



## FINAL TECHNICAL REPORT: PROJECT 4 EXTENSION and OUTREACH

**PERIOD COVERED BY FINAL REPORT:** October 1, 2001 - September 30, 2006  
**DATE OF FINAL REPORT:** December 15, 2006  
**EPA COOPERATIVE AGREEMENT NUMBER:** CR 829095 & CR 829096  
**PROGRAM NAME (TITLE):** SPACE-TIME AQUATIC RESOURCES MODELING AND ANALYSIS PROGRAM (STARMAP)  
**PROJECT TITLE:** Extension of Expertise on Design and Analysis to States and Tribes  
**INVESTIGATORS:** N. Scott Urquhart (Principal Investigator, CSU), Stephen W. Johnson (WQTI), Richard A. Davis (CSU), Don L. Stevens, Jr. (OSU)  
**INSTITUTIONS:** Colorado State University (CSU), Oregon State University (OSU), and Water Quality Technology, Inc (WQTI)  
**RESEARCH CATEGORY:** Research Program on Statistical Survey Design and Analysis for Aquatic Resources  
**PROJECT PERIOD:** 10/1/2001 - 9/30/2006

**OBJECTIVE OF RESEARCH:** (a) To identify and establish the statistical needs of personnel in State and Tribal environmental management agencies (target audience); (b) to prepare, test, and deliver various (traditional, electronic, and web-based) means of delivering relevant information to the target audience.

**SUPPLEMENTAL KEYWORDS:** Outreach, water, watersheds, ecological effects, indicators, aquatic, Bayesian, statistics, survey sampling, EMAP, monitoring distance learning, web-based learning

**RELEVANT WEB SITE:** <http://www.stat.colostate.edu/starmap>

**FUNDING:** This project was jointly funded by STARMAP at Colorado State University and DAMARS at Oregon State University.

### 1. ACCOMPLISHMENTS of PROJECT 3: DEVELOPMENT AND EVALUATION OF AQUATIC INDICATORS

The client community for the results of these two research programs consisted of aquatic monitoring scientists in state, tribal, federal, and more local agencies charged with monitoring aquatic resources in compliance with the Clean Water Act. Such aquatic scientists will be assisted by affiliated statisticians and landscape ecologists. Thus the outreach and extension efforts extended to each of these groups of scientists, using a variety of means. Program personnel

- ◆ Engaged in direct interaction with personnel in relevant state, tribal, and more local environmental agencies.
- ◆ Interacted with EPA personnel who have direct contact with aquatic monitoring personnel in the states and more local agencies.
- ◆ Communicated with diverse members of the client community in a wide variety of conferences and other settings. They gave more than 200 talks and displayed at least 20 posters. The Program Directors organized and conducted five specialty conferences, and made substantial contributions to the organization and execution of several other conferences; most of these conferences included international participants. One of the Directors edited two issues of the *Journal of Environmental and Ecological Statistics* as part of this communication effort.
- ◆ Presented short courses and tutorials in several settings, some based on a textbook coauthored by one of the Program's principal investigators.
- ◆ Developed a set of browser-based learning materials suitable for self-study that has been submitted as part of this report. EPA is free to utilize those materials as it sees fit.
- ◆ Gave presentations to teachers and students in high school advanced placement statistics courses to interest students in possible careers in environmental statistics.

This Project had three main modes of outreach and extension: Direct implementation of project tools in the design and execution of active state, regional, tribal, and more local monitoring efforts, primarily executed by Stevens (DAMARS) and Theobald (STARMAP); a CD-ROM containing relevant learning materials, directed by Urquhart (STARMAP); and communication to various communities by publications, oral presentations, and posters in diverse contexts, executed by all members of both Programs.

STAR Program Reporting Requirements specify the nature of this and three subsequent sections. Two additional sections are appropriate for this Project: A listing of specific outreach activities (Section 5), and a list of outreach communications (Section 6), the latter organized by type of communication.

- ◆ Most of the personnel of both STARMAP and DAMARS participated in interactions with various members of the client community, but major and sustained efforts in this area were made by Don Stevens, the Director of DAMARS, and David Theobald, a STARMAP Principal Investigator. Don Stevens interacted throughout the Programs' lives with the San Francisco Estuary Institute and other California agencies, and several Oregon state agencies. Toward the end of the Programs, he and, to a lesser extent, David Theobald and collaborators, interacted with the Alaska Department of Fish and Wildlife in on the design of monitoring activities related to Pacific salmon. David Theobald, a STARMAP landscape ecologist, developed GIS tools relevant to aquatic monitoring. The nature of these tools are documented in the report for Project 3. Theobald and collaborators made these tools available to diverse potential

users and gave a number of presentations to the client community on their use; the requesters for these tools span a wide range of aquatic interests, including a surprising number from outside the US. In the case of Alaska salmon they actually installed the software and demonstrated its use on computers of the Alaska Department of Fish and Game. Scott Urquhart, the STARMAP Director, had continuing interactions with the National Park Service's Inventory and Monitoring Program, and with the San Diego Metropolitan Wastewater treatment activity in collaboration with Kerry Ritter of the Southern California Coastal Water Research Project.

- ◆ STARMAP results have received international exposure, both by current investigators and former investigators who have gone on to other positions, but continue to report on results originating from their work with STARMAP: Germany (Jennifer Hoeting, 2002; Richard Davis, 2005), New Zealand (Jennifer Hoeting, 2003), France (Jean Opsomer, 2003), Australia (Jean Opsomer, 2003; Richard Davis, 2003 & 2004; Don Stevens, 2005 & 2006; Erin Petersen, 2005 & 2006; Loveday Conquest, 2005), Denmark (Richard Davis, 2003 & 2004), Greece and Cyprus (Richard Davis, 2004), India (Jay Breidt, 2004; Jennifer Hoeting, 2005), Sweden (Jean Opsomer, 2004; Richard Davis, 2004 & 2006; Don Stevens and Loveday Conquest, 2006), Singapore (Jay Breidt, 2004), Spain (Jean Opsomer, 2004), Portugal (Richard Davis, 2004 & 2006; Don Stevens, 2006), Japan (Richard Davis 2004 & 2006), Italy (Giovanni Ranalli, 2005 & 2006), Czech Republic (Richard Davis, 2005 & 2006), Pacific Rim Nations (Don Stevens, 2005), and Republic of China (Richard Davis, 2006). Most of this international exposure came at the expense of cooperating organizations; STARMAP funded, with prior approval, only three of the trips to give these talks.

## 2. SIGNIFICANCE OF ACCOMPLISHMENTS

This Project has effectively communicated the results of the STARMAP and DAMARS Programs to diverse members of the client community in a variety of effective ways. Most of the communications have been contemporary, but the CD ROM based learning materials can be used in several ways, including being available on the internet.

## 3. STAKEHOLDERS AND USERS OF RESULTS

There are many potential users of the methods developed by STARMAP and DAMARS. The two Programs have organized and presented a number of conferences or parts of conferences directed specifically at potential users. Program personnel also have participated in a number of conferences at the invitation of potential users. Some of the conferences listed below are explained in more detail in Section 5 or 6. The conferences listed immediately below had a major involvement of potential users of developed methods.

- ◆ Don Stevens (DAMARS) and Tony Olsen (EPA, WED) presented the short course **Spatial Sampling** at the Joint Statistical Meetings, Seattle, WA, August, 6-10, 2006.
- ◆ David Theobald (STARMAP), John Norman (STARMAP), Erin Peterson (formerly of STARMAP), and Don Stevens (DAMARS) were the major presenters at the Workshop on Modeling Salmon Habitat, hosted by the Alaska Department of Fish & Game (ADF&G) and The Nature Conservancy, Anchorage, Alaska, May 17-19,

2006. (See Section 5 for more detail.)

- ◆ Conference on Statistics for Aquatic Resources Monitoring, Modeling, and Management (SARMMM), hosted by DAMARS: This was the Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005. It was well attended by both statisticians and natural resource managers, especially ones from the Pacific Northwest, but other attendees came from across the US, and several from other countries. This included a well-attended day-long short course (9/7/05) for natural resource managers on Designing Aquatic Resources Surveys.
- ◆ Monitoring Science and Technology Symposium, Denver, CO, September 21-24, 2004: The STARMAP Director organized two and a half days of sessions on the statistical aspects of natural resource surveys. Stevens (DAMARS) and Urquhart (STARMAP) made major presentations as a part of the short course. Three STARMAP graduate students also made presentations in other conference sessions. This short course was well attended by resource managers from throughout the US and elsewhere in the Americas.
- ◆ The Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004, hosted by STARMAP: This conference was well attended by Program participants, statisticians and natural resource managers, especially ones from EPA Region 8, but other attendees came from across the US, and included at least one international participant. The keynote address was given by an EPA resource manager.
- ◆ Graybill Conference, June 16 - 18, 2004: This conference constituted outreach to the statistical community, providing STARMAP and DAMARS investigators with an opportunity to present some of their results to both established and young statisticians. It was attended by about 80 statisticians, and was officially sponsored by STARMAP. The STARMAP Director served as editor of a special edition of *Environmental and Ecological Statistics* which served as the conference proceedings, and provided an outlet for several young environmental statisticians. The keynote address was given by a member of the Programs' Science Advisory Committee.
- ◆ EMAP Symposium 2004, Newport, RI, May 3 - 7, 2004: The STARMAP director organized a session on the statistical aspects of the linkage of Clean Water Act sections 305(b) and 303(d) and he and another STARMAP PI made presentations.
- ◆ Temporal Sampling Workshop, Port Angeles, WA, November 12 - 14, 2003, sponsored by the National Park Service: Urquhart (STARMAP), and Stevens (DAMARS) gave invited talks, and Ranalli (STARMAP) participated.
- ◆ The Second Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, August 11 - 13, 2003, hosted by DAMARS: This conference was well attended by Program participants, statisticians and local natural resource managers, including ones from EPA, WED and Oregon Department of Fish and Wildlife. The keynote address was given by an EPA resource manager.
- ◆ The First Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 20 - 11, 2002, hosted by STARMAP: It was well attended by Program participants, statisticians and local natural resource

managers, including ones from EPA Region 8. The keynote address was given by an EPA resource manager.

#### **4. HOW PRODUCTS WILL FURTHER SCIENCE/ MANAGEMENT OF RESOURCES**

The products of this project are both tangible (the manuscripts, presentations, software, and learning tools) and intangible (the insight and knowledge of environmental sampling that has been passed on to non-statistician environmental scientists and managers). The tangible products developed by STARMAP and DAMARS provide an expanded tool kit for designing, monitoring, and analyzing the resulting data resulting from studies of aquatic resources at a variety of levels, from national surveys to studies near a single oceanic sewage outfall. The intangible products have the potential for greater impact on how the resources of this Nation are managed. DAMARS and STARMAP have demonstrated the utility of rigorous statistical design and analysis of environmental monitoring program to diverse parts of the client community for which these tools were developed and evaluated. Thus, we have not only provided tools, but we have provided the tools to people who are in a position to apply them, and given them the knowledge to do so. There is substantial evidence that the use of tool kit is spreading... more states, tribes, federal agencies, even other countries, are recognizing its utility.

#### **5. LISTING OF SPECIFIC OUTREACH ACTIVITIES**

*YEAR 5* (October 1, 2005 - September 30, 2006)

- ◆ Personnel under STARMAP Project 3 collaborated with other STAR researchers, especially ones at CSU, EPA personnel at WED, and in the states and other agencies in developing, implementing, and testing relevant GIS tools.
  - For example, this project's current and former investigators actively participated in at a Workshop on Modeling Salmon Habitat, hosted by the Alaska Department of Fish & Game (ADF&G) and The Nature Conservancy, Anchorage, Alaska, May 17-19, 2006. The ADF&G is responsible, according to state legislation, for locating freshwater anadromous fish habitat and documenting each stream segment in the Anadromous Waters Catalogue that is used by anadromous fish. Since the majority of Alaskan waters have never been surveyed, an efficient method for identifying which waters that have a high probability of use is an important step in prioritizing on-ground surveys. ADF&G invited biologists, GIS specialists, and managers from around Alaska, and researchers from around the US and the world (Australia and Japan) to come for three days. The first day was devoted to an overview of fish biology and some of the challenges that the managers were facing. The second day speakers described specific datasets, such as PRISM and NHD, that were available and how the Alaska datasets were different from similar ones in the conterminous US. The afternoon session dealt with GIS tools and methodologies, at which Dave Theobald and Erin Peterson (a former STARMAP doctoral student) gave their presentations, that could be used for predicting salmon habitat. Presentations by other researchers concerned modeling fish habitat, fish distribution, and conservation areas. Statistical methods were described on the third day. Jay Ver Hoef (STARMAP Science Advisory Committee chair) talked about the spatial models and also gave a presentation about spatial design. Don Stevens (DAMARS) gave a talk about

probability-based design. On the last day everyone who attended the workshop was involved in a discussion about which approach the ADF&G should use. During the modeling portion of the discussion, the mediator started by saying that he had already decided to use the spatial models investigated and used by STARMAP investigators. That was not surprising as they had already invested so much time developing the GIS datasets. On the other hand, they must not have seen a more relevant method. Theobald, Peterson, Norman, and Ver Hoef continued collaborations over the subsequent weekend with the ADF&G statisticians, GIS analysts, and Mike Wiedmer who is the manager in charge of the anadromous fish sampling. The STARMAP group got the GIS tools working, and the ADF&G datasets formatted correctly. Ver Hoef tested his code so that they would be able to use it, and Theobald showed them the RRQRR tools for their sampling design. They decided to use the probability-based survey design that Stevens had presented. The breadth of the DAMARS/STARMAP presence at this meeting illustrates the substantial influence these two programs have had on environmental sampling and monitoring, especially in aquatic systems.

- The STARMAP group (Theobald and Norman) applied their FLOWS tools and database to construct basic data needed by The Nature Conservancy to conduct their Central Shortgrass Prairie Ecoregional Assessment.
- The GIS tools have substantial lists of adopters. Users listed under STARMAP Project 3 includes a wide variety of domestic agencies, including several parts of EPA, in at least 18 states, as well users in at least 11 other countries.
- ◆ Don Stevens has continued his direct outreach efforts of behalf of both STARMAP and DAMARS:
  - Stevens attended a two-day workshop in Corvallis, OR, April 17 & 18, 2006 on effectiveness monitoring sponsored by the Oregon Watershed Enhancement Board. He gave a presentation entitled "Importance of scale, sampling design, and statistics in effectiveness monitoring".
  - Stevens presented two talks in Europe during the summer of 2006. Although the trips were funded by another source, the talks publicized DAMARS/STARMAP research. The invited talk "Using a Master Sample to Coordinate Monitoring of Multiple Species", by Don L. Stevens, Jr., David P. Larsen, and Anthony R. Olsen, was presented at the meeting of The International Environmetrics Society (TIES) in Kalmar, Sweden, and the talk "Spatial properties of design-based versus model-based approaches to environmental sampling" by Don L. Stevens, Jr., presented at ACCURACY 2006: The 7th international symposium on spatial accuracy assessment in natural resources and environmental sciences, Lisbon, Portugal. This talk also was published in the proceedings of the Symposium.
  - Stevens was elected as the North American Representative to the Executive Board of The International Environmetrics Society. He is also serving as the Continuing Education Officer for the Section on Statistics and the Environment of the American Statistical Association.
  - Stevens has continued work with Oregon Department of Fish and Wildlife (ODFW) on design and analysis of coho salmon monitoring. A major effort during the third

quarter was developing methodology to modify the frame for the ODFW coastal coho sample. Since the original sample was drawn in 1998, the frame has changed substantially, both with addition of newly identified coho-bearing streams and elimination of non-accessible stream reaches. Moreover, the objective has changed from obtaining estimates at the scale of monitoring areas (5 covering the Oregon coast) to obtaining estimates at the coho population level (30 more or less distinct populations on the coast).

- Stevens has worked with the team developing the California Rapid Assessment Method (CRAM) for Wetlands. Most recently, the focus has been on calibrating CRAM to more intensive methods of wetland condition assessment. Next phase of the study will be to implement CRAM statewide.
- OSU Graduate students Jessica Merville and Bill Gaeuman have been working with the ODFW to extend adaptive sampling techniques to stream networks. The particular focus has been on developing efficient ways to sample bull trout redds in Eastern Oregon streams. ODFW has census data on several stream networks that Merville & Gaeuman have been using to compare different sampling strategies.
- ◆ Urquhart and Ritter met with personnel of the San Diego Metropolitan Wastewater District to obtain data and metadata from an near-coastal project they helped design two years ago. Ritter analyzed this data to evaluate the design, and gave a talk about the methods at California and the World Ocean Conference 2006.
- ◆ Giovanna Ranalli continued her collaboration with Henry A. Walker, USEPA, NHEERL, Atlantic Ecology Division, Narragansett, R.I. and Phillip Trowbridge, New Hampshire Department of Environmental Services, Concord, NH. (See STARMAP Project 2 {also a DAMARS project} for further information on this.)
- ◆ The National Park Service has an Inventory and Monitoring Program which shares many features and approaches with EMAP. The STARMAP Director has collaborated with the design team of that program on various technical aspects of monitoring. Urquhart was invited participate in that program's annual meeting and gave a talk on Designing Surveys over Time (Panel Surveys): Variance, Power and Related Topics, San Diego on February 10, 2006.
- ◆ Jay Araas, masters student in statistic converted the oral presentations he video taped at WED in June, 2004, into pdf files where all of the presentation talks have been converted into textual material which can be displayed with PowerPoint slides in a side-by-side pdf format. A copy of his Masters Report is web available at link given in the complete output listing.

*YEAR 4* (October 1, 2004 - September 30, 2005)

- ◆ Development of browser-based learning materials continued. A decision to represent all material in pdf format had been made, and Stacey Hancock, a CSU statistics graduate student, incorporated video clips of the field training into the materials. Hari Iyer became actively involved in this effort.
  - A CSU graduate student attended and videotaped the EMAP training session at EPA's Western Ecology Division Lab in May, 2004. This material has been incorporated into part 4 of the learning materials.
- ◆ Wetlands are included in aquatic systems. Urquhart participated, June 14 - 15, 2005, in a review of the methodology being used for the upcoming National Wetlands Status

and Trends report, due out in December, 2005. This produced other contacts, and a wetlands data set whose investigation just started:

- Personnel of Minnesota's Department of Natural Resources are designing an expanded (over NIW's 175 plots) sampling of wetlands. Urquhart assisted in that design effort. Personnel there supplied STARMAP with the areas of 17 wetland classes for Minnesota's 175 NWI two-mile square plots, and the analogous data for the plots divided into four and 16 subplots. The objective of this was to incorporate costs into making decisions about optimal size of wetland monitoring plots. Preliminary spatial analysis is interesting.
- He also collaborated with Brian Gray of USGS on this trip.
- ◆ The STARMAP Director actively recruited high school students into statistics by giving talks to two advanced placement statistics classes in a Fort Collins high school. Scheduling constraints in previously visited high schools precluded revisits this reporting year.
- ◆ OTHER STAR GRANTEES
  - Alix Gitelman continued collaborations with Ken Reckhow of the North Carolina Water Resources Research Institute.
  - Collaborative relations continued with PI's Hoeting and Theobald with the these CSU investigators, also funded by EPA's STAR program: LeRoy Poff (Biology), Brian Bledsoe (Civil Engineering), Will Clements ( Fish and Wildlife Biology). A new statistics student has begun working closely with Bledsoe.
- ◆ Urquhart finished editing a special issue of *Environmental and Ecological Statistics*, based on the Graybill Conference for which he served as program chair.
- ◆ Stevens planned and executed the Fourth Joint Annual Program Meeting. This meeting was a success in terms of both content and attendees. DAMARS and STARMAP personnel continued to work with the Oregon Department of Fish & Wildlife on the joint sessions.
- ◆ Doctoral student Leigh Ann Harrod (DAMARS) created a manual titled "Ignorable Nonresponse Adjustment Procedures and Algorithms," with an accompanying CD-ROM. The manual guides the user through data analysis for probability-based survey data with nonresponse, provides documentation for the weighting adjustment functions, and provide a copy of the R software. Harrod gave a presentation of the software as a part of the short course given in conjunction with SARMMM.
- ◆ Don Stevens continued his direct outreach efforts of behalf of both STARMAP and DAMARS:
  - Stevens visited the San Francisco Estuary Institute (SFEI) October 18-20, 2004. SFEI has used a GRTS-based rotating panel design for monitoring trace contaminants in the San Francisco estuary since 2002. Stevens worked with personnel at SFEI on the analysis of data resulting from a variable probability survey design, and acquainted them with the R software for survey design being developed by Tony Olsen at USEPA NHEERL-WED.
  - Stevens visited with Mathematics faculty and students at Eastern Oregon State University in La Grande, Oregon, on November 3 & 4, 2004. The purpose of the visit was to interest potential graduate students in environmental statistics. He presented a seminar on "Environmental Monitoring, Statistics, and the Art of Non-Representation: The Need and Evidence for a Paradigm Shift". He also visited a

mathematical modeling class and discussed statistical modeling, using Oregon coastal coho salmon population as an example.

- Stevens presented two seminars at the USEPA WED laboratory in November. “The Generalized Random Tessellation Stratified Sampling Design for Selecting Spatially-Balanced Samples” was presented on Nov 2 and “Local Neighborhood Variance Estimator for GRTS Survey Designs” (with Tony Olsen) was presented Nov 16, 2004.
- Stevens has continued working with Core Development Team for the California Rapid Assessment Method (CRAM) for wetland condition. The Core Development Team includes representatives from USEPA Region 9, San Francisco Estuary Institute (SFEI), the Southern California Coastal Water Research Project (SCCWRP), the California Conservation Core, the California Coastal Commission, and UCLA. The CRAM is modeled on Ohio RAM (ORAM) and is being extended to cover wetland types in California, e.g., salt marshes, and tidal influenced wetlands. In January, Stevens met with the Core Development Team to discuss approaches to calibrating CRAM. The proposed approach was submitted to USEPA Region 9 for approval. Calibration will take place in late 2005 through early 2006.
- Stevens participated and made a presentation in a workshop on Experimental and Survey Design in Fisheries: A Statistics Workshop presented at the annual meeting of the Oregon Chapter of the American Fisheries Society, February 16, 2005.
- Stevens presented two short courses in 2005. “Statistical Design and Analysis for Environmental Monitoring” was a half-day course presented at the State of the Salmon Conference – 2005, Anchorage, AK in April. “Designing Aquatic Resource Surveys” was a full day course presented in conjunction with the SARMMM conference at Corvallis, OR in September. The primary audience for both courses was aquatic monitoring practitioners in federal, state and tribal agencies. The Anchorage course had about 15 attendees, and over 60 persons attended the Corvallis course.
- Stevens participated in the re-design of the monitoring plan for San Francisco Bay, as part of a design team consisting of representatives the San Francisco Estuary Institute (SFEI), USEPA Region 9, DAMARS, USGS, and SF Bay Area Regional Water Resource Control Board. The design is an excellent example of using prior information to guide design. Separate designs were put in place for water column and sediment. The sediment design applies Rotating Panel Generalized Random Tessellation Stratified (GRTS) methodology. Stevens has been working with SFEI to complete the revision of the report on the redesign of the San Francisco Estuary Regional Monitoring Program in response to reviewer comments. The report has now been published and is available at this URL given below with the complete citation.

*YEAR 3* (October 1, 2003 - September 30, 2004)

- ◆ The STARMAP Director invested substantial effort this year in the organization and execution of several meetings having a substantial outreach motivation:
  - EMAP 2004, a session on the statistical aspects of the linkage of Clean Water Act sections 305(b) and 303(d).

- Graybill Conference, June 16 - 18, 2004: This constituted outreach to the statistical community, providing STARMAP and DAMARS investigators with an opportunity to present some of their results to both established and young statisticians. It was attended by about 80 statisticians, and was officially sponsored by STARMAP. The Director served as editor of a special edition of *Environmental and Ecological Statistics* which will serve as the conference proceedings
- Monitoring Science and Technology Symposium: The Director organized two and a half days of sessions on the statistical aspects of natural resource surveys. Three STARMAP graduate students made presentations in other sessions.
- ◆ Contacts were made with EPA personnel (Region 8, 9 and 10 and WED/NHEERL/ORD), and Tribal representatives. Hoeting, Urquhart and most of the CSU STARMAP-funded graduate students participated in a conference on EPA STAR-funded research May 12, 2004. Hoeting and Urquhart made a presentation on STARMAP's work.
- ◆ Urquhart (STARMAP), Ranalli (STARMAP) and Stevens (DAMARS) participated in the Temporal Sampling Workshop, Port Angeles, WA, November 12 - 14, 2003, sponsored by the National Park Service.
- ◆ Stevens participated in the Pacific Rim Salmon Monitoring and Protocol Review, Welches, OR, March 8-12, 2004, representing both DAMARS and STARMAP.
- ◆ The STARMAP Director actively recruited high school students into statistics by giving talks to eight advanced placement statistics classes in four high schools, two in Denver and two in Colorado Springs. He also prepared materials for use by teachers of such statistics classes, and talked about them at a statistics teachers conference.

*YEAR 2* (October 1, 2002 - September 30, 2003)

- ◆ The first two first units of the planned learning materials, on "Why Sample?" and "How to Sample", were drafted and tested this year.
  - The interface and preliminary content was tested at an evaluation gathering August 13, 2003 at Oregon State University. The findings were used in further implementation of the materials.
  - Personnel affiliated with Colorado State University's Office of Instructional Services assisted in the development of the materials mentioned above.
- ◆ Tribal needs assessment by Water Quality Technology was completed; a copy was forwarded to EPA/STAR. Report is available on the web, in the complete output listing.
- ◆ The STARMAP Director participated in the all-hands meeting of the ACE Inc EaGLes Project in Charleston, SC, May 28 - 29, 2003
- ◆ Contacts were made with EPA personnel (Region 8, 9 and 10 and WED/NHEERL/ORD), and Tribal representatives.
- ◆ The STARMAP and DAMARS Directors participated in the EaGLes Conference, Annapolis, MD, December 4 - 6, 2002. Urquhart gave a talk on metadata, and participate in an evaluation of analyses of case studies. The Director of DAMARS participated similarly.
- ◆ The STARMAP Director participated in the conference "Spatial Statistics: Integrating Statistics, GIS, and Statistical Graphics," held October 17-19, 2002, in Seattle, Washington. It was sponsored by the Statistics and Environment Section of the American Statistical Association (ASA) and the National Research Center for Statistics and the Environment.

*YEAR 1* (October 1, 2001 - September 30, 2002)

- ◆ Tribal needs assessment continued by Water Quality Technology; three summaries are available. A preliminary report was presented at the CSU conference.
- ◆ Contacts were made with EPA personnel (Region 8 and WED/NHEERL/ORD), and Tribal representatives.

## 6. LISTING OF SPECIFIC OUTREACH COMMUNICATIONS

In one sense all of the outputs of both STARMAP and DAMARS constitute outreach and extension, but to different communities: Potential users of the developed methods in the states, tribes, federal agencies, and academics, as well as statisticians and landscape ecologists who might use the methods on behalf of the previously listed clients. The list which follows summarizes communications to only the first community. Note that this list is a subset of the entire output list from STARMAP; the complete list, supplied as a separate document as a part of this final report, provides internal links to most of the presentation materials, technical reports, and some manuscripts. Published material ordinarily was copyrighted by the publisher, so access to it usually is restricted to subscribers of that publication. The subset below includes all communications with client communities and outlets having an explicit environmental dimension.

### ***PUBLICATIONS and ACCEPTED MANUSCRIPTS:***

- ◆ Francisco-Fernandez, M., M. Jurado-Exposito, J.D. Opsomer, and F. Lopez-Granados A nonparametric analysis of the distribution of *Convolvulus arvensis* in wheat-sunflower rotations. To appear in *Environmetrics* (accepted, 2006)
- ◆ Peterson, E.E., D.M. Theobald, and J.M. Ver Hoef (2007). Support for geostatistical modeling on stream networks: Developing valid covariance matrices based on hydrologic distance and stream flow. To appear in *Freshwater Biology* (November, 2006).
- ◆ Theobald, D.M., D.L. Stevens, Jr., D. White, N.S. Urquhart, A.R. Olsen, and J.B. Norman Using GIS to generate spatially-balanced random survey designs for natural resource applications. To appear in *Environmental Management*.
- ◆ Ritter, K.J. and M.K. Leecaster (2007). Multi-Lag cluster enhancement of fixed grid sample designs for estimating the variogram in near coastal systems. *Environmental and Ecological Statistics* **14**: .
- ◆ Gitelman, A.I. and A.T. Herlihy (2007). Isomorphic chain graphs for modeling spatial dependence in ecological data. *Environmental and Ecological Statistics* **14**: .
- ◆ Dailey, M.C., A.I. Gitelman, F.L. Ramsey, and S. Starcevich. Habitat selection models to account for seasonal persistence in radio telemetry data. *Environmental and Ecological Statistics* **14**: .
- ◆ Theobald, D.M. and J.B. Norman (2007). FLoWS (Functional Linkage of Water basins and Streams): ArcGIS tools for network-based analysis of freshwater ecosystems. *HydroLine*, ESRI Press (in press).
- ◆ Francisco-Fernandez, M., M. Jurado-Exposito, J.D. Opsomer, and F. Lopez-Granados (2006). A nonparametric analysis of the distribution of *Convolvulus arvensis* in wheat-

- sunflower rotations. *Environmetrics* **17**:849-860.
- ◆ Ver Hoef, J.M., E.E. Peterson, and D.M. Theobald (2006). Spatial statistical models that use flow and stream distance. *Environmental and Ecological Statistics* **13**: 449-464.
  - ◆ Peterson, E.E. and N.S. Urquhart (2006). Predicting water quality impaired stream segments using landscape-scale data and a regional geostatistical model: A case study in Maryland. *Environmental Monitoring and Assessment* **121**:613-636.
  - ◆ Breidt, F.J., N.-J. Hsu, and W.J. Coar (2006). A diagnostic test for autocorrelation in increment-averaged data with application to soil sampling. To appear in *Environmental and Ecological Statistics* **13**.
  - ◆ Peterson, E.E., A.A. Merton, D.M. Theobald, and N.S. Urquhart (2006). Patterns of spatial autocorrelation in stream water chemistry. *Environmental Monitoring and Assessment* **121**: 569-594.
  - ◆ Thomas, D.E., D.S. Johnson, and B. Griffith (2006). A Bayesian random effects discrete-choice model for resource selection: Population-level selection inference. *Journal of Wildlife Management* **70**: 404-412.
  - ◆ Farnsworth, M.L., J.A. Hoeting, N.T. Hobbs, and M.W. Miller (2006). Linking chronic wasting disease to mule deer movement scales: A hierarchical Bayesian approach. *Ecological Applications* **16**: 1026–1036.
  - ◆ Stevens, Jr. D.L. (2006). Spatial properties of design-based versus model-based approaches to environmental sampling. ACCURACY 2006: Proceedings of the 7th International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences. July 5-7, 2006, Lisbon, Portugal pp 119-125 of 908.
  - ◆ Hoeting, J.A., R.A. Davis, A.A. Merton, and S.E. Thompson (2006). Model selection for geostatistical models. *Ecological Applications* **16**: 87-98.
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- ◆ Theobald, D.M., J.B. Norman, E.E Peterson, and S.B. Ferraz (2005). *FLoWS v1: Functional Linkage of Watersheds and Streams tools for ArcGIS v9*. Natural Resource Ecology Lab, Colorado State University.
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#### **SUBMISSIONS**

- ◆ Irvine, K.M., A.I. Gitelman, and J.A. Hoeting. Spatial designs and strength of spatial signal: effects on covariance estimation. *Journal of Agricultural, Biological and Environmental Statistics* (resubmitted August, 2006).

**MANUSCRIPTS**

- ◆ Irvine, K.M. and A.I. Gitelman. Multi-scale analysis: Implications for modeling presence/absence of species. Under revision.
- ◆ Williams, S.J. and N.S. Urquhart. Comparing a Design-based vs Model-Based Estimator of Variance for Environmental Studies. In preparation for the *Journal of Agricultural, Biological and Environmental Statistics* (July, 2006)
- ◆ Theobald, D.M. and J.B. Norman. 2006. Spatially-balanced sampling using the Reversed randomized Quadrant-Recursive Raster algorithm: A User's Guide for the RRQRR ArcGIS v9 tool. August 2006.
- ◆ Theobald, D.M., J.B. Norman, and D. Merritt (2006). Estimating aquatic fragmentation (in preparation for *Bioscience*).
- ◆ Urquhart, N.S. and M.J.C. Kearsley. Executing a spatially balanced sampling design along the Colorado River in Grand Canyon National Park, AZ (in preparation)
- ◆ Johnson, D.S. and J.A. Hoeting. Bayesian inference for geostatistical regression models. Under revision
- ◆ Opsomer, J.D. and M.G. Ranalli. Estimating nonresponse probabilities with p-splines. Working paper.
- ◆ Jensen, S. and A.I. Gitelman. Fitting graphical models: Some computational consideration. working paper
- ◆ Delorey, M.J. and F.J. Breidt. Spatial ensemble estimates of temporal trends with application to acid neutralizing capacity. working paper - 2006.
- ◆ Theobald, D.M. and S.B. Ferraz. Hydrologic-weighting for functional watershed modeling. *Journal of American Water Resources Association* (in preparation).
- ◆ Theobald, D.M. Catchment areas, not watersheds: Flexible definition of watersheds to understand aquatic resources. (in preparation).
- ◆ Huang, H.-C., N.-J. Hsu, D.M. Theobald, and F.J. Breidt. Spatial Lasso with applications to GIS model selection. In final preparation for submission to the *Journal of Computational and Graphical Statistics*.

**TECHNICAL REPORTS**

- ◆ Theobald, D.M. and J.B. Norman (2006). Spatially-Balanced Sampling Using the Reversed Randomized Quadrant-Recursive Raster Algorithm: A User's Manual for the RRQRR ArcGIS v9 tool. Natural Resource Ecology Lab, Colorado State University, Fort Collins, CO.
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- ◆ Theobald, D.M., J.B. Norman, and M.R. Sherburne (2006). FunConn v1 User's Manual: ArcGIS Tools for Functional Connectivity Modeling. Natural Resource Ecology Lab, Colorado State University. 51 pages.
- ◆ Araas, J.F. (2005). EMAP West Training Presentations. Masters Project Report, Department of Statistics, Colorado State University,
- ◆ Peterson, E.E. (2005). Predicting the Likelihood of Water Quality Impaired Stream Segments Using Landscape-scale Data and a Hierarchical Methodology. Doctoral Dissertation, Department of Geosciences, Colorado State University.
- ◆ Lowe, S., B.E. Thompson, R. Hoenicke, J.E. Leatherbarrow, K. Taberski, R.W. Smith, and D.L. Stevens, Jr. (2005). Re-design Process of the San Francisco Estuary Regional Monitoring Program for Trace Substances (RMP) Status and Trends Monitoring Component for Water and Sediment. Contribution 109, San Francisco Estuary Institute, 7770 Pardee Lane, Oakland, CA 94621.
- ◆ Scarzella, G. (2003). Learning Materials for Surface Water Monitoring. Masters Project Report, Department of Statistics, Colorado State University, Fort Collins. 91pp
- ◆ Johnson, S.W. (2003). Needs Assessment of Tribal Requirements for Instruction in the Use of Statistically-Based Aquatic Water Quality Monitoring Techniques. Water Quality Technology, Inc., Fort Collins, CO. 12pp.

### ***PRESENTATIONS:***

{Note: The first author listed in the citations below gave the presentation, unless subsequent author is marked with an \* as the presenter.}

- ◆ Williams, S.J. A Comparison of Variance Estimates of Stream Network Resources. Seminar, Department of Statistics, Colorado State University, October 20, 2006
- ◆ Urquhart, N.S. Designing Monitoring Surveys Over Time (Panel Surveys): Power, Variance, and Related Topics. Seminar, Department of Statistics, Kansas State University, October 19, 2006
- ◆ Higgs, M.D. Bayesian Models for Ordered Categorical Spatial Data and Categorical Habitat Data. Seminar, Department of Statistics, Colorado State University, September 28, 2006
- ◆ Ritter, K.J., K. Schiff, N.S. Urquhart, D. Olson, A. Groce, and T. Stebbins. Mapping Chemical Contaminants in Oceanic Sediments Around Point Loma's Treated Wastewater Outfall. California and the World Ocean Conference 2006, September 17-20, 2006
- ◆ Pratesi, M., N. Salvati, and M.G. Ranalli. P-splines M-quantile Small Area Estimation: Assessing the Ecological Conditions of Lakes in the Northeastern US. Conference on Spatial Data Methods for Environmental and Ecological processes, Foggia, Italy, September 14-15, 2006
- ◆ Coar, W.J. and F.J. Breidt. Smoothing Through State-Space Models for Stream Networks. North American Benthological Society, Anchorage, Alaska, June 4-9, 2006
- ◆ Irvine, K.M., A.I. Gitelman, and S.E. Thompson. Spatial designs and strength of spatial signal: effects on covariance estimation. Joint Statistical Meetings, Seattle, WA, August 6-10, 2006 (2<sup>nd</sup> place honorable mention in the student paper competition sponsored by the Section on Statistics in the Environment of the American Statistical

Association.)

- ◆ Jennifer Hoeting, a STARMAP Principal Investigator, and Geof Givens presented a short course entitled **Statistical Computing: Techniques for Integration and Optimization** two different places:
  - Alaska Chapter of the American Statistical Association (With R applications, two days), Juneau, AK, July, 2006, and
  - Joint Statistical Meetings (one day), Seattle, WA, August 6-10, 2006
- ◆ Don Stevens and Tony Olsen presented the short course **Spatial Sampling** at the Joint Statistical Meetings, Seattle, WA, August, 6-10, 2006
- ◆ Stevens, Jr. D.L. Spatial Properties of Design-based Versus Model-based Approaches to Environmental Sampling. ACCURACY 2006: The 7th International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences, July 5-7, 2006, Lisbon, Portugal
- ◆ Stevens, Jr. D.L., D.P. Larsen, and A.R. Olsen. Using a Master Sample to Coordinate Monitoring of Multiple Species (Invited). The International Environmetrics Society, June 18-22, 2006, Kalmar, Sweden
- ◆ Hoeting, J.A. presented two talks, Introduction to Bayesian Data Analysis Methods, and An Introduction to WinBUGS, to the PRIMES Workshop on Bayesian Methods in Wildlife Population Monitoring, Colorado State University, Fort Collins, CO, June 14-16, 2006
- ◆ Theobald, D.M. and J.B. Norman. The FLoWS GIS Tools. Workshop on Modeling Salmon Habitat, hosted by the Alaska Department of Fish & Game and The Nature Conservancy, Anchorage, Alaska, May 17-19, 2006
- ◆ Peterson E.E., D.M. Theobald, N.S. Urquhart, J.M. Ver Hoef, and A.A. Merton. Regional GIS-based Geostatistical Models for Stream Networks. Workshop on Modeling Salmon Habitat, hosted by the Alaska Department of Fish & Game and The Nature Conservancy, Anchorage, Alaska, May 17-19, 2006
- ◆ Stevens, Jr. D.L. Importance of Scale, Sampling Design, and Statistics in Effectiveness Monitoring. Workshop on Effectiveness Monitoring, sponsored by the Oregon Watershed Enhancement Board, Corvallis, OR, April 17 - 18, 2006.
- ◆ Breidt, F.J., S.M. Ogle, and K.H. Paustian. Uncertainty Analysis for a US Inventory of Soil Organic Carbon Stock Changes. Workshop on Uncertainty in Ecological Analysis, Mathematical Biosciences Institute, The Ohio State University, Columbus, OH, April 3, 2006
- ◆ Hoeting, J.A. Modeling in the Presence of Uncertainty. Invited discussant for papers by A. Gelfand and J. Breidt. Workshop on Uncertainty in Ecological Analysis, Ohio State University, Columbus, OH, April 2006
- ◆ Stevens, Jr. D.L. Probabilistic Sampling: Can Lessons from Coastal River Systems Be Applied to a Mainstem Species? Workshop in on Monitoring White Sturgeon in the Columbia Basin sponsored by the Columbia Basin Fish and Wildlife Authority, Spokane, WA, March 14-15, 2006
- ◆ Peterson E.E., D.M. Theobald, N.S. Urquhart, J.M. Ver Hoef, and A.A. Merton. Patterns of Spatial Autocorrelation in Stream Water Chemistry. Centre for Riverine Landscapes Seminar Series, Griffith University, Brisbane, Australia. March 4, 2006; Abbreviated

version presented at North American Benthological Society, Anchorage, Alaska, June 4-9, 2006

- ◆ Urquhart, N.S. Designing Surveys over Time (Panel Surveys): Variance, Power and Related Topics. National Park Service, Inventory and Monitoring Program, San Diego, February 10, 2006
- ◆ Araas, J.F. EMAP West Training Presentations. Masters Seminar (Teleconference), Department of Statistics, Colorado State University, December 15, 2005
- ◆ Smith, J.J. Modeling and Predicting Median Substrate Size in Oregon and Washington Streams Utilizing Geographic Information Systems. Masters Seminar, Department of Statistics, Colorado State University, December 6, 2005
- ◆ Peterson, E.E., D.M. Theobald, N.S. Urquhart, J.M. Ver Hoef, and A.A. Merton. Predicting Water Quality Impaired Stream Segments Using Landscape-scale Data and a Regional Geostatistical Model. Statistical Society of Australia, St. Lucia, Queensland, Australia. October 18, 2005
- ◆ Montanari, G.E. and M.G. Ranalli. Nonparametric Methods for Sample Surveys of Environmental Populations. Invited talk, Annual Meeting of the Italian Statistical Society on Statistics and the Environment, September 21-23, 2005, Messina, Italy
- ◆ Larsen, D.P. and N.S. Urquhart. Designs for Estimating Variability Structure and Implications for Detecting Watershed Restoration Effectiveness. American Fisheries Society, Anchorage, AK, September 11-15, 2005
- ◆ Urquhart, N.S. Overview of STARMAP. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Delorey, M.J., F.J. Breidt, and J.D. Opsomer. Nonparametric, Model-Assisted Estimation for a Two-Stage Sampling Design. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7-9, 2005
- ◆ Ranalli, M.G. Acid Neutralizing Capacity CDF Estimation in the Northeastern Lakes Survey: A Nonparametric Model Calibrated Pseudo Empirical Maximum Likelihood Approach. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Wang, H. and M.G. Ranalli. Low-rank Smoothing Splines on Complex Domains: Smoothing Estuaries. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Opsomer, J.D., G. Claeskens, M.G. Ranalli, G. Kauermann, and F.J. Breidt. Small Area Estimation Using Penalized Spline Regression. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Theobald, D.M., J.B. Norman, E.E. Peterson and S.B. Ferraz. Functional Linkage of Watersheds and Streams Using Landscape Networks of Reach Contributing Areas. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Merton, A.A. and E.E. Peterson. Using the Maryland Biological Stream Survey Data to Test Spatial Statistical Models: A Collaborative Approach to Analyzing Stream Network Data. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005

- ◆ Coar, W.J. and F.J. Breidt. State-Space Models for Within-Stream Network Dependence. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Theobald, D.M., J.B. Norman, and D.M. Merritt. Quantifying Fragmentation of Freshwater Systems Using a Measure of Discharge Modification (and Other Applications). Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Breidt, F.J., H.-C. Huang, N.-J. Hsu, and D.M. Theobald. Spatial Lasso with Application to GIS Model Selection. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7-9, 2005
- ◆ Hoeting, J.A. Geostatistical Modeling: Model Selection and Parameter Estimation. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Gitelman, A.I. and K.M. Georgitis. Connecting Correlated Predictors Using Graphical Models. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Davis, R.A., T.C.M. Lee, and G.A. Rodriguez-Yam. Structural Break Detection in Time Series. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Urquhart, N.S. Developments in Trend Detection in Aquatic Surveys. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Hancock, S.A. Developing Learning Materials for Surface Water Monitoring. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Norman, J.B., D.M. Theobald, E.E. Peterson and S.B. Ferraz. Functional Linkage of Watersheds and Streams: ArcGIS FLoWS Tools. Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005
- ◆ Peterson, E.E. Predicting the Likelihood of Water Quality Impaired Stream Segments Using Landscape-scale Data and a Hierarchical Methodology. Doctoral Defense Seminar in Earth Resources, Department of Geosciences, Colorado State University, August 23, 2005
- ◆ Peterson, E.E., A.A. Merton, N.S. Urquhart\*, D.M. Theobald, and J.A. Hoeting. Using the Maryland Biological Stream Survey Data to Test Spatial Statistical Models. Second Maryland Stream Conference, Carroll College, Westminster, MD, August 10 - 13, 2005
- ◆ Gitelman, A.I. Bayesian Network Models to Account for Correlation Across Scales. ESA/INTECOL, Montreal, Canada, August 8, 2005
- ◆ Hoeting, J.A. and G.H. Givens. Computational Statistics: Methods for Optimization and Monte Carlo Integration. Continuing Education Course. Joint Statistical Meetings, Minneapolis, MN, August 7 - 11, 2005
- ◆ Gitelman, A.I. Connecting Correlated GIS Predictors in a Bayes Network Model. WNAR/IMS Meeting, Fairbanks, AK, June 21 - 24, 2005

- ◆ Georgitis, K.M., A.I. Gitelman, and J.A. Hoeting. Estimation and Model Selection for Geostatistical Models. WNAR/IMS Meeting, Fairbanks, AK, June 21 - 24, 2005
- ◆ Johnson, D.S. Bayesian Model Determination for Spatial Regression Data. WNAR/IMS Meeting, Fairbanks, AK, June 21 - 24, 2005
- ◆ Ranalli, M.G., F.J. Breidt, and H. Wang. Low-rank Thin Plate Splines for Unusual Spatial Structures: Smoothing Estuaries and Stream Networks. WNAR/IMS Meeting, Fairbanks, AK, June 21 - 24, 2005
- ◆ Dailey, M.C., A.I. Gitelman, F.L. Ramsey, and S.Starcevich. Habitat Selection Models to Account for Seasonal Persistence in Radio Telemetry Data. 2005 WNAR/IMS Meeting, Fairbanks, AK, June 21 - 24, 2005
- ◆ Breidt, F.J., H.-C. Huang, N.-J. Hsu, and D.M. Theobald. Spatial Lasso with Application to GIS Model Selection. 2005 WNAR/IMS Meeting, Fairbanks, AK, June 21 - 24, 2005
- ◆ Theobald, D.M., B.R. Noon, and A.R. Olsen. Vital Signs Monitoring Sample Design Workshop – Inventory and Monitoring Program, Intermountain Region. Short Course, National Park Service, Lakewood, CO, May 25 - 26, 2005
- ◆ Theobald, D.M. Developing Practical and Efficient Sample Designs for Inventory and Monitoring of Natural Resources Using Spatially-balanced Sampling. University of Redlands and Environmental Systems Research Institute (makers of ArcGIS), Redlands, CA, May 12, 2005 (ESRI is interested in potentially incorporating a spatially-balanced sampling tool in their core GIS product with release v9.3.)
- ◆ French, J. Exploring Spatial Correlation in Rivers. Spring Meeting, Colorado/Wyoming Chapter of the American Statistical Association, Boulder, CO, April 22, 2005;; Seminar, Department of Statistics, Colorado State University, April 4, 2005
- ◆ Urquhart, N.S. Statistics and the Clean Water Act. Spring Meeting, Colorado/Wyoming Chapter of the American Statistical Association, Boulder, CO, April 22, 2005
- ◆ Stevens, Jr. D.L. Statistical Design and Analysis for Environmental Monitoring or Generally Random Thoughts on Statistics. Presentation at a workshop on probabilistic sampling at the State of the Salmon Conference, Anchorage, Alaska, April 17-20, 2005
- ◆ Stevens, Jr. D.L. The Generalized Random Tessellation Stratified Sampling Design for Selecting Spatially-Balanced Samples. Seminar at the CSIRO Marine Research Laboratory, Cleveland, Australia, April 14, 2005
- ◆ Opsomer, J.D., G. Claeskens, M.G. Ranalli, and F.J. Breidt. Small Area Estimation Using Penalized Spline Regression. Invited talk, International Biometric Society, Eastern North American Region meeting, Austin, TX, March 21, 2005.
- ◆ Urquhart, N.S. Statistics as a Profession. Presentations to high school advanced placement classes at Rocky Mountain High School, Fort Collins, CO, March 11, 2005. (two classes),
- ◆ Urquhart, N.S. an Academician's View of EPA's Ecology Program, Especially its Environmental Monitoring and Assessment Program (EMAP). Invited presentation to the Ecological Research Subcommittee of U.S. EPA Board of Scientific Counselors, Research Triangle Park, NC, March 7, 2005
- ◆ Ranalli, M.G., F.J. Breidt, and H. Wang. Low-rank Smoothing Splines on Complex Domains. Seminar, Atlantic Ecology Division, EPA, Narragansett, RI, March 1, 2005
- ◆ Stevens, Jr., D.L. Experimental and Survey Design in Fisheries: A Statistics Workshop.

Annual Meeting, Oregon Chapter of the American Fisheries Society, February 16, 2005

- ◆ Stevens, Jr. D.L. and A.R. Olsen. Local Neighborhood Variance Estimator for GRTS Survey Designs. USEPA WED, Corvallis, OR, November 16, 2004
- ◆ Stevens, Jr., D.L. Environmental Monitoring, Statistics, and the Art of Non-Representation: The Need and Evidence for a Paradigm Shift. Seminar, Department of Mathematical Science, Eastern Oregon State University, La Grande, Oregon, November 4, 2004
- ◆ Stevens, Jr., D.L. The Generalized Random Tessellation Stratified Sampling Design for Selecting Spatially-Balanced Samples. USEPA WED, Corvallis, OR, November 2, 2004
- ◆ Jennifer Hoeting and Geof Givens presented two short courses, based on their book which has since been published, in conjunction with Computational Environmetrics Workshop, Chicago, October 21, 2004 :
  - Methods of Integration for Environmental Problems in Statistics: Quadrature, Monte Carlo Integration and Markov Chain Monte Carlo Methods
  - Optimization Methods for Environmental Problems in Statistics: Numerical Maximum Likelihood, Combinatorial Optimization, EM Algorithm
- ◆ Johnson, D.S. Bayesian Model Determination for Geostatistical Regression Models. Computational Environmetrics Conference, Chicago, IL, October 21-23, 2004
- ◆ Breidt, F.J. Semiparametric Mixed Models for Increment-Averaged Data with Application to Carbon Sequestration in Agricultural Soils. Computational Environmetrics Conference, Chicago, IL, October 21-23, 2004. Also presented at the Fifth Winemiller Symposium: New Developments of Statistical Analysis in Wildlife, Fisheries, and Ecological Research, University of Missouri, Columbia, MO, October 16, 2004
- ◆ Theobald, D.M. Robust Spatial Sampling of Natural Resources Using a GIS Implementation of the GRTS Algorithm. Monitoring Science and Technology Symposium, Denver, CO, September 21-24, 2004
- ◆ Stevens, Jr. D.L. The Generalized Random Tessellation Stratified Sampling Design for Selecting Spatially-Balanced Samples. Monitoring Science and Technology Symposium, Denver, CO, September 21-24, 2004
- ◆ Urquhart, N.S. Anatomy of Sampling Studies of Ecological Responses Through Time. Monitoring Science and Technology Symposium, Denver, CO, September 21-24, 2004
- ◆ Breidt, F.J. Small Area Estimation for Natural Resource Surveys. Monitoring Science and Technology Symposium, Denver, CO, September 21-24, 2004.
- ◆ Delorey, M.J. and F. J. Breidt. Distribution Function Estimation in Small Areas for Aquatic Resources: Spatial Ensemble Estimates of Temporal Trends in Acid Neutralizing Capacity. Monitoring Science and Technology Symposium, Denver, CO, September 21-24, 2004
- ◆ Peterson, E.E., T.M. Theobald, and J.M. Ver Hoef. Ecologically Representative Distance Measures for Spatial Modeling in Stream Networks. Monitoring Science and Technology Symposium, Denver, CO, September 21-24, 2004
- ◆ Merton, A.A., J.A. Hoeting, and R.A. Davis. Model Selection for Geostatistical Models. Monitoring Science and Technology Symposium, Denver, CO, September 21-24,

- 2004; also presented at the Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
- ◆ Harsh, B. Developing Ecosystem Health Monitoring Program for Rivers and Streams in South-East Queensland, Australia. Seminar, Department of Statistics, September 13, 2004
  - ◆ Ritter, K.J., M.K. Leecaster, N.S. Urquhart\*, K.C Schiff, D. Olsen, and T. Stebbins. Multi-Lag Cluster Enhancement of Fixed Grids for Variogram Estimation in Near Coastal Systems. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ Georgitis, K.M. and A.I. Gitelman. Multi-Scale Analysis: Implications for Modeling Presence/Absence of Bird Species. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ Theobald, D.M., J.B. Norman, E.E. Peterson, and S.B. Ferraz. A Framework for Landscape Indicators for Measuring Aquatic Responses. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ Peterson, E.E. Predicting the Likelihood of Water Quality Impaired Stream Reaches Using Landscape Scale Data and a Hierarchical Methodology. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ Jensen, S. A Brief Introduction to Reversible Jump MCMC for Bayesian Networks and an Application. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ Gitelman, A.I. Chain Graphs for Spatial Dependence in Ecological Data. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ Dailey, M.C., A.I. Gitelman, F.L. Ramsey and S. Starceovich. Bayesian Models for Radio Telemetry Habitat Data. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ Merton, A.A., J.A. Hoeting, and R.A. Davis. Model Selection for Geostatistical Models. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ Johnson, D.S. and J.A. Hoeting. State-Space Models for Biological Monitoring Data. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ Breidt, F.J and J.D. Opsomer. Nonparametric Survey Regression Estimation Using Penalized Splines. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ Urquhart, N.S. Overview of the STARMAP Program. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Fort Collins, CO, September 10 - 11, 2004
  - ◆ McKenzie, D. Increasing the Role of Statistics in Water Quality Management Decisions. Third Annual Conference on Statistical Survey Design and Analysis for Aquatic

Resources, Fort Collins, CO, September 10 - 11, 2004

- ◆ Opsomer, J.D. Theory and Methods for Nonparametric Regression Estimators. Seminar on Funding Opportunities in Survey and Statistical Research, Federal Committee on Statistical Methodology, Washington DC, June 21, 2004
- ◆ Davis, R.A., J.A. Hoeting, A.A. Merton, and S. Thompson. Model Selection for Geostatistical Models. Keynote address at the International Biometric Conference, Cairns, Australia, July 11 - 16, 2004
- ◆ Ver Hoef, J.M and E.E. Poston. Some New Spatial Statistical Models for Stream Networks. Graybill Conference, Colorado State University, Fort Collins, CO, June 17 - 18, 2004
- ◆ Ritter, K.J., M.K. Leecaster, and N.S. Urquhart. Two-Phase Sampling Approach for Augmenting Fixed Grid Designs to Improve Local Estimation for Mapping Aquatic Resources. Graybill Conference, Colorado State University, Fort Collins, CO, June 17 - 18, 2004
- ◆ Gitelman, A.I. Chain Graphs for Spatial Dependence in Ecological Data. Graybill Conference, Colorado State University, Fort Collins, CO, June 17 - 18, 2004.
- ◆ Urquhart, N.S. A Statistician Collaborating with Ecologists: from Examples to Lessons Learned. Talk for new participants in the PRIMES program. Colorado State University, Fort Collins, CO June 14, 2004
- ◆ Breidt, F.J. Small Area Estimation for Aquatic Resources. Seminar, Western Ecology Division, Environmental Protection Agency, Corvallis, OR, June 2, 2004
- ◆ Theobald, D.M. FLOWS Software. American Water Resources Association-GIS workshop, Nashville, TN, May 17-19, 2004
- ◆ Theobald D.M. Linking Watersheds and Streams Through Functional Modeling of Watershed Processes. American Water Resources Association Specialty Conference on GIS and Water Resources in May, 2004
- ◆ Hoeting, J.A. and N.S. Urquhart. Space-time Aquatic Resource Modeling and Analysis Program (STARMAP). Science to Achieve Results (STAR) Environmental Research Seminar. EPA Region 8, Denver, CO, May 12, 2004.
- ◆ Ritter, K.J. Two-Phase Sampling Approach for Augmenting Fixed Grid Designs to Improve Local Estimation for Mapping Aquatic Resources. Southern California Academy of Sciences Annual Meeting, California State University, Long Beach May 14 - 15, 2004
- ◆ Urquhart, N.S. A Statistical Perspective on Linking Sections 305(b) and 303(d) of the Clean Water Act. EMAP Symposium 2004, Newport, RI, May 3 - 7, 2004.
- ◆ Breidt, F.J. Linking CWA sections 305(b)/303(d)- small area estimation. EMAP Symposium 2004, Newport, RI, May 3 - 7, 2004.
- ◆ Urquhart, N.S. Statistical Aspects of Collections of Bees to Study Pesticides. "Bee Workshop," prior to the EMAP Conference in Newport, RI, May 3, 2004. Sponsored by EPA's Office of Pollution and Prevention and Toxics.
- ◆ Theobald, D.M. Modeling Functional Landscape Connectivity Using Effective Distance and Graph Theory. International Association of Landscape Ecologists, Las Vegas, NV, April 1, 2004
- ◆ Breidt, F.J., N.-J. Hsu, and S.M. Ogle. A Semiparametric Stochastic Mixed Model for Increment-Averaged Data with Application to Carbon Sequestration in Agricultural Soils. 2004. International Biometric Society, ENAR, Spring Meeting, Pittsburgh, PA

March 29, 2004

- ◆ Urquhart, N.S. Uses of Power in Designing Long-Term Environmental Surveys. Seminar, San Diego Chapter of the American Statistical Association, March 29, 2004.
- ◆ Stevens, Jr. D.L. Sample Design Considerations for Determining Salmonid Population Size & Trends. Pacific Rim Salmon Monitoring and Protocol Review, Welches, OR, March 8-12, 2004
- ◆ Urquhart, N.S. Confusing Concepts in Statistics. **Winter Workshop, 'Stats Anyone?'** Colorado-Wyoming Chapter of the American Statistical Association, Cherry Creek High School, Denver, CO, February 7, 2004. {This was a gathering of high school teachers of advanced placement statistics.
- ◆ Hoeting, J.A, R.A. Davis, A.A. Merton, and S.E. Thompson. Model Selection for Geostatistical Models. Statistics in Ecology Workshop, Jackson Hole, Wyoming, December 4, 2003
- ◆ Urquhart, N.S. Designing Panel Surveys Specifically Relevant to National Parks in the Northwest. Temporal Sampling Workshop, Port Angeles, WA, November 12 - 14, 2003
- ◆ Urquhart, N.S. Metadata: A Legacy for Our Grandchildren. Temporal Sampling Workshop, Port Angeles, WA, November 12 - 14, 2003
- ◆ Scarzella, G. Learning Materials for Surface Water Monitoring. Masters Seminar (Teleconference), Department of Statistics, Colorado State University, November 11, 2003
- ◆ Theobald, D.T. Landscape metrics based on hydrologic networks and hydrologically-weighted distances. Seminar, EPA/NHEERL/WED Lab, Corvallis, OR August 13, 2003
- ◆ Theobald, D.T. Linking Watersheds and Streams Through Functional Landscape Metrics. Second Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources
- ◆ Gitelman, A.I. and S. Jensen. Causal Modeling for Aquatic Resources. Second Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, August 11 - 13, 2003
- ◆ Leecaster, M.K. and K.J. Ritter. Local Enhancement of Global Estimation. Second Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, August 11 - 13, 2003
- ◆ Johnson, D.S. And J.A. Hoeting. Statistical Models for Stream Ecology Data: Random Effects Graphical Models. Second Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, August 11 - 13, 2003
- ◆ Opsomer, J.D., F.J. Breidt, and S. Everson-Stewart. Nonparametric Small Area Estimation for the Northeastern Lakes Survey. Second Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, August 11 - 13, 2003
- ◆ Coar, W.J. , F.J. Breidt, R.A. Davis, and N.S. Urquhart. Predicting the Perennial Status of Western Streams. Second Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, August 11 - 13, 2003
- ◆ Delorey, M.J. and F.J. Breidt. Distribution Function Estimation in Small Areas for Aquatic Resources: Spatial Ensemble Estimates of Temporal Trends in Acid Neutralizing Capacity. Second Annual Conference on Statistical Survey Design and Analysis for

- Aquatic Resources, Corvallis, OR, August 11 - 13, 2003
- ◆ Scarzella, G. Learning Materials For Surface Water Monitoring. Second Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, August 11 - 13, 2003
  - ◆ Urquhart, N.S. The Status of the STARMAP Program at the End of Year 2. Second Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, August 11 - 13, 2003
  - ◆ Theobald, D.M. and M. Kneeland. Hydrologic network metrics based on functional distance and stream discharge. Seminar, Department of Geography, University of Utah. April 18, 2003; also University of Colorado, Boulder, April 23, 2003
  - ◆ Theobald, D.M. and M. Kneeland. Hydrologic network metrics based on stream discharge. US-International Association of Landscape Ecologists Annual meeting, Banff, Alberta. April 3, 2003
  - ◆ Johnson, A.A., F.J. Breidt\*, and J.D. Opsomer. Nonparametric Model-Assisted Estimation of Distribution Functions from Survey Data. Invited talk, Eastern North America Region, International Biometric Society, Tampa, FL, March 30 - April 2, 2003
  - ◆ Johnson, A.A., F.J. Breidt, and J.D. Opsomer. Semiparametric Model-Assisted Estimation of Distribution Functions in Surveys with Auxiliary Information. Eastern North America Region, International Biometric Society, Tampa, FL, March 30 - April 2, 2003
  - ◆ Everson-Stewart, S.P., F.J. Breidt, and J.D. Opsomer. Nonparametric Survey Regression Estimation in Two-Stage Spatial Sampling. Eastern North America Region, International Biometric Society, Tampa, FL, March 30 - April 2, 2003
  - ◆ Urquhart, N.S. A Few Thoughts on Monitoring Studies for the Colorado River in the Grand Canyon. Technical Work Group, Glen Canyon Adaptive Management Plan, Meeting. Phoenix, AZ, February 27, 2003
  - ◆ Urquhart, N.S. Selection of Water Quality Monitoring Sites and Colorado State University's STARMAP. National Water Quality Monitoring Council, Phoenix, AZ, December 11, 2002
  - ◆ Urquhart, N.S. Metadata: A legacy for Our Grandchildren. All EaGLes Meeting, Annapolis, MD, December 4 - 6, 2002
  - ◆ Urquhart, N.S. Case Study 6: Indicators of Marsh Maintenance of Elevation; submitted by Chuck Hopkinson, ACE INC. ALL EaGLes Meeting, Annapolis, MD, December 4 - 6, 2002
  - ◆ Leecaster, M.K., J.A. Hoeting, and K.J. Ritter. Optimal Lattice and Geostatistical Sample Designs for EMAP. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002
  - ◆ Kellum, B., J.A. Hoeting, and N.S. Urquhart. Predicting Acid Neutralizing Capacity. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002
  - ◆ Johnson, D.S. and J.A. Hoeting. Composition Models for Benthic Invertebrate Data. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002

- ◆ Breidt, F.J. and J.D. Opsomer. Local Inferences via Nonparametric Model-Assisted Methods. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002
- ◆ Everson-Stewart, S. Nonparametric Survey Regression Estimation in Two-Stage Spatial Sampling. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002
- ◆ Johnson, A.A., F.J. Breidt, and J.D. Opsomer. Estimating Distribution Functions from Survey Data Using Nonparametric Regression. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002
- ◆ Delorey, M.J. Semiparametric Mixed Models in Small Area Estimation. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002
- ◆ Theobald, D.M. Developing GIS Indicators and Metrics. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002
- ◆ Ritter, K.J., D. Birkes, and N.S. Urquhart. Quantifying Taxonomic Richness in Terms of the Level of Rarity Assessed by a Fixed Count. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002
- ◆ Johnson, S.V. Evaluation of Tribal Needs: A Preliminary Report. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002
- ◆ Gitelman, A.I. Causal Modeling of Benthic Invertebrate Data. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 20, 2002
- ◆ Urquhart, N.S. STARMAP: The Program at Colorado State University. The STARMAP Outreach Project. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 20, 2002
- ◆ Hoeting, J.A. Methodology for Bayesian Model Averaging. Invited session at International Biometrics Conference, Freiburg, Germany, July 2002
- ◆ Hoeting, J.A. Autoregressive Models for Capture-Recapture Data. Invited session at WNAR/IMS meetings, Los Angeles, June 2002
- ◆ Urquhart, N.S. Possible Lessons for CEER-GOM from EMAP. All-Hands Conference, Consortium for Estuarine Ecoindicators Research for the Gulf of Mexico, Ocean Springs, MS, March 26, 2002
- ◆ Gitelman, A.I., Preliminary Results on Causal Modeling and Bayes Networks. Seminar. WED/NHEERL/EPA, Corvallis, OR, March 14, 2002
- ◆ Urquhart, N.S. A New Program At CSU Applying Spatial and Temporal Modeling of Statistical Surveys to Aquatic Resources. Seminar, Department of Statistics, Colorado State University, December 3, 2001
- ◆ Urquhart, N.S. The STARMAP Program at Colorado State University. US EPA Laboratory at Las Vegas, NV, November 19, 2001 ; repeated at EPA Region 8, Denver, CO, May

13, 2002

**POSTERS**

- ◆ Theobald, D.M., J.B. Norman, E.E. Peterson, and S.B. Ferraz. Functional Linkage of Watersheds and Streams (FLoWS): Network-based ArcGIS Tools to Analyze Freshwater Ecosystems. Poster displayed at the Maryland Stream Conference, Carroll College, Westminster, MD, August 10 - 13, 2005 and at the Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7-9, 2005.
- ◆ French, J. and N.S. Urquhart. Review of Geostatistics in Aquatic Systems. Poster displayed at the Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7 - 9, 2005.
- ◆ Peterson, E.E. and N.S. Urquhart. Predicting Water Quality Impaired Stream Segments Using Landscape-scale Data and a Regional Geostatistical Model: A Case Study in Maryland. Displayed at the Second Maryland Stream Symposium, Westminster, MD, August 10 - 13, 2005 and Fourth Annual Conference on Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, September 7-9, 2005.
- ◆ Olsen, A.R., N.S. Urquhart, and D.L. Stevens, Jr. EMAP Monitoring Design and Design Team. Displayed at the Ecological Research Subcommittee of U.S. EPA Board of Scientific Counselors, Research Triangle Park, NC, March 8, 2005.
- ◆ Francisco-Fernandez, M. M. Jurado-Exposito, J.D. Opsomer, and F. Lopez-granados. A Nonparametric Analysis of the Distribution of *Convolvulus Arvensis* in Wheat-Sunflower Rotations. Poster, Computational Environmetrics Conference, Chicago, IL, October 21-23, 2004.
- ◆ Coar, W.J. and F.J. Breidt. Sampling Perennial Streams: An Application in Model Based Optimal Design. Displayed at the Third Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 10 - 11, 2004.
- ◆ Dailey, M.C. and A.I. Gitelman, F.L. Ramsey. Hierarchical Bayesian Models for Seasonal Radio Telemetry Habitat Data. Displayed at the Graybill Conference, Colorado State University, June 16 - 18, 2004, The International Environmetrics Conference, Portland, ME, June 28 - July 1, 2004, and the Third Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 10 - 11, 2004.
- ◆ Delorey, M.J. and F.J. Breidt. Distribution Function Estimation in Small Areas for Aquatic Resources. Displayed at the Graybill Conference, Colorado State University, Fort Collins, CO, June 17 - 18, 2004, and Third Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 10 - 11, 2004.
- ◆ Delorey, M.J. and F.J. Breidt. Nonparametric, Model-Assisted Estimation for a Two-Stage Sampling Design. Displayed at the Third Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 10 - 11, 2004.
- ◆ Georgitis, K., A.I. Gitelman, D.L. Stevens, Jr., N.P. Danz, and J.M. Hanowski. What Is a

Multi-scale Analysis? Implications for Modeling Presence/Absence of Bird Species. Displayed at The International Environmetrics Conference, Portland, ME, June 28 - July 1, 2004, and at the Third Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 10 - 11, 2004.

- ◆ Peterson, E.E., D.M. Theobald, M.J. Laituri, and N.S. Urquhart. Predicting the Likelihood of Water Quality Impaired Stream Reaches Using Landscape Scale Data and a Hierarchical Methodology: A Case Study in the Southern Rocky Mountains. Displayed at the American Water Resources Association GIS Specialty Conference, Nashville, TN, May 17-19, 2004 ; related posters displayed the Second Annual Conference: Statistical Survey Design and Analysis for Aquatic Resources, Corvallis, OR, August 11 - 13, 2003, and the Third Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 10 - 11, 2004.
- ◆ Urquhart, N.S. and G. Scarzella. Learning Materials for Surface Water Monitoring. Displayed at the EMAP Symposium 2004, Newport, RI, May 4 - 7, 2004, and at the Third Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 10 - 11, 2004.
- ◆ Breidt, F.J., S. Everson-Stewart, A.A. Johnson, and J.-D. Opsomer. Applications of Nonparametric Survey Regression Estimation in Aquatic Resources. Second Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Oregon State University, Corvallis, OR, August 11 - 13, 2003.
- ◆ Kellum, B.R., J.A. Hoeting, and N.S. Urquhart. Analysis and Modeling of Acid Neutralizing Capacity in the Mid-Atlantic Highlands Area. Second Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Oregon State University, Corvallis, OR, August 11 - 13, 2003.
- ◆ Kneeland, M. and D.M. Theobald. Assessment of a Semi-automated Catchment Delineation and Flow Accumulation Method. Second Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Oregon State University, Corvallis, OR, August 11 - 13, 2003.
- ◆ Jensen, S. and A.I. Gitelman. Bayesian Belief Networks: Computational Considerations for the Environmental Researcher. Second Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Oregon State University, Corvallis, OR, August 11 - 13, 2003.
- ◆ Kneeland, M. and D.M. Theobald. Linking Watersheds to Streams: Using a Direct Measure of Flow to Model Hydrological Networks. Poster. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002.
- ◆ Kneeland, M. and N.S. Urquhart. Statistical Survey Design and Analysis for Aquatic Resources: External Collaborators of the CSU and OSU Programs. Poster. First Annual Conference on Statistical Survey Design and Analysis For Aquatic Resources, Colorado State University, Fort Collins, CO, September 21, 2002.
- ◆ Kearsley, M.J.C. and N.S. Urquhart (2002). Design and Implementation of Riparian Vegetation Monitoring Along the Colorado River in Grand Canyon. Poster.

STARMAP/DAMARS Project 4: Outreach and Extension

Ecological Society of America, Tucson, AZ, August 5, 2002.

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