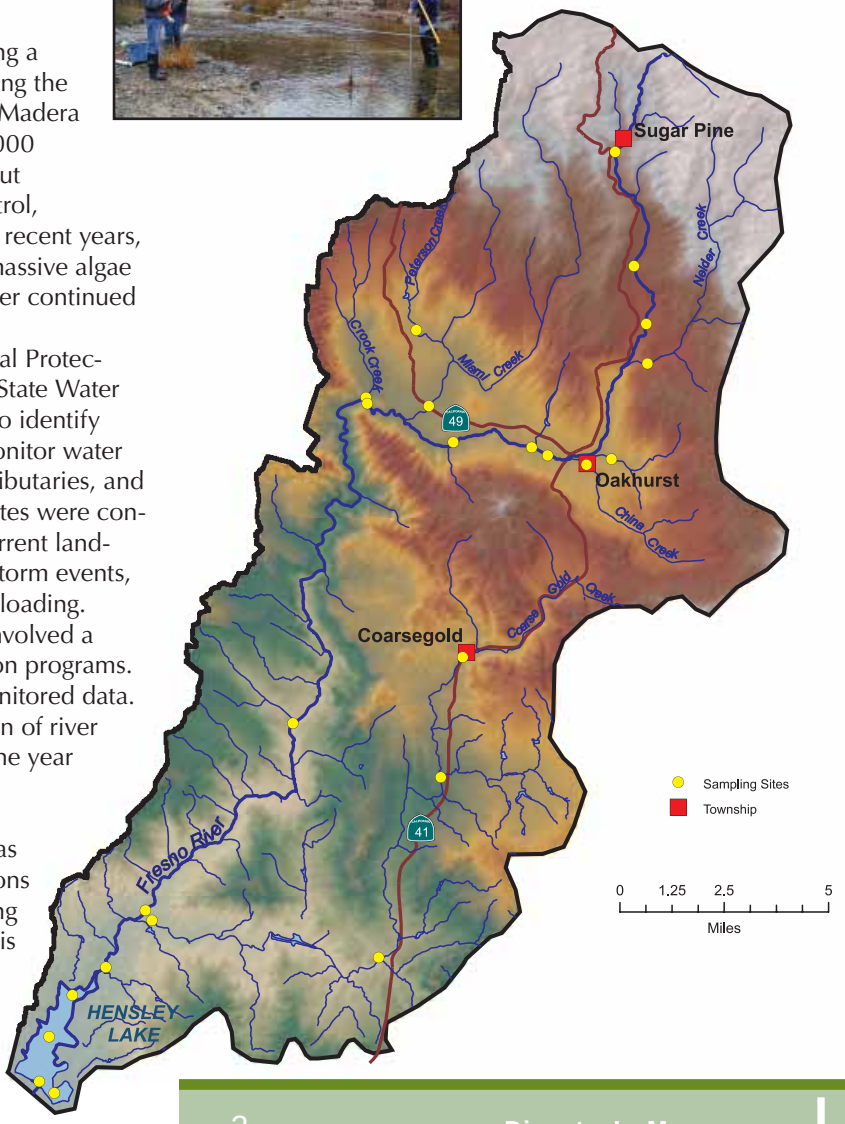
CSU Geospatial Review
GEOGRAPHIC INFORMATION SCIENCE IN THE CALIFORNIA STATE UNIVERSITY SYSTEM VOLUME 4 • SPRING 2006

Fresno

Watershed Monitoring and Hydrologic Simulation using GIS

Fresno River and Hensley Lake Water Quality Monitoring Project



CSU Fresno faculty and students are leading a study to identify nutrient sources impacting the upper Fresno River and Hensley Lake in Madera County. The reservoir has a storage capacity of 90,000 acre-feet (0.11 km^3) and a water surface area of about 1,500 acres (600 ha) and was created for flood control, irrigation, resource management, and recreation. In recent years, excessive nutrient loading in the watershed led to massive algae blooms in the reservoir, causing public concerns over continued beneficial uses of Fresno River and Hensley Lake.

Supported by a grant from the U.S. Environmental Protection Agency that is being administered through the State Water Resources Control Board, the research team seeks to identify nutrient sources impacting the watershed and to monitor water quantity and quality in the Fresno River, its major tributaries, and Hensley Lake. Six sampling events at 24 sampling sites were conducted during the 2003–04 water year. Past and current land-use patterns, residential development, and the big storm events, were analyzed to determine the sources of nutrient loading.

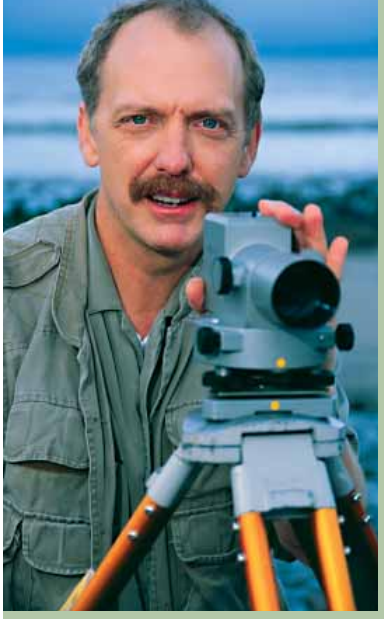
The field monitoring and hydrologic modeling involved a combined use of GIS, GPS and hydrologic simulation programs. The simulation results were calibrated using the monitored data. The results indicated that: (1) the annual contribution of river water to the lake was significantly decreased after the year 2000 as a result of residential development; (2) the dissolved oxygen in the river was at critical (near-minimum) levels for potential beneficial uses (such as swimming and aquatic life); (3) nutrient concentrations in the river were always lower than in the lake during the low flow period, suggesting that the river water is diluting the lake, with large amount of nutrients probably coming from big-storm events in the watershed; and (4) high bacteria (total coliform and E. coli) numbers prevailed in the middle and downstream reaches of the river, documenting the contribution of disease-causing bacteria from the watershed.

These results are being used to recommend restoration measures by land managers (county, state, federal) and property owners throughout the drainage area. While this watershed, like many others in the foothills of the Sierra Nevada, will never be restored to pristine conditions, efforts such as water conservation, land use and waste management, will hopefully restore the water quality condition to be above the critical levels designed for recreation and other beneficial uses.

MORE INFORMATION:

Zhi Wang, Ph.D., Department of Earth and Environmental Sciences, California State University, Fresno, zwang@csufresno.edu

INSIDE



Director's Message
2006

The Increasing Significance of Education in GIScience

UNIVERSITIES have contributed to the development of GIS and related technologies in the U.S. from the beginning, starting with the development of spatial analysis methods in the 1950's and 1960's with significant contributions from the University of Washington and the Harvard Laboratory for Computer Graphics and Spatial Analysis, among others. Much of this pioneering work focused on research methods.

As focus in GIScience shifted from theory to practice and the discipline has become more accepted for important applied work in federal, state and local government, much of the action has come in developing datasets and methods applicable to the work of these agencies. In recent years, the need to coordinate the development and use of spatial data sets, and the need to streamline funding for data development, has led to formation of regional and state GIS organizations. These partly mirror the earlier and ongoing development of federal data efforts such as the National Spatial Data Infrastructure.

For many reasons including the size and complexity of the state, California has taken a long time to organize its GIScience efforts. Now the California GIS Council has found its footing as a functional entity. Challenges of physical meetings have come into conflict with the need for greater continuity (and thus the need for more frequent meetings), but solutions are arising, including new types of virtual meetings on the internet, and significant involvement of regional groups. At the January 23–27 virtual meeting, GIS Council members recognized the obvious need to include academic institutions, and the council charter was amended to specifically add our sector. This is good news for the CSU and good news for the State; we have a lot to contribute.

We're also seeing an expansion of interest in teaching these technologies to a broad spectrum of students. Currently, the most active work at the University Consortium for Geographic Information Science (UCGIS) has shifted from research paradigms to GIS education. With our tight linkages between research and education, CSU faculty and staff are uniquely suited to making substantial contributions to furthering this new agenda.

Jerry Davis, *Director,* CSU GIS Specialty Center
San Francisco State University

University Education Takes Center Stage at the 2005 UCGIS Summer Assembly

The 2005 University Consortium for Geographic Information Science (UCGIS) Summer Assembly was held 28 June through 1 July in Jackson Hole, Wyoming. Being much smaller than a typical professional organization meeting, yet with contributions from universities nation-wide, the summer assembly lends itself to active participation in developing agendas and editing products.

Until the 2004 publication of UCGIS's Research Committee, *A Research Agenda for Geographic Information Science* (edited by McMaster and Usery), the leading role of UCGIS was in developing the research agenda. Much has changed since the CSU first participated as a member university system in the 1998 UCGIS Summer Assembly in Park City, Utah. During that meeting, research agendas and white papers were the major topic of discussion. The important work of the Educational Committee was just beginning, thanks to the efforts by our own Richard Wright, San Diego State. By 2005, education appeared to take center stage, or at least gained a much larger role.

The most active work group was busy developing the Geographic Information Science and Technology Body of Knowledge document. Led by David DiBiase of Penn State, six additional editors, and contributions from a 54-member Advisory Board, the aims of this document were similar to that of the research agenda. The current Body of Knowledge includes more than 350 topics; these are organized into 79 units and 10 knowledge areas, ranging from traditional GIS topics to remote sensing, field methods, and other area significant to the scope of geographic information science. For this to be successful, the goal is to disseminate it widely and gain contributions from the broader academic community, so we recommend reviewing the document at: http://www.ucgis.org/priorities/education/modelcurriculaproject.asp

To contribute to this important document, please take the time to review it, or sections of it—it's a good idea to focus on four or five units of particular interest—and pass along ideas to Jerry Davis, who has volunteered to serve on the Advisory Board. He will organize and pass these ideas along to the editors.

MORE INFORMATION:
Contact the 2005 CSU Delegates to UCGIS

Jerry Davis, Ph.D., jerry@sfsu.edu
San Francisco State University

Gisela Bichler, Ph.D., bichler@csusb.edu
CSU, San Bernardino

San Diego

A Web-based GIS Awareness Program for High School Students

The San Diego Educational GIS Consortium, composed of San Diego State University, San Diego Mesa College (part of the San Diego Community College District), and San Diego City Schools, is developing a scalable GIS skills certification program to prepare high school students for entry into a range of jobs in GIS-related fields. This project received funding through the Advanced Technology Education Program of the National Science Foundation—$770,000 for three years. One major goal of the project is to develop a Web-based GIS career awareness program to encourage high school students to pursue careers in geospatial information technology. The research team at San Diego State University utilized ESRI's ArcIMS, ArcExplorer, and ArcPAD (mobile GIS) software to develop Web-based learning modules for high school teachers and students.

Dr. Tsou (Geography) and Dr. Eckberg (Computer Science) at SDSU worked together with graduate students Anthony Howser, Jing-Yi Chen, Kimberly Dodson, and Gagan Arora to establish a research Web site for hosting the Web-based GIS career awareness program and online GIS learning modules. The GIS career program and the research Web site are geared towards high school students. By combining multimedia presentation and advanced Web technologies (Flash animation, online video clips, and interactive Web mapping tools), the research Web site provides high school students and teachers with an introduction to fundamental GIS theory and concepts. The comprehensive GIS introduction and linked Web resources can help students assess their interest in and aptitude for GIS-related careers.

Dr. Jay Vavra, a biology teacher at High Tech High School, helped develop the GIS learning module called, "San Diego Bay Marine Monitoring Study," shown in FIGURE 1. This study is an environmental monitoring project for the San Diego Bay area.

The research team developed two platforms for each GIS learning module: (1) a desktop version, for students lacking broadband Internet access capability, that uses ESRI's ArcExplorer Java Edition for Education, a stand-alone GIS viewer; and (2) a Web version for those students having high-speed Internet access. This version utilizes ESRI's ArcIMS 9.0 with JavaScript customization for Web mapping user interfaces. The ArcIMS mapping tools developed in this project can provide interactive, dynamic, query-based learning tools for high school GIS education.

At the start, the GIS career awareness program uses the "teach with" GIS method in which GIS technology tools are applied within existing high school course curriculum. After learning these Web-based GIS modules, the high school teachers and students proceed to the second step in which they "learn about" GIS and can better understand how GIS may be used in different career opportunities. URL: http://geoinfo.sdsu.edu/hightech

MORE INFORMATION:
Ming-Hsiang (Ming) Tsou, Ph.D., Department of Geography, San Diego State University, mtsou@mail.sdsu.edu or 619/594-0205

Dr. Tsou lecturing at a local high school.

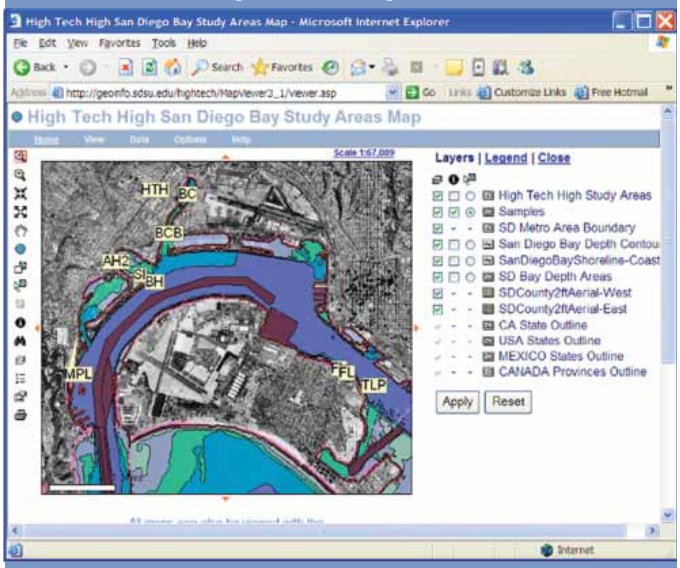


FIGURE 1: San Diego Bay Study Areas Map from the GIS learning module called, "San Diego Bay Marine Monitoring Study."

The CSU GIS Specialty Center

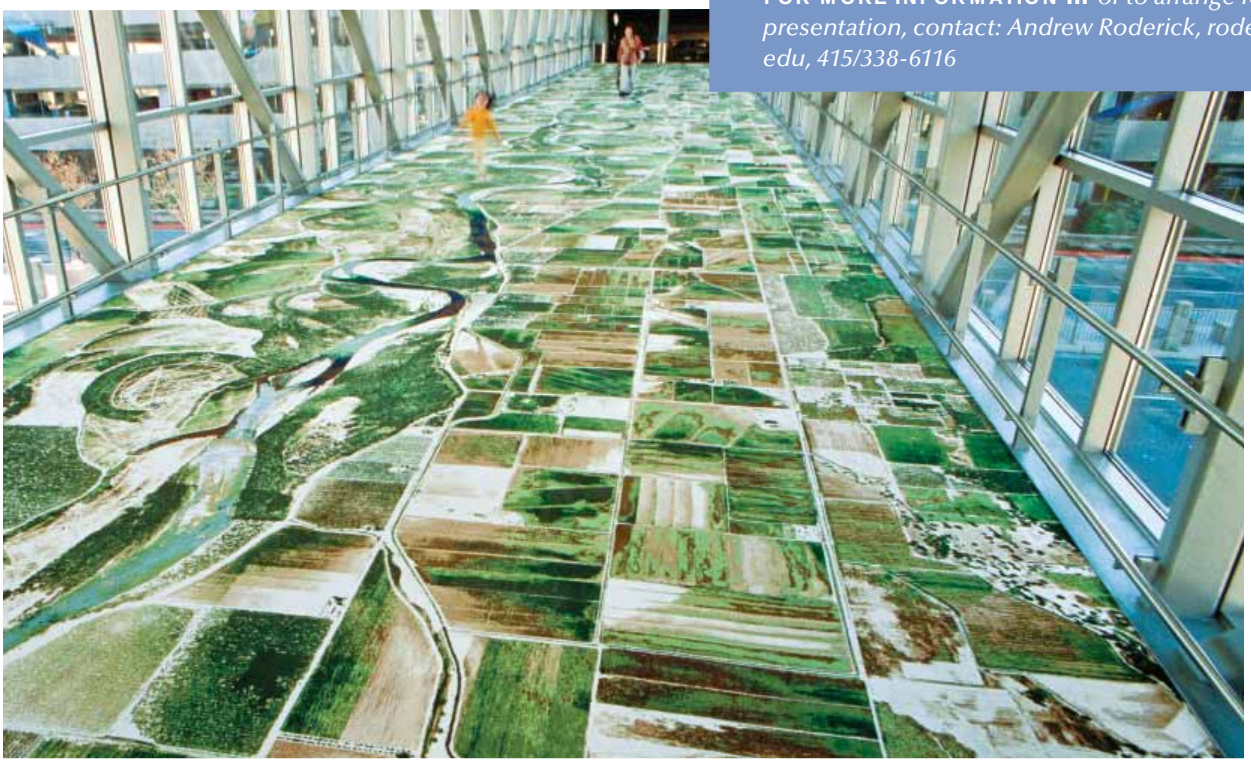
In 1992 the CSU GIS Specialty Center was established to promote the use of geographic information systems (GIS) and other geographic techniques for spatial analysis within the CSU system. Member campuses participate in software site licenses with Environmental Systems Research Institute, Inc. (ESRI) for GIS software, and Leica Geosystems, LLP for remote sensing and image processing software. Benefits of these two programs include training, technical workshops, membership in the University Consortium for Geographic Information Science (UCGIS) and in the California Geographic Information Association, and complimentary registrations for ESRI's User and Education User Conferences. Perhaps most importantly, the GIS Specialty Center promotes intercampus dialogue on teaching, research and application issues within the field of Geographic Information Science. For more information regarding the GIS Specialty Center and the programs it offers, please see the web site at www.calstate.edu/gis or contact Debra Dwyer, the site license administrator, at gis@sfsu.edu

Chico

Flying Carpet: Not Your Typical GIS Project

CSU Chico's Geographical Information Center (GIC) has been involved with an unusual project over the past year. San Francisco Bay Area artist Seyed Alavi, who studied at San Jose State University and the San Francisco Art Institute, proposed a public art project involving digital imagery for the Sacramento International Airport. Alavi's piece is titled *Flying Carpet*, and is installed at Sacramento International Airport on the pedestrian bridge connecting Terminal A to the parking garage. For the project, the GIC provided a color digital mosaic of approximately 50 miles of the Sacramento River. This image was woven into a carpet by Ulster Carpet of Ireland. The carpet depicts a snapshot of the river between Colusa, California and a point just south of Hamilton City near Chico with associated riparian vegetation and surrounding agricultural fields. The original mosaic image was developed by the GIC as part of a Sacramento River riparian mapping project. Color aerial photography was flown in 1999 and images were digitally scanned and orthorectified. The orthophotos and mosaic composites have been used in a variety of resource applications, but this was their first employment in a public art project. A walk across this *Flying Carpet* evokes the experience of flying over the nearby landscape as well as provides a unique welcome to Sacramento. Additional information about the project can be found by choosing 'flying carpet' from the menu at Seyed Alavi's Web site: http://here2day.netwiz.net/seyedsite/publicart/publicartframe.html

MORE INFORMATION:
Contact the Geographical Information Center, Charles Nelson, Director, cwnelson@csuchico.edu, CSU, Chico



DIVA: An Innovative Digital Resource

A new Web-based resource is coming to CSU campuses. The Data and Instruction Virtual Archive (DIVA) is a flexible tool that supports faculty use of digital files in teaching and research and is compatible with a wide range of digital media including GIS files, quantitative data, images, documents and multimedia files. It helps faculty store, manage and disseminate digital files and specifically supports the unique requirements of ArcGIS datasets.

DIVA provides CSU faculty a private workspace from which they can search for digital files held within the system or upload new, original files not there. They can also quickly create course and assignment pages which can be easily password protected allowing access only to students in a given course. All this can be done from any computer with an internet connection, and the system will sit on a reliable and secure hardware back-end. A full-time Data Manager provides oversight to data and files in the system. Methods will be available for connecting to learning managements systems or personal Web sites.

DIVA also serves as a community building platform. As it is adopted by greater numbers of CSU faculty, the repository of files will grow and come to represent a body of CSU resources and research programs. It establishes a previously non-existent infrastructure connecting faculty, research organizations and initiatives across campuses.

DIVA is an ideal resource for CSU GIS users. Future versions will include integration with ArcIMS for dynamic map generation on the Web. We are working closely with the CSU GIS Specialty Center and also the CSU Social Science Research and Instructional Council (SSRIC) for coordination with their existing resources and activities.

The DIVA team will visit campuses throughout Spring 2006. DIVA will be available to all subscribing CSU campuses in Fall 2006.

FOR MORE INFORMATION ... *or to arrange for a campus presentation, contact: Andrew Roderick, roderick@sfsu.edu, 415/338-6116*

2005 CENSUS WORKSHOP

Dr. Eugene Turner of CSU Northridge leading the 2005 Census Data Workshop held September 16, 2005 at CSU Northridge.

Coming Events

June 14
CSU Remote Sensing Committee Annual Meeting at San Diego State University

June 28–July 1
University Consortium of Geographic Information Science Summer Assembly in Vancouver, WA. www.ucgis.org.

August 7–11
CSU GIS Specialty Center Lunch meeting at the ESRI International Users Conference in San Diego

April 3–7, 2007
CalGIS Conference in Oakland, CA

What is Geographic Information Science (GISci)?

GEOGRAPHIC INFORMATION SCIENCE is the synthesis of spatial theory, methods and technologies used to study and map geographic relationships, distributions, networks, temporal change and other spatially aware information in order to better understand and manage limited earth resources. It includes:

GEOGRAPHIC INFORMATION SYSTEMS (GIS)
Comprehensive databases tied to location, with an integrated set of tools for querying, analyzing, and displaying information. Important classes of GIS tools include those that support: (1) logical map overlay, (2) proximity analysis and spatial buffering; (3) network analysis (e.g. of roads or streams); (4) geocoding and address matching; and (5) three-dimensional surface modeling.

REMOTE SENSING
Analysis of the earth's surface and interpretation of its features using imagery collected from air or space platforms. Image processing methods use visible and invisible (e.g. ultraviolet and infrared) parts of the electromagnetic spectrum as well as active radiation (RADAR and LIDAR) to interpret land cover patterns of vegetation, soil, land use, and environmental systems, including up-to-the-minute changes in these systems.

CARTOGRAPHY
The art and science of making maps. Cartographical theories and methods focus on information content, symbolization and design to appropriately communicate the results of studies.

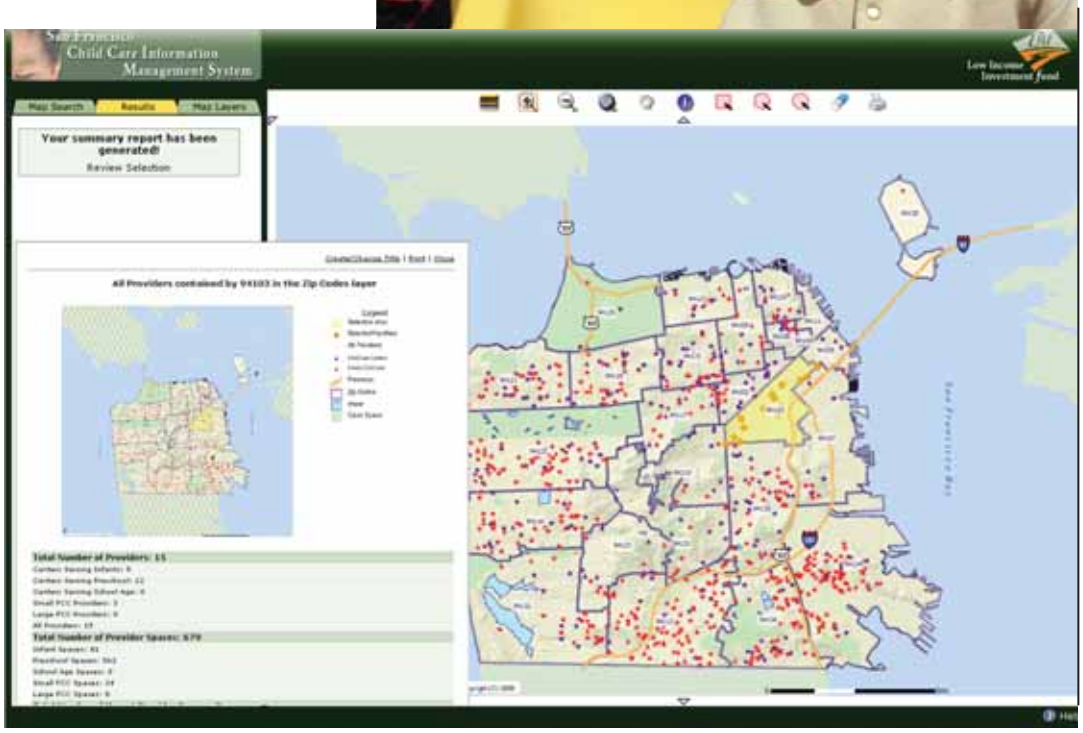
GLOBAL POSITIONING SYSTEMS (GPS)
Provides a means for determining earth location and navigation, using a constellation of satellites and the technology for interpreting their signals. Field data collection for GIS and remote sensing projects is increasingly dependent on GPS.

WHILE HAVING ITS ROOTS in geography, many disciplines have contributed to the development and use of Geographic Information Science. In the CSU System, anthropologists, biologists, business marketers, computer scientists, economists, engineers, environmental scientists, foresters, geologists, historians, journalists, landscape architects, natural resource planners, oceanographers, political scientists, sociologists, urban planners, and wildlife scientists also use these technologies in their classes and for their research.

San Francisco Child Care Internet Mapping Project

The Institute for Geographic Information Science (IGISc) was established in January 1988 as a center for geospatial research at San Francisco State University. IGISc focuses on applying state-of-the-art information technology to pressing interdisciplinary data, information, and research. Central to the interdisciplinary nature of this center is encouraging and fostering interdisciplinary cooperation within the SFSU campus and also the surrounding community in the application of spatial technologies. This purpose is best illustrated by a recent project initiated by IGISc in conjunction with a local San Francisco agency, the Low Income Investment Fund (LIIF).

The LIIF of San Francisco is leveraging spatial information technology to create more efficient management practices for the hundreds of child care facilities throughout San Francisco. An internet mapping service (ArcIMS 9.x ESRI, Inc.) was developed by the IGISc to deliver planning information to LIIF and its partners that consists of intelligent and interactive maps, map layers, and reports. The Child Care Internet Mapping Project (sfccmap.com) is currently serving as a tool to support capacity-building, planning efforts, and the enhancement of San Francisco child care facilities.



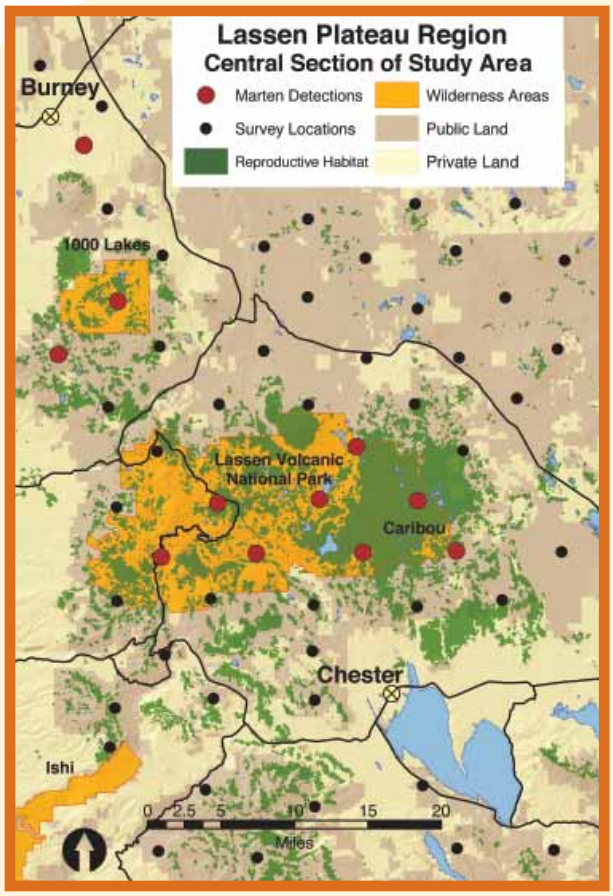
Results of a search for child care facilities in the 94103 zip code.

The IMS site currently provides LIIF and its partners with a custom interface for the delivery of information on child care facilities in relation to specific cultural, demographic, and physical features of San Francisco. The system provides users with the ability to define a geographic area of interest within the city that can then be used to subset the data set(s) for query and identification. For example, a user can select a specific zip code or other spatial extent (neighborhood, Supervisor District, distance from geocoded address, interactively drawn bounding graphic, etc.) and generate a summarized or detailed report of up-to-date information (facility type, occupancy/vacancy status, ages supported, languages spoken, etc.) on the child care providers contained within the selected area. Due to the sensitive nature of child care provider data, the system also offers multiple tiers of functionality depending on a user's level of security access. Child care provider data is updated on a quarterly or semiannual basis depending on the participating program.

Since the Child Care Internet Mapping Project was brought online, the mapping service has demonstrated its usefulness as a community-based planning tool and been met with great praise. As a result of the system's success, other associated San Francisco agencies have joined in the planned expansion of this Web-based tool, in both data and functionality. Future directions are to extend the capabilities of the Child Care Internet Mapping Project to neighboring counties partnered with LIIF.

MORE INFORMATION:

Institute for Geographic Information Science, San Francisco State University, Barry Nickel, Associate Director, 415/338-3566
Jesse Cohen, GIS Specialist, 415/338-6332



Humboldt

Multiple-scale habitat modeling for the American marten using GIS and Remote Sensing

Thomas Kirk and Dr. Steven Steinberg of the Advanced Spatial Analysis Facility (ASAF) at Humboldt State University, in collaboration with Dr. William Zielinski of the U.S. Forest Service Pacific Southwest Research Station, have developed a GIS-based regional model of American marten reproductive habitat using the structural and compositional aspects of forest vegetation.

Forest carnivores, such as the American marten (*Martes americana*), have experienced serious reductions in their distribution throughout northeastern California over the past several decades. The secretive, forest-dwelling weasel is one of the most habitat-specific mammals in North America and is considered a biological indicator species by federal land management agencies. Martens require large diameter trees, snags, and logs for essential natal and maternal den sites, structures located primarily in late-mature forests.

The California Wildlife-Habitat Relationships (CWHR) system was used to characterize optimal marten reproductive habitat. This system is used by foresters, land managers, and biologists to classify vegetation types based on species composition, size-class, and canopy cover. We modified the CWHR model to include habitat information based on results from field surveys conducted by the U.S. Forest Service from 1999–2002. The region surveyed included four national forests and Lassen Volcanic National Park, an area of some 27,000 square kilometers. The model was implemented across the region using the California Department of Forestry's Fire and Resource Assessment Program (FRAP) vegetation data. The FRAP data, compiled from satellite imagery and fine scale vegetation inventories, provides seamless coverage across multiple land ownerships at 100-meter resolution.

Multiple-scale habitat analyses were conducted in GIS to investigate the landscape ecology of martens. Forest composition, landscape pattern, fragmentation levels, and other variables were evaluated at 184 sample unit locations by creating circular "landscapes" at three spatial scales: 300, 2000, and 7800 hectares. Land cover, land use, landscape metrics, climate, stream density, road density, and Landsat TM spectral data were used in logistic regression analyses to predict marten occurrence. Area-based landscape metrics provided more information on marten occurrence than patch- or isolation-based metrics, and models developed at larger spatial scales performed better than those at smaller scales. Results from this research were included in a symposium entitled: *Fisher and Marten in California: Moving Science and Management Forward* hosted by the Western Section of the Wildlife Society this past February in Sacramento.

MORE INFORMATION:
Thomas A. Kirk, Humboldt State University
Environmental and Natural Resource Sciences, tkirk@fs.fed.us
707/825-2990

GIScience Curricular Development Grant Program

We are pleased to congratulate the recipients of GIScience Curricular Development Grants for 2005/2006: **Michael Reibel**, Cal Poly, Pomona, for a course in business geographics; and **Steven Steinberg**, Humboldt State University, for a course in GIS for rural communities. The purpose of these grants is to support GIScience curricular excellence in the CSU, with funding provided to support faculty developing GIScience course modules.

We have funding available for one additional grant for 2006/2007. Proposals will be accepted from all disciplines and may even be discipline specific—the idea is to encourage sharing ideas among our campuses. Grants will cover one course assigned time plus a limited budget for costs (for data acquisition, media and other materials). The recipient will be expected to produce course modules (exercises, related instructional materials and datasets) suitable for distribution to interested faculty in the CSU. Please submit 2-page proposals describing your proposed modules, its audience (types of courses), and a short budget, with a 2-page CV and a letter of support from your department Chair, to CSU GIS Specialty Center, San Francisco State University, 1600 Holloway Ave., San Francisco, CA 94132, by 1 August 2006.

Remote Sensing Committee Report

At its June 11, 2005 meeting and workshop at San Francisco State University, the California State University Remote Sensing Committee (RSC) looked at the hyperspectral and image segmentation capabilities of some leading remote sensing software packages. Hyperspectral methods, related to the long-established image spectroscopy used in mineral analysis (applied both on Earth and Mars probes), take advantage of sensors such as AVIRIS that collect more than 100 bands in narrow spectral widths. The results of research into the application of hyperspectral methods using ENVI and IDL software was presented by Hong-Lie Qiu, CSU Los Angeles. Toby Garfield (San Francisco) then presented his work on the CI-CORE coastal research alliance, a project involving multiple CSU campuses and investigating challenges facing marine and estuarine environments. In this project, hyperspectral imagery of the nearshore and coastal zones has been used to investigate algal blooms, coastal runoff, and near-shore bathymetry, also employing the ENVI / IDL suite.

Jeff Milliken of the U.S. Bureau of Reclamation in Sacramento, a graduate of the master's program in Geography at SFSU, provided a demonstration of the eCognition software package. Distributed in the U.S. by PCI, eCognition was developed in Germany as a sophisticated image segmentation and contextual classification package. Jeff demonstrated the classification of surface water and submerged substrate features based on very high spatial resolution visible/NIR data of irrigation areas along the lower Colorado River captured by the Leica ADS40 airborne imaging system.

Larry Fox (Humboldt) gave an overview of the Feature Analyst software package that runs as an extension to ArcGIS or ERDAS Imagine. Feature Analyst primarily supports pixel-based image classification, based on a neural network type of machine learning classifier. The software package is unique in that spatial pattern recognition can be incorporated into the classification process. Larry demonstrated that spatial objects such as forest stands can be classified more effectively than with more conventional per-pixel classification routines.

The 2006 Leica ERDAS Training courses are again scheduled: June 12th–16th at San Diego and June 19th–23rd at Monterey Bay. The Remote Sensing Committee will meet in San Diego on Wednesday, June 14th following that day's training.

MORE INFORMATION:

Douglas A. Stow, Ph.D., Chair of the Remote Sensing Committee, San Diego State University, stow@mail.sdsu.edu

0506-069

CSU Geospatial Review
CSU GIS Specialty Center
San Francisco State University
1600 Holloway Avenue
San Francisco, CA 94132