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The International ENVIRONMETRICS Society - TIES

TIES 2011, Third North American Regional Meeting

The International Environmetrics Society's Third North American Regional Meeting

Quantitative Methods for the Analysis of Long-Term Monitoring Data

July 18–20, 2011

Radisson Hotel–La Crosse
La Crosse, Wisconsin

Invited sessions

- Statistical models for the analysis of binary matrices in ecological problems
- Integrative statistical methods for design and analysis of long-term ecological monitoring efforts
- Bridging the gap: Linking models to management in long-term monitoring programs
- Statistical problems in past, present and future climate studies
- Forest inventory and monitoring using time series of ground and remotely sensed data
- Temporal trend estimation using bird survey data
- Statistical issues in long term natural resources monitoring survey
- Space-time modeling of environmental and ecological monitoring data

Technical topics

- Air quality monitoring and assessment
- Analysis of extremes
- Assessing status and trends
- Design-adjusted models
- Ecological, natural resource and environmental monitoring
- Ecological, natural resource and environmental risk assessment
- Energy and the environment
- Environmental epidemiology
- Environmental standards
- Environmetrics in meteorology and climatology
- Model-assisted survey methods
- Modelling and managing ecological and environmental systems
- National ecological, natural resource and environmental statistics
- Network design and efficient data collection
- Nonparametric methods
- Space-time modelling
- Water quality monitoring and assessment

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Important Dates

Date	Schedule
March 1	Abstract submission opens
April 11	Registration open
May 31	Deadline for submission of abstracts to appear in the conference Program
June 8	Final abstract acceptance notifications mailed
June 10	Early registration closes
June 30	Final conference program available
July 18	Conference begins
July 20	Conference closes

Schedule Overview

Date	Schedule
July 18 (afternoon only)	Presentations and welcome reception (with poster session)
July 19	Presentations and conference banquet
July 20	Presentations (conference closes at 5 p.m.)

The International ENVIRONMETRICS Society - TIES

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Committees:

Program committee

Sylvia Esterby, University of British Columbia
Brian Gray, US Geological Survey
Ron McRoberts, US Forest Service
Wayne Thogmartin, US Geological Survey
Dale Zimmerman, University of Iowa

Local organizing committee

Brian Gray, US Geological Survey
Andrea Hansen, University of Wisconsin-La Crosse
Patrick McKann, US Geological Survey
Wayne Thogmartin, U.S. Geological Survey

The International ENVIRONMETRICS Society - TIES

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Contact:

Brian Gray
US Geological Survey
Upper Midwest Environmental Sciences Center
La Crosse, WI 54603
ties.na2011@environmetrics.org

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TIES Homepage:

The International Environmetrics Society (TIES) is a non-profit organization aimed to foster the development and use of statistical and other quantitative methods in the environmental sciences, environmental engineering and environmental monitoring and protection. To this end, the Society promotes the participation of statisticians, mathematicians, scientists and engineers in the solution of environmental problems and emphasizes the need for collaboration and for clear communication between individuals from different disciplines and between researchers and practitioners. The Society further promotes these objectives by conducting meetings and producing publications, and by encouraging a broad membership of statisticians, mathematicians, engineers, scientists and others interested in furthering the role of statistical and mathematical techniques in service to the environment. In 2008, TIES became one of the sections of the International Statistical Institute (ISI).

Visit http://environmetrics.org/ for more information on The International Environmetrics Society.

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Call for Abstracts:

Abstracts are still being accepted but for poster presentations only.

Submit Abstract

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Scientific Program:

The final scientific program and book of abstracts, with addendum, are available.

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Invited Sessions

- **Statistical models for the analysis of binary matrices in ecological problems**
  Organizer: Robert M. Dorazio, U.S. Geological Survey and University of Florida

  Inference in food Webs based on maximum likelihood and Bayesian approaches
  Stefano Allesina, The University of Chicago, Chicago

  Estimating abundance-based patterns of species co-occurrence using phylogenetic data and spatial covariates
  Robert M. Dorazio, U.S. Geological Survey and University of Florida; Edward F. Connor, San Francisco State University

  Horse racing and the assembly of ecological communities: a novel application of the Plackett-Luce model to biology
  Joshua Ladau, Gladstone Institutes, GICD; Edward F. Connor, San Francisco State University

- **Integrative statistical methods for design and analysis of long-term ecological monitoring efforts**
  Organizer: Robert A. Gitzen, University of Missouri

  Integrating and applying quantitative recommendations about ecological monitoring
  Robert A. Gitzen, The University of Missouri, Missouri

  Model-based monitoring of spatio-temporal ecological processes
  Mevin Hooten, U.S. Geological Survey and Colorado State University

  National Aquatic Resource Surveys: Multiple objectives leading to design complexity
  Anthony R. Olsen and Thomas A. Kincaid, USEPA NHEERL Western Ecology Division

  Integrating drivers and responses in causal networks using structural equation modeling
  Jim Grace, U.S. Geological Survey

- **Bridging the gap: Linking models to management in long-term monitoring programs**
  Organizer: Kathryn M. Irvine, Montana State University

  Introduction
  Kathryn M. Irvine, Montana State University

  Building a Bridge to Management: Making science count in management decision making
  Melinda Knutson, U.S. Fish and Wildlife Service

  The curious case of camas: Lessons learned from an edible lily
  Thomas Rodhouse, U.S. National Park Service

  Translation: Bridging the gap between research questions and statistical inference
  Megan Higgs, Montana State University

- **Statistical problems in past, present and future climate studies**
  Organizer: Bo Li, Purdue University

  The Reliability of Multiproxy Global Temperature Reconstructions
  Blake McShane, Northwestern University

  Spatial ANOVA Modeling of High-resolution Regional Climate Model Outputs from NARCCAP

Emily Kang, Statistical and Applied Mathematical Sciences Institute (SAMSI)

Paleoclimate reconstruction using long-memory processes
Luis Barboza, Purdue University

Title pending
Pamela Matin, University of Chicago

- **Forest inventory and monitoring using time series of ground and remotely sensed data**
  Organizer: Ron McRoberts, U.S. Forest Service

Modeling a spatially explicit time series of woody biomass
Mark D. Nelson, U.S. Forest Service; Ronald E. McRoberts, U.S. Forest Service; Kirk M. Stueve, U.S. Forest Service; Sean P. Healey, Rocky Mountain Research Station, U.S. Forest Service

Modeling the impact of drought on tree mortality using national forest inventory data
Greg C. Liknes, U.S. Forest Service; Patrick L. Zimmerman, U.S. Forest Service; Charles H. Perry, U.S. Forest Service; Christopher W. Woodall, U.S. Forest Service

Approaches to remote sensing-based change detection
Ronald E. McRoberts, U.S. Forest Service; Lisa G. Mahal, University of Nevada, Las Vegas

- **Temporal trend estimation using bird survey data**
  Organizer: John Sauer, USGS Patuxent Wildlife Research Center

Model selection in hierarchical models of population change
William A. Link, US Geological Survey

Estimating population change of Mottled Duck from multiple-platform surveys
Mark C. Otto, US Fish and Wildlife Service

Estimating population change from the Breeding Bird Survey using open population N-mixture models
Richard Chandler, US Geological Survey

Black duck population change in eastern North America: Estimation using information from several surveys
John R. Sauer, US Geological Survey

- **Statistical issues in long term natural resources monitoring survey**
  Organizer: Zhengyuan Zhu, Iowa State

The National Resources Inventory: design and estimation for creating a longitudinal database
Sarah Nusser, Iowa State University

A measurement study in a longitudinal survey with errors-in-variables
Cindy Yu, Iowa State University

Calibration of soil erosion estimates under new protocols
Zhengyuan Zhu, Iowa State University

Using the national resources inventory to analyze trends in resource condition
Jeff Goebel, U.S. Department of Agriculture

- **Space-time modeling of environmental and ecological monitoring data**
  Organizer: Dale Zimmerman, University of Iowa

A closer look at plant dynamics using the centered autologistic model
Petrutza Caragea, Iowa State University

A continuous-time proportional hazards model for spatial-temporal ecological monitoring data
Jun Zhu, University of Wisconsin

A hierarchical multi-scale downscaling approach for evaluating the response of endangered fish populations to climate change
Chris Wikle, University of Missouri

Combining satellite images and weather data to back-predict vegetation indices
Kate Cowles, University of Iowa

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Posters:

Please see the list of technical topics for the conference. Posters on these and any aspect of environmental, natural resource and spatial assessments will be considered. We also encourage posters that give an overview of ongoing, finalized or future research programs and projects.

Instructions for Presenters

Poster dimensions should be between A1 and A0 (A1 is 594 mm x 841 mm; A0 is 841 mm x1189 mm).

Submission of abstracts for posters follows that under Abstracts.

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Welcome Reception

Please join us for a welcome reception during the evening of **Monday, July 18** at 6 p.m. at the Radisson Hotel in La Crosse. On-site registration will be open prior to the reception. Buses to the University of La Crosse campus will be available after the event for those staying in UW-L dormitories.

Conference Banquet

The conference banquet will occur the evening of **Tuesday, July 19** on a paddlewheel cruiser. Attendees will spend 2 hours enjoying the scenery of the Upper Mississippi River. Buses to the University of La Crosse campus will be available after the event for those staying in UW-L dormitories.

Upper Midwest Environmental Sciences Center Tour

A tour of the Center will be offered on **Wednesday, July 20** at 6 p.m. Located on an island in the Mississippi River, the Center is a leading research center conducting ecological research to support the Department of the Interior's and other local, state and federal resource agencies management of natural resources, fish, and wildlife. Participants are invited to sign up for this tour at the conference registration table. A shuttle bus is provided. www.umesc.usgs.gov

Mississippi Explorer 1-1/2 Hour Wildlife Eco-Tour

If you are in town on Sunday or Thursday mornings, you can take advantage of regularly-scheduled wildlife tours on the Mississippi River; these cruises leave at 10:30 a.m. If interested, call 877.647.7397 for reservations and information (www.mississippiexplorer.com/ports/port-la-crosse.php).

Those interested in sightseeing, fishing, bicycling or backpacking in the La Crosse area may find further information at the La Crosse Area Convention & Visitors Bureau.

The International ENVIRONMETRICS Society - TIES

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Registration:

Registration Fees and Student Fees:

Registration fee includes admission to all talks, conference program and abstract book, on-site continental breakfast and lunch on July 19 and 20, morning and afternoon coffee breaks, conference banquet on Tuesday, July 19 and admission to the welcome reception on Monday, July 18.

On or Before June 10, 2011

- $225.00 TIES member fee
- $260.00 New TIES Member[1], developed country fee
- $225.00 New TIES Member[1], developing country fee
  (For listing of developing countries, please visit http://isi-web.org/developing)
- $290.00 Non-TIES member fee
- $120.00 Full-time student fee[2]

After June 10, 2011

- $260.00 TIES member fee
- $295.00 New TIES Member[1], developed country fee
- $260.00 New TIES Member[1], developing country fee
  (For listing of developing countries, please visit http://isi-web.org/developing)
- $325.00 Non-TIES member fee
- $135.00 Full-time student fee[2]

Footnotes:

[1]Registration fee includes TIES membership for the remainder of 2011 and for 2012. The 2011 rate for regular membership is €25 or €8 developing countries.

[2]All students become TIES members automatically. The International Environmetrics Society offers students membership free of charge.

Conference Cancellation Policy: Full refund less $50 processing fee before July 11, 2011. No refunds on or after July 11. Substitutions will be accepted.

Registration implies permission for photos, publicity & inclusion in a participant list unless Continuing Education and Extension is notified in writing prior to the event.

The International ENVIRONMETRICS Society - TIES

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Registration Form:

The registration for TIES 2011 is preferably done by filling out the online registration form. You will be asked to provide:

- Your name and title
- Your affiliation - institution, department, address, telephone, fax, e-mail
- Presentation type - no presentation/oral/poster

Full-time students are asked to provide additional information:

- Supervisor's name and e-mail
- Expected date of thesis submission
- Presentation title (if applicable)

A letter confirming student status may be submitted by the student or supervisor. May be mailed or e-mailed to address below.

If the online submission form does not work for you, please submit printable form by regular mail or e-mail:

Continuing Education and Extension
University of Wisconsin-La Crosse
1725 State St., 205 Morris Hall
La Crosse, WI 54601
608.785.6504 or toll-free 1.866.895.9233
continuinged@uwlax.edu

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Venue:

The conference will be held at the **Radisson Hotel, 608.784.6680,** 200 Harborview Plaza, La Crosse, Wis.

The Radisson Hotel is located in historic downtown La Crosse and within easy walking distance of Riverside Park and downtown restaurants. It also overlooks the scenic Mississippi River.

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La Crosse Area:

La Crosse is a community of approximately 50,000 located in western Wisconsin on the Mississippi River, and nestled between majestic bluffs. Scenic bluffs, valleys ("coulees"), woods and streams surround the city, making it a favorite stop for boaters and campers in the spring, summer and fall, and skiers and snowmobilers in the winter. La Crosse is a river town, with all the charm and romance of the steamboat era.

For additional information on the La Crosse area including restaurants and attractions, go to www.explorelacrosse.com.

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The International ENVIRONMETRICS Society - TIES

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Accommodation

Accommodation is available at the conference site, the Radisson Hotel, and at dormitories at the nearby University of Wisconsin-La Crosse.

Radisson Hotel:

Radisson Hotel, 608.784.6680, 200 Harborview Plaza, La Crosse, Wis.

The Radisson Hotel is located on the Mississippi River in downtown La Crosse, Wisconsin. The downtown area offers many unique shops and quality restaurants, all within walking distance of the Radisson Hotel.

Radisson Hotel Room Rates:

- $70 single/queen bed(per night)
- $100 double or single/two queen beds(per night)
- $110 triple (per night)
- $120 quad (per night)

Rates do not include 13.5% occupancy tax. The Radisson Hotel provides a complimentary airport shuttle.

Reservation cut-off date is **June 17, 2011**. Please reference "TIES 2011 Conference" when making your reservation. Please call **608.784.6680** to make reservations.

Amenities:

- Complimentary high speed in-room internet access with 24 hour tech support
- Complimentary airport shuttle
- Complimentary pool and fitness center

Dormitory rooms, University of Wisconsin-La Crosse:

Conference participants also have the option to stay in the UW-La Crosse Reuter Hall. Each suite has four individually locked bedrooms, a kitchen, living room and shared bathroom. The rooms are air-conditioned.

UW-La Crosse Reuter Hall Rate:

- $38 per night/per person, includes blanket, sheets, pillow, pillowcase and internet access (Towel package available for purchase at time of Reuter Hall check-in or bring your own.)

Dormitory rooms are private, with shared bathroom facilities. Internet access and morning and evening shuttles to and from the conference are complimentary. UW-La Crosse is within walking and bicycling distance of hiking and biking trails in
La Crosse's Myrick-Hixon Marsh and Hixon Experimental Forest.

Dormitory reservations may be made during registration, or by calling UW-La Crosse Continuing Education at 608.785.6504.

La Crosse has an airport serviced by American and Northwest/Delta airlines. An Amtrak is also available.

The International ENVIRONMETRICS Society - TIES

BOOK OF ABSTRACTS

TIES 2011 – The 3rd North American Regional Meeting of The International Environmetrics Society

July 18-20, 2011

Radisson Hotel, La Crosse, Wisconsin

Program committee

Sylvia Esterby, University of British Columbia
Brian Gray, U.S. Geological Survey
Ron McRoberts, U.S. Forest Service
Wayne Thogmartin, U.S. Geological Survey
Dale Zimmerman, University of Iowa

Local organizing committee

Brian Gray, U.S. Geological Survey
Andrea Hansen, University of Wisconsin-La Crosse
Patrick McKann, U.S. Geological Survey
Wayne Thogmartin, U.S. Geological Survey

Final Program

3rd North American Regional Meeting, TIES 2011
Radisson Hotel, La Crosse, Wisconsin

July 18-20, 2011

Monday

12:00 – 13:00 Registration

13:00 - 13:15 Opening comments

13:15 - 14:45 **Statistical Problems in Past, Present and Future Climate Studies**
Chair and Organizer: Bo Li, Purdue University

The Reliability of Multiproxy Global Temperature Reconstructions
Blake McShane, Northwestern University

Spatial ANOVA Modeling of High-resolution Regional Climate Model Outputs from NARCCAP
Emily Kang, Statistical and Applied Mathematical Sciences Institute (SAMSI)

Paleoclimate Reconstruction Using Long-Memory Processes
Luis Barboza, Purdue University

14:45 - 15:15 Break

15:15 - 16:45 **Statistical Models for the Analysis of Binary Matrices in Ecological Problems**
Chair and Organizer: Robert M. Dorazio, U.S. Geological Survey and University of Florida

Inference in Food Webs Based on Maximum Likelihood and Bayesian Approaches
Stefano Allesina, The University of Chicago, Chicago

Estimating Abundance-Based Patterns of Species Co-occurrence Using Phylogenetic Data and Spatial Covariates
Robert M. Dorazio, U.S. Geological Survey and University of Florida; Edward F. Connor, San Francisco State University

Horse Racing and the Assembly of Ecological Communities: A Novel Application of the Plackett-Luce Model to Biology
Joshua Ladau, Gladstone Institutes, GICD; Edward F. Connor, San Francisco State University

18:00 - 20:00 Welcome Reception and Poster Presentations, Radisson Ballroom A

Tuesday

7:00 – 8:00 Breakfast

8:00 – 10:00 **Temporal Trend Estimation Using Bird Survey Data**
Chair and Organizer: John Sauer, USGS Patuxent Wildlife Research Center

Black Duck **Population Change in Eastern North America: Estimation Using Information from Several Surveys**
John R. Sauer, US Geological Survey

Estimating **Population Change of Mottled Duck from Multiple-Platform Surveys**
Mark C. Otto, US Fish and Wildlife Service

Estimating **P**opulation **Change from the Breeding Bird Survey Using Open Population N-Mixture Models**
Richard Chandler, US Geological Survey

Controlling for Detectability in Count Survey Data: a Comparison of Approaches
William A. Link, US Geological Survey

10:00 - 10:30 Break

10:30 - 12:00 **Forest Inventory and Monitoring Using Time Series of Ground and Remotely Sensed Data**
Chair and Organizer: Ron McRoberts, U.S. Forest Service

Modeling **a** Spatially **Explicit Time Series of Woody Biomass**
Mark D. Nelson, U.S. Forest Service; Ronald E. McRoberts, U.S. Forest Service; Kirk M. Stueve, U.S. Forest Service; Sean P. Healey, Rocky Mountain Research Station,U.S. Forest Service

Modeling the Impact of Drought on Tree Mortality Using National Forest Inventory Data
Greg C. Liknes, U.S. Forest Service; Patrick L. Zimmerman, U.S. Forest Service;Charles H. Perry, U.S. Forest Service; Christopher W. Woodall, U.S. Forest Service

Approaches to Remote Sensing-Based Change Detection
Ronald E. McRoberts, U.S. Forest Service; Lisa G. Mahal, University of Nevada, Las Vegas

12:00 - 13:15 Lunch (provided)

13:15 - 15:15 **Integrative Statistical Methods for Design and Analysis of Long-Term Ecological Monitoring Efforts**
Chair **and Organizer: Robert A. Gitzen, University of Missouri**

Integrating and Applying Quantitative Recommendations about Ecological Monitoring
Robert A. Gitzen, Department of Fisheries and Wildlife Sciences, The University of Missouri, Missouri

Model**-Based Monitoring of Spatio-Temporal Ecological Processes**
Mevin Hooten, U.S. Geological Survey and Colorado State University

National **Aquatic Resource Surveys: Multiple Objectives Leading to Design Complexity**
Anthony R. Olsen and Thomas A. Kincaid, USEPA NHEERL Western Ecology Division

Integrating **Drivers and Responses in Causal Networks Using Structural Equation Modeling**
Jim Grace, U.S. Geological Survey, National Wetlands Research Center

15:15 - 15:45 Break

15:45 - 17:05	**Statistical Methods for Spatial Data** Chair: Megan Higgs, Montana State University
Ballroom A	Modeling the Presence and Absence of Fish in a Stream Network *Margaret Short, University of Alaska Fairbanks* **Investigating** the relationship between spatial autocovariance function range parameters and patch sizes in ecological landscapes *Nicholas A. Som, Department of Forest Ecosystems and Society, Oregon State University; Kathryn, M. Irvine, Northern Rocky Mountain Science Center, US Geological Survey; Lisa M. Ganio, Department of Forest Ecosystems and Society, Oregon State University* Filtered Kriging for Spatial Data with Heterogeneous Measurement Error Variances *William F. Christensen, Brigham Young University* A Bayesian Hierarchical Occupancy Model for Track Surveys Conducted in a Series of Linear, Spatially Correlated, Sites *John Fieberg, Minnesota Department of Natural Resources; Bob Dobrow, Department of Mathematics, Carlton College; Chrisna Aing, Department of Mathematics, Carlton College; Sarah Halls, Department of Mathematics, Carlton College; Kiva Oken, Department of Mathematics, Carlton College*
15:45 – 17:05	**Statistical Methods for Monitoring Data** Chair: Patrick Zimmerman, US Forest Service
Ballroom B	Incorporating Random Effects into Classification and Regression Trees for Modeling Presence/Absence of a Species *Mark McKelvey, Iowa State University; Philip Dixon, Iowa State University* Estimating Variance Components and Variance Partition Coefficients on the Inverse Link Scale Using Estimates from Generalized Linear Mixed Models *Brian Gray, US Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI, USA; Sherwin Toribio, Mathematics Department, University of Wisconsin – La Crosse, La Crosse, WI, USA* Estimating Change in Species Richness from Repeated Sampling of Incidence Data *Steen Magnussen, Canadian Forest Service, Natural Resources Canada* Prediction and Discrimination for Post-Fire Tree Mortality in the Western United States *Lisa M. Ganio, Oregon State University; Travis J. Woolley, Oregon State University; Robert A. Progar, USDA Forest Service, Pacific Northwest Research Station; Matthew J. Rinella, USDA Agricultural Research Service, Fort Keogh LARRL; David C. Shaw, Oregon State University*
17:30	Gather at the Gift Shop of the La Crosse Queen, Riverside Park
17:45	Boarding of the La Crosse Queen
18:00 - 20:00	Banquet Dinner Cruise, La Crosse Queen departs

Wednesday	
7:00 – 8:00	Breakfast
8:00 - 9:30	**Statistical Issues in Long Term Natural Resources Monitoring Survey** Chair and **Organizer**: Zhengyuan Zhu, Iowa State
	The Natural Resources Inventory: Design and Estimation for Creating a Longitudinal Database *Sarah Nusser, Iowa State University* **A Measurement Study in a Longitudinal Survey with Errors-in-Variables** *Cindy Yu, Iowa State University* **Calibration of Soil Erosion Estimates Under New Protocols** *Zhengyuan Zhu, Iowa State University* **Using the National Resources Inventory to Analyze Trends in Resource Condition** *Jeff Goebel, U.S. Department of Agriculture*
9:30 - 10:00	Break
10:00 - 12:00	**Space-Time Modeling of Environmental and Ecological Monitoring Data** Chair and Organizer: Dale Zimmerman, University of Iowa
	A Closer Look at Plant Dynamics Using the Centered Autologistic Model *Petrutza Caragea, Iowa State University* **A Continuous-Time Proportional Hazards Model for Spatial-Temporal Ecological Monitoring Data** *Jun Zhu, University of Wisconsin* **A Hierarchical Multi-Scale Downscaling Approach for Evaluating the Response of Endangered Fish Populations to Climate Change** *Chris Wikle, University of Missouri* Combining Satellite I**mages** and Weather Data to Back-Predict Vegetation Indices *Kate Cowles, University of Iowa*
12:00 - 13:15	Lunch (provided)
13:15 - 14:45	**Bridging the gap: Linking Models to Management in Long-Term Monitoring Programs** Chair and Organizer: Kathryn M. Irvine, Montana State University
	Building a Bridge to Management: Making Science Count in Management Decision Making *Melinda Knutson, U.S. Fish and Wildlife Service* The Curious Case of Camas: Lessons Learned from an Edible Lily *Thomas Rodhouse, U.S. National Park Service* Translation: Bridging the Gap Between Research Questions and Statistical Inference *Megan Higgs, Montana State University*
14:45	Closing Comments
15:15 – 17:00	Bus departs for Tour of the US Geological Survey's Upper Midwest Environmental Sciences Center (Optional)

POSTERS

Spatio-Temporal Modeling of Long-Term Trends in the Marine Macrofaunal Community of Port Valdez, Alaska

Arny Blanchard, Institute of Marine Science, University of Alaska Fairbanks

Space-Time Modeling of the Diurnal Behavior of the Atmospheric Hydrologic Cycle

Jonathan Hobbs, Iowa State University

Using Graphical Models to Incorporate Empirical Evidence into the Evaluation of Long-Term Monitoring Efforts

Kathryn M. Irvine, US Geological Survey, Northern Rocky Mountain Science Center; Robert K. Al-Chokhachy, US Geological Survey, Northern Rocky Mountain Science Center; Eric K. Archer, USDA Forest Service; Jeffrey L. Kershner, US Geological Survey, Northern Rocky Mountain Science Center; Scott Miller, Department of Watershed Sciences, Utah State University; Brett B. Roper, USDA Forest Service

Investigations into species invasion and disease transmission at the interface between mathematics and biology

Maria Jansen, Kacie Van Calster, Barbara Bennie, James P. Peirce, Department of Mathematics, University of Wisconsin-La Crosse; Matthew Rittenhouse, Kari Soltau, Roger J. Haro, Gregory J. Sandland, Department of Biology, University of Wisconsin-La Crosse

Time-Space Kriging for Large Datasets

Dong Liang, University of Iowa; Kumar, Naresh, University of Iowa

Climate and Life History: Lessons learned for the Indiana Bat

Kezia Manlove, Yellowstone Ecological Research Center; Robert Crabtree, Yellowstone Ecological Research Center; Jennifer Sheldon, Yellowstone Ecological Research Center; Lori Pruitt, Fish and Wildlife Service; Scott Pruitt, Fish and Wildlife Service

Can Extinction and Colonization be Accurately Estimated? Assessment of Dynamic Occupancy Modeling Through Simulation

Patrick McKann, Brian Gray, Wayne Thogmartin, Upper Midwest Environmental Sciences Center, US Geological Survey

Hierarchical Spatial Count Models of Mesocarnivore Abundance: Spatial Scaling of the Response

Wayne Thogmartin, United States Geological Survey, Upper Midwest Environmental Sciences Center; Dan Hertel, United States Fish and Wildlife Service, Habitat and Population Evaluation Team; Patrick McKann, United States Geological Survey, Upper Midwest Environmental Sciences Center; Rex Johnson, United States Fish and Wildlife Service, Habitat and Population Evaluation Team

Accuracy Assessment of Forest Disturbance Mapping

Patrick Zimmerman, USDA Forest Service, FIA

Abstracts

Listed in alphabetic order (by first author)

ORAL PRESENTATION

INFERENCE IN FOOD WEBS BASED ON MAXIMUM LIKELIHOOD AND BAYESIAN APPROACHES.

Allesina, Stefano[1]
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Food webs are networks describing who eats whom in an ecosystem. The nodes (species) are connected by directed edges (feeding relations). Recently, I introduced likelihood-based methods to select among probabilistic models for food web structure. Here I give a brief overview of the problem and the methodological challenges. As an example, I show how taxonomic information can inform models for food web structure.

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ORAL PRESENTATION

PALEOCLIMATE RECONSTRUCTION USING SELF-SIMILAR PROCESSES.

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We use a Bayesian filtering method to reconstruct the temperature anomalies in Celsius degrees in the Northern Hemisphere at the past millennium. Our method is different from the previous ones in that (1) we employed a long memory model to link the temperature and three forcings (greenhouse gases, volcanism and solar irradiance), the evidence of this long-memory behavior is suggested clearly from the data and (2) we carefully studied the proxy data that have been widely used and chose an optimal set according to a Principal Component Analysis. The memory component is fitted using spectral information of the temperature series during the last 100 years. The solution of this Bayesian problem is approximated by using a Markov-Chain Monte-Carlo method. Our results give us a reconstruction of the past unobserved anomalies over the period 998-1899 as well as a full evaluation of the reconstruction's uncertainty.

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POSTER PRESENTATION

SPATIO-TEMPORAL MODELING OF LONG-TERM TRENDS IN THE MARINE MACROFAUNAL COMMUNITY OF PORT VALDEZ, ALASKA.

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Multidisciplinary oceanographic investigations and environmental monitoring comprise 40 years of research (1971 to 2010) in Port Valdez, Alaska, which is the site of the marine oil terminal where Alaska North Slope crude oil is transferred to oil tankers. Spatio-temporal modeling of environmental and biological variables integrated in a weight-of-evidence approach contributes to understanding effects of natural and anthropogenic stresses on fauna and key sources of variability within the ecosystem. Within the deep basin of the fjord, the sediment-dwelling invertebrate (macrofauna) community took up to 26 years to recover from the 9.2 magnitude Great Alaska earthquake that struck Prince William Sound March 27, 1964. Investigation of sediment characteristics at shallow sites adjacent to the marine oil terminal (1989 to 2010) shows that sediment polycyclic aromatic hydrocarbons (PAH) (from effluent discharged at the marine oil terminal) and trends in the faunal

community are weakly associated. Changes in PAH concentrations had stronger associations with the abundance of two tube-dwelling, marine worms (Galathowenia oculata and Melinna cristata). The worms responded negatively to PAH values much lower than a commonly applied sediment quality criterion (Effects Range-Low). Ecological interactions between biological communities and environmental gradients in flux (recovery of the physical environment from the earthquake and declining PAH concentrations) can be difficult to evaluate but analysis of trends using methods for correlated data was effective for demonstrating such interactions in macrofaunal communities of Port Valdez.

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ORAL PRESENTATION

MODELING POPULATION DYNAMICS AND DETECTION PROBABILITY USING BREEDING BIRD SURVEY DATA.

Chandler, Richard[1]; Royle, J. Andrew[1]; Sauer, John[1]; Pardieck, Keith[1]
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The Breeding Bird Survey (BBS) is the primary source of information on population dynamics of North American birds and is unique in its spatial and temporal coverage. Nonetheless, it has been criticized because it was not designed to estimate detection probability which could bias trend estimates if, for instance, increasing traffic noise has caused a decline in detection probability over time. A recently developed hierarchical model permits estimation of population trend and detection probability using simple repeated count data as collected by the BBS. We extended the model to include random observer effects on detection probability, and applied it to Golden-winged Warbler data. Our results support previous findings that this species has declined rapidly since 1966, and we found no evidence of a trend in detection probability over this time. In addition to yielding estimates of detection probability, this model provides a means of modeling recruitment and apparent survival, and thus it allows for the evaluation of hypotheses regarding the factors affecting long-term population dynamics.

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ORAL PRESENTATION

FILTERED KRIGING FOR SPATIAL DATA WITH HETEROGENEOUS MEASUREMENT ERROR VARIANCES.

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When predicting values for the measurement-error-free component of an observed spatial process, it is generally assumed that the process has a common measurement error variance. However, it is often the case that each measurement in a spatial data set has a known, site-specific measurement error variance, rendering the observed process nonstationary. We present a simple approach for estimating the semivariogram of the unobservable measurement-error-free process using a bias-adjustment of the classical semivariogram formula. We then develop a new kriging predictor which filters the measurement errors. For scenarios where each site's measurement error variance is a function of the process of interest, we recommend an approach which also uses a variance-stabilizing transformation. The properties of the heterogeneous variance measurement-error-filtered kriging (HFK) predictor and variance-stabilized HFK predictor, and the improvement of these approaches over standard measurement-error / filtered kriging are demonstrated using simulation. The approach is illustrated with climate model output from the Hudson Strait area in northern Canada. In the illustration, locations with high or low measurement error variances are appropriately down- or up-weighted in the prediction of the underlying process, yielding a realistically smooth picture of the phenomenon of interest.

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ORAL PRESENTATION

BACK TO THE FUTURE: OLD ALGORITHM + NEW HARDWARE = FAST INDEPENDENT SAMPLING FOR BAYESIAN SPATIOTEMPORAL MODELS.

Cowles, Mary Kathryn[1]
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Bayesian conditional autoregressive models are a popular choice for analyzing environmental data measured at sites on a regular grid and/or at equally-spaced time points. The standard Markov chain Monte Carlo (MCMC) algorithms for fitting these models often suffer from slow convergence. In this talk, a new R package is introduced that harnesses the computing power of graphical processing units (GPUs) -- the ordinary graphics cards that control the displays on our computer screens -- for Bayesian model fitting. The massive parallelism afforded by GPUs makes independent sampling from the Bayesian posterior and predictive distributions feasible for a broad class of CAR models, thereby avoiding the challenges inherent in using MCMC. Use of the new R package is illustrated with an analysis of spatial and temporal trends in Iowa vegetation based on data from satellite images.

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ORAL PRESENTATION

ESTIMATING ABUNDANCE-BASED PATTERNS OF SPECIES CO-OCCURRENCE USING FORAGING GUILDS AND SPATIAL COVARIATES.

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We developed a statistical model to estimate the abundances of species encountered while surveying a set of ecologically relevant locations -- as in a metacommunity of species. In the model we assume that abundances of related species (e.g., species of the same foraging guild) are correlated. We also assume that abundances vary among locations owing to systematic and stochastic sources of heterogeneity. For example, if abundances differ among locations owing to differences in habitat, then measures of habitat can be included in the model as covariates. Naturally, the quantitative effects of these covariates are assumed vary among species. In the model we also account for the effects of detection errors on the observed counts of each species. This aspect of the model is especially important for rare species that may be difficult to detect in multi-species surveys. We illustrate the model using point counts of avian species obtained while sampling a community of forest birds during the breeding season.

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ORAL PRESENTATION

A BAYESIAN HIERARCHICAL OCCUPANCY MODEL FOR TRACK SURVEYS CONDUCTED IN A SERIES OF LINEAR, SPATIALLY CORRELATED, SITES.

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Using river otter (Lontra canadensis) snow track survey data as a motivating example, we develop a 3-level occupancy model with parameters that describe (1) site-level occupancy probabilities, (2) otter movement (and thus, track availability), and (3) recorded presence-absence of tracks (conditional on the availability of tracks for detection). We incorporated several recent developments in occupancy modeling, including the presence of both false negatives and false positives, spatial and temporal correlation, and repeated sampling across distinct observers. We investigated optimal allocation of sampling effort (e.g. within and among snowfall events) using simulations. We also compared models that allowed site-level occupancy and track laying processes to be spatially correlated to models that assumed independence among sites. Both types of models (independence and spatial) performed well across a range of simulated parameter values, but the spatial model resulted in more accurate point estimates for detection parameters and credibility intervals with better coverage rates when data were spatially correlated. When applied to real data, the spatial model resulted in a higher estimate of the

occupancy rate than the baseline model (0.82 versus 0.59). A minimum of 15-20 helicopter flights, distributed among at least three unique snow events, were needed to meet precision goals (standard error of the occupancy estimate < 0:05). The 3-level model offers the potential to account for a significant source of heterogeneity in the detection of animal sign (e.g., scat, scent marks, tracks) and thus has relevance to many surveys conducted by natural resource agencies.

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ORAL PRESENTATION

PREDICTION AND DISCRIMINATION FOR POST-FIRE TREE MORTALITY IN THE WESTERN UNITED STATES.

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The ability to accurately discriminate between live and dead trees following wild and prescribed fires in the western US has important management and forest conservation implications. A recent review of statistical logistic regression models for predicting post-fire tree mortality described over two dozen models developed from tree mortality data from a wide range of geographic regions in the western US. But the ability of these models to accurately discriminate between tree death and survival across the range of conditions and species is largely unknown. We examined the discriminatory ability of 6 previously published models on 5 large datasets compiled from different regions of the western United States. We used traditional receiver operating characteristic curves to compare model sensitivity over all possible false positive rates. In addition we examined the sensitivity for specific false positive rates that are of interest to forest managers. A lack of consistent behavior for any single model across regions led us to describe the general features of tree populations and explanatory variables that produce good discriminators.

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ORAL PRESENTATION

INTEGRATING ECOLOGISTS AND STATISTICIANS IN LONG-TERM MONITORING.

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Integrating expertise of statisticians and ecologists is crucial for developing monitoring programs that produce relevant, useful information. We offer perspectives on three general "needs" related to quantitative considerations in monitoring. First, there is a high demand for strategies that meet multiple purposes and offer flexibility for dealing with changes in objectives and funding. Ecologists need to track broad-scale resource changes as well as address re-occurring and changing management questions. Some experts suggest that a monitoring framework optimized for one of these purposes could be combined with supplemental monitoring to meet other objectives; further applications of hybrid static/dynamic, probability/model-based designs may be especially valuable. Second, monitoring design continues to require more effective integration of statistical- and subject-matter expertise. Ecologists typically need significant help in thinking conceptually about general study design options, including thorough identification of relevant sources of bias and variance. Often ecologists are unclear about the importance of quantitative survey design and their primary role in setting quantitative objectives based on some intended uses of monitoring data and potential resource changes of concern. In addition to identifying sample sizes and trade-offs, power/precision examinations often serve as an unintended test of whether a monitoring study has a clear idea of its purpose. Finally, widespread development of complex monitoring designs means

there will be a continued high demand for expertise in complex design-based analyses, hierarchical modeling, and structural equation modeling.

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ORAL PRESENTATION

USING THE NATIONAL RESOURCES INVENTORY TO ANALYZE TRENDS IN RESOURCE CONDITION.

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The National Resources Inventory (NRI) is a longitudinal survey conducted by the U.S. Department of Agriculture's Natural Resources Conservation Service, in cooperation with the Center for Survey Statistics and Methodology (Iowa State University). The NRI utilizes a two-stage unequal probability area sampling approach. The NRI survey program provides data at 5-year intervals for the period 1982 to 2007; the data have assisted in the development of agri-environmental policies and programs at national and regional levels, starting with the 1985 Farm Bill. Data were collected every five years for the period 1982 to 1997; data collection has been annual since 2000. Numerous challenges have been encountered in developing a longitudinal data base covering this 25 year period. For example, budgets fluctuate, data collection technicians and technologies constantly change, and natural resource issues of interest evolve. Analysis of trends using NRI data is discussed in relation to these and other statistical and operational challenges.

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ORAL PRESENTATION

INTEGRATING DRIVERS AND RESPONSES IN CAUSAL NETWORKS USING STRUCTURAL EQUATION MODELING.

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Structural equation modeling (SEM) is a multiequational framework for studying causal networks. Two aspirations are distinctive for the method, (1) a desire to learn about causal relationships and (2) disentangling multiple interacting processes through the analysis of networks. SEM incorporates two major features (1) the inclusion of latent variables and (2) the analysis of path relations. SEM is best understood as an analysis framework and can be contrasted with the univariate model. While historically based on maximum likelihood procedures, Bayesian methods are starting to be incorporated in SEM practice, expanding the range of applications. Longitudinal data obtained through long-term monitoring can be analyzed in a number of ways within the SEM tradition. Currently, there is much interest in the style of analysis referred to as "latent trajectory models" (LTMs). LTMs build upon the latent variable modeling tradition within SEM, thereby capitalizing on the capabilities of SEM for (1) handling covariates, (2) nonlinear specification, (3) model testing, (4) model fit diagnostics, and (5) handling missing data. Within LTMs, trajectory intercepts and slopes are treated as random variables represented using latent variables; thus, the implementation is multi-level and incorporates random effects. This approach allows for each unit that is repeatedly observed to have an individual intercept and trajectory that differs from the group. The method also incorporates networks of relationships at multiple levels. In this paper, an introduction to this methodology including its strengths and limitations, will be presented using ecological examples.

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ORAL PRESENTATION

ESTIMATING VARIANCE COMPONENTS AND VARIANCE PARTITION COEFFICIENTS ON THE INVERSE LINK SCALE USING ESTIMATES FROM GENERALIZED LINEAR MIXED MODELS OF CROSS-CLASSIFIED DATA.

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Long-term environmental and ecological monitoring data are often be classified by two or more factors (e.g., data may derive from both multiple lakes and multiple years). We focus on cases where levels of each factor are treated as random, data will be modeled using a generalized linear mixed model (GLMM) with nonlinear link, and interest is in variance components (VCs) and relative variance components (variance partition coefficients, VPCs) on an inverse link scale. Previous studies of the estimation of VCs and VPCs on the inverse link scale from GLMM estimates have been limited to outcomes from nested designs. We propose an approach for calculating VCs and VPCs on the inverse link scale for discrete outcomes from two-way cross-classified random effects designs, and evaluate this method using Monte Carlo simulations of grouped binomial data. GLMMs were fitted using first-order marginal and penalized quasi-likelihood (PQL1), the REML analogue of PQL1 (RPQL1), Laplace estimation and Markov chain Monte Carlo. Bias and precision in VC and VPC estimates improved as group (cluster) size for both random main effects increased and, for a given main effect, when the number of groups associated with the alternate main effect increased. The influence of estimation method on bias and precision of VC and VPC estimates was typically slight when numbers of groups for both main effects were 10 and 20 but when numbers of groups equaled 5 were best under RPQL1.

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ORAL PRESENTATION

TRANSLATION: MOVING FROM DATA TO DECISIONS THROUGH STATISTICAL INFERENCE.

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The importance of aligning research questions with study design and statistical inference is important for any study, but particularly critical for when results are directly linked to management decisions. In reality, the level of sophistication of research questions and statistical methods can quickly exceed that justified by the data collected. For economic, statistical, and social reasons, it can be difficult to deviate from historic monitoring programs. However, a critical look at the information available in current monitoring data relative to the research and management goals is crucial for successful decision making. When there are substantial costs and/or significant resistance to updating existing protocol, the statistician must creatively communicate the importance of collecting new data to an audience with little, if any, statistical knowledge. We must build an accessible bridge between the data collected and the uncertainty in management decisions. Relatively simple computer simulations, coupled with graphical displays, provide one strategy for communicating the importance of aligning data collection with decision making to a wide audience of stake holders. I will provide an example related to the management decision of setting mortality limits.

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POSTER PRESENTATION

SPACE-TIME MODELING OF THE DIURNAL BEHAVIOR OF THE ATMOSPHERIC HYDROLOGIC CYCLE.

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Over time scales of hours to days, the atmospheric branch of the hydrologic cycle is strongly impacted by transport of water vapor and subsequent precipitation. Coupled through the water balance equation, both processes vary with the passage of large-scale weather systems but also exhibit characteristic diurnal cycles. The spatial variability of these day-to-night patterns provides important insight about the hydrologic cycle. / A multi-scale spatio-temporal model is developed to characterize the joint behavior of the water vapor transport and precipitation over central North America. The approach aims to identify the space-time variation of the mean behavior of both fields and their space-time coherence. Day-to-day changes are characterized at different spatial scales to distinguish scales at which systematic propagation is preferred. Model behavior is illustrated through a Bayesian analysis of regional reanalysis products and observed precipitation datasets.

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ORAL PRESENTATION

MODEL-BASED MONITORING OF SPATIO-TEMPORAL ECOLOGICAL PROCESSES.

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Static sampling designs for collecting spatial data are being used readily by ecologists, however, most ecological systems involve a multivariate spatial process that evolves dynamically over time. Efficient monitoring of such spatio-temporal systems can be achieved by modeling the dynamic system and reducing the uncertainty associated with the effect of design choice on unknown quantities of interest. Inherent dependence in the underlying process is critical for developing intelligent models that enable the specification of optimal designs for future monitoring efforts. We present a review of model-based monitoring methodology and examples of both adaptive and dynamic designs in plant and animal ecological studies.

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POSTER PRESENTATION

USING GRAPHICAL MODELS TO INCORPORATE EMPIRICAL EVIDENCE INTO THE EVALUATION OF LONG-TERM MONITORING EFFORTS.

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One facet of developing a successful long-term effectiveness monitoring program is formulating a conceptual model that outlines anthropogenic stressors and their hypothesized impacts on biological integrity. Benthic macroinvertebrates (BMI) are one of the primary tools for quantifying the cumulative impacts of land management activities on the biological integrity of stream ecosystems. While BMIs have been found to be extremely effective at characterizing chemical and physical conditions within lowland, urban, and some forested applications, to date no validation of the hypothesized responses of BMIs to management activities across a large spatial extent has been done. Additionally, the reliance on collecting macroinvertebrate data can be cost prohibitive for long term monitoring, thus verifying their utility as biondicators is imperative. We use data from the Pacific Anadromous Fish Strategy and Inland Fish Strategy Biological Opinions (PIBO) program to verify whether there is empirical evidence for the a priori hypothesized causal relationships using graphical models. Specifically, it is thought that macroinvertebrate assemblages will be negatively impacted by grazing and roads indirectly via within stream habitat degradation (more fine sediments), higher in stream temperatures, riparian habitat alterations (lower canopy cover). Possible moderating factors are watershed-level variables such as forest

type and slope. Incorporating empirical evidence into the evaluation of the conceptual model underpinning a monitoring program is a necessary step to provide a critical evaluation of whether the a priori set of measurable variables is appropriate for continued measuring.

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ORAL PRESENTATION

SPATIAL ANOVA MODELING OF HIGH-RESOLUTION REGIONAL CLIMATE MODEL OUTPUTS FROM NARCCAP.

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We consider current (1971-2000) and future (2041-2070) average seasonal surface temperature fields from two regional climate models (RCMs) driven by the same atmosphere-ocean general circulation model (GCM) in the North American Regional Climate Change Assessment Program (NARCCAP). We analyze the differences between future and current temperature fields and include the factor of season, the factor of RCM, and their interaction in a two-way ANOVA model. Noticing that classical ANOVA approaches doesn't include "spatial" modeling and can't account for the spatial variability across the domain, we propose to use the Spatial Random Effects (SRE) model for the main effects and interactions and build a spatial two-way ANOVA model hierarchically. Using the SRE model also enables us to model the spatial dependence through the spatial basis functions, and the computation associated with analyzing the high-resolution RCM outputs can be carried out efficiently, due to the fixed number of spatial basis functions in the SRE model and the resulting dimension reduction.

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ORAL PRESENTATION

BUILDING A BRIDGE TO MANAGEMENT: MAKING SCIENCE COUNT IN MANAGEMENT DECISION MAKING.

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Resource management decision making is a complex endeavor that incorporates science as well as social values. From a sociological and organizational standpoint, the enterprises of science and resource management tend to operate in different spheres. Scientists and managers have different fundamental objectives. Scientists want to understand how the world works. Managers want to manage land to achieve some conservation outcome. They want to use what is known about how the world works to help them make good decisions that increase the likelihood of achieving their desired outcomes. A common dilemma facing resource managers is how to best incorporate scientific information into the decision making process and how to employ monitoring information to help improve future management decisions. The challenge for both scientists and managers is how to work together to reduce the uncertainty that is associated with management decision making. Fortunately, corporate managers also want to make smarter decisions and to that end, decision analysis tools were developed. These tools were adapted to a resource management context and are now poised to revolutionize the practice of conservation on the ground. We will show some examples of how decision analysis tools are used for one-time and iterative resource management decisions (adaptive management). We will argue that explicitly tailoring monitoring to inform decision making in a modeling framework puts the hard thinking on the front end rather than the back end of the learning process and equips resource managers to meet the escalating conservation challenges that they face.

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POSTER PRESENTATION

TIME-SPACE KRIGING FOR LARGE DATASETS.

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Time-space Kriging (TSK) is an important development for multi-level spatiotemporal research and for addressing the problems of mismatch in the spatiotemporal scales, missing values across space and time and misalignment in the spatiotemporal datasets. Due to the convergence of spatial and temporal domains, TSK poses both modeling (non-separable and non-stationarity covariance) and computation (big n problem) challenges. Markov Cube (or spatiotemporal voxel) Kriging (MCK) is developed and its comparison is presented with the local TSK (LTSK). / / Like the classical Kriging methods, TSK requires a separable and stationary covariance assumption. Since the covariance structure across space and time varies differently, separable and stationary covariance assumptions are difficult to satisfy. The proposed MCK incorporates both non-stationary and non-separable covariance at multi-level spatiotemporal scales. Since TSK involves a O(n3) matrix decomposition, implementing TSK is computationally prohibitive using the traditional methods, especially for large datasets. The proposed MCK is a Bayesian hierarchical model that utilizes Gaussian Markov Random Fields (GMRF) priors to achieve the model richness and also spatiotemporal structures within GMRF priors for developing an efficient solution to the big n problem. MCK was implemented with- and with-out the local spatiotemporal random effects (MCK(l)) and MCK(0)), respectively. Cross-validation suggests that MCK(l) and LTSK outperformed MCK(0), but MCK(l) was computationally less efficient as compared to LTSK. The use of MCK(l) and LTSK are likely to advance exposure science to the next level by providing robust estimates of environ

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ORAL PRESENTATION

MODELING THE IMPACT OF DROUGHT ON TREE MORTALITY USING NATIONAL FOREST INVENTORY DATA.

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Numerous recent studies link widespread tree mortality to drought conditions. Because of concerns that climate change may be increasing the frequency, intensity, and duration of drought events, it is desirable to improve our understanding of the relationship of tree mortality to drought. The decline spiral model proposes tree mortality is frequently the result of inciting, predisposing, and contributing factors that work in concert. We examined the relative contributions of a host of factors that could lead to mortality using linear models. Data from the Forest Inventory and Analysis program of the USDA Forest Service were analyzed for the Great Lakes states of Minnesota, Wisconsin, and Michigan for the period 2000-2009, a time in which significant droughts were experienced in parts of the study area. The fate of individual trees was tracked on a five-year return interval, and the proportion of trees that died was modeled as a response to drought information, stand age, stand density, topography, and damage agents. Drought information included both the traditional Palmer Drought Severity Index as well as the Vegetation Drought Response Index, derived in part from satellite observations of vegetative conditions. Results indicate substantial spatial variability in the relative contributions of factors that lead to mortality. Future work exploring alternative modeling approaches that help identify causality and lead to better prediction of mortality patterns is suggested.

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ORAL PRESENTATION

CONTROLLING FOR DETECTABILITY IN COUNT SURVEY DATA: A COMPARISON OF APPROACHES.

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It has long been recognized that counts of animals can be unreliable as a basis for inference: not all animals are counted, and variation in the proportion of animals counted can be confounded with changes in abundance. For example, in the North American Breeding Bird Survey (BBS), new observers tend to be better birders than the observers they replace; change in the observer pool can be confounded with population change. / / Mark-capture-recapture (MCR) studies obtain information about individual animals, thus providing a basis for estimating detection probabilities. There is no question that MCR data are of greater inferential value than count survey data such as generated by the BBS. Nor can there be any question of the importance of accounting for factors influencing detection rates. However it seems that many analysts assume that to control for detectability one must be able to estimate detection rates. This is not true – analyses of the BBS, for instance, control for differences among and within observers. One result of this misconception is the application of closed population models in situations where there either is no closed population or the notion of a closed population can only be invoked by allowing for extreme individual heterogeneity in detection probabilities, with its inherent failings (Link 2003). Among analysts favoring estimation of detection probabilities, the N-mixture models developed by Royle (2004) and extended by Dail and Madsen (2010) have been enthusiastically received. This paper compares methods for count surveys, providing caveats regarding untestable modeling assumptions implicit in various approaches.

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ORAL PRESENTATION

ESTIMATING CHANGE IN SPECIES RICHNESS FROM REPEATED SAMPLING OF INCIDENCE DATA.

Magnussen, Steen[1]
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Four estimators of species richness are evaluated for estimation of change when data comes from a repeated survey of species incidence in a fixed set of forest inventory plots (quadrats). The evaluation is done with Monte Carlo simulations of simple random sampling from four case study populations with repeat observations of species incidence. Change estimated as the difference between the numbers of species observed on two sample occasions had the lowest root mean squared error, but it was frequently more biased than alternative model-based estimators of change. The bias issue and a poor coverage of computed confidence intervals dissuade the use of this estimator. An urn-type estimator - capable of capturing the temporal correlation in the incidence data - was, overall, a better choice in terms of bias and coverage of computed confidence intervals.

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POSTER PRESENTATION

CLIMATE AND LIFE HISTORY: LESSONS LEARNED FOR THE INDIANA BAT.

Manlove, Kezia[1]; Crabtree, Robert[1]; Sheldon, Jennifer[1]; Pruitt, Lori[2]; Pruitt, Scott[2]
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Migratory species present a unique problem for managers, in that changes in resources and conditions at any space-time combination in a species's life history may drive population decline. Efficient allocation of conservation resources relies on identifying the spatiotemporal life history "window" within which environmental thresholds are limiting. In this investigation, we propose a protocol for identifying these critical windows, and then apply the protocol in an effort to characterize the relationship between climate and population trends in the Indiana bat (Myotis sodalis), an endangered migratory insectivorous bat that has declined substantially in the last century. This analysis relies on a twenty-three year, multilocation response dataset, used in tandem with climate data derived from the NASA Terrestrial Observation and Prediction System (TOPS). Our protocol relies on a

strong understanding of the spatiotemporal life history of the species of interest to generate a set of potential physiological drivers, identification of proxy covariates for drivers that are not directly measurable (where appropriate), and then refinement of the proposed covariate set through the use of AIC variable importance and model selection. In the end, we find evidence that the critical climate driver for the Indiana bat is hibernacula temperature during the winter months.

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POSTER PRESENTATION

CAN EXTINCTION AND COLONIZATION BE ACCURATELY ESTIMATED? ASSESSMENT OF DYNAMIC OCCUPANCY MODELING THROUGH SIMULATION.

McKann, Patrick[1]; Gray, Brian[1]; Thogmartin, Wayne[1]
[1]*USGS-La Crosse*

Occupancy estimation is a method of determining the probability (psi) that a randomly selected site in an area of interest is occupied by a species during a survey event, given imperfect detection (p) of that species. Occupancy models may be extended to multi-year surveys, and, in this case, the dynamic probabilities of colonization (gamma), persistence (phi), and extinction (1-phi) can also be estimated. We used simulated dynamic occupancy data to investigate the performance of a published dynamic occupancy model written for WinBUGS (Royle and Kery, 2007). In the simulation, p, psi, gamma, and phi were varied in 135 plausible combinations. In an attempt to decrease the number of varying parameters, and to represent a reasonable size for a field study, the number of sites, the number of visits per site per year, and the number of years were fixed at 30, 5, and 5, respectively. All data were simulated using R; WinBUGS 1.4 was used for the analyses. While we found complex interactions among estimated parameters, some generalizations can be made. Low p had a major effect on the bias and precision of the estimation of all parameters. Neither p nor psi was affected by gamma and phi. Gamma was generally overestimated, and phi was generally underestimated. A fifth parameter, growth rate, defined as psi[year]/psi[year-1], was shown to have erratic behavior at lower levels of psi, and was grossly overestimated at low p and low psi.

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ORAL PRESENTATION

INCORPORATING RANDOM EFFECTS INTO CLASSIFICATION AND REGRESSION TREES FOR MODELING PRESENCE/ABSENCE OF A SPECIES.

McKelvey, Mark[1]; Dixon, Philip[1]
[1]*Iowa State University*

Classification and regression trees (CART) are a flexible, frequently-used method for modeling occupancy probabilities. Many studies include a cluster-type sampling design where there is a clear spatial correlation between sampling locations. This correlation causes the variance of the node occupancy estimates in CART to be biased. We suggest a generalized estimating equation (GEE)-based approach in which the naïve variance estimates (calculated as if all locations were independent) are "corrected" based on the data available in each parent node of the tree. The corrected variance estimates are then used to revise the binary-split decision criterion of the tree. We demonstrate this method using data from a study on bird occurrence in Oregon.

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ORAL PRESENTATION

CONSTRUCTING CONFIDENCE INTERVALS FOR REMOTE SENSING-BASED ESTIMATES OF DEFORESTATION.

McRoberts, Ronald E.[1]
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Estimation of deforestation, particularly for tropical developing countries, has become a priority activity in the context of climate change research and programs focused on reducing deforestation and forest degradation (REDD). Although the national forest inventories of countries with boreal and temperate forests typically have adequate ground sample data for this purpose, such is not the case for many tropical developing countries for which forest areas are remote and often inaccessible. For the latter countries, the Good Practice Guidance of the International Panel on Climate Change recommends the use of a combination of ground data from a sparse array of sample plots and satellite imagery as the most feasible and cost-effective sources of data for estimating deforestation. Within the remote sensing community, assessments of uncertainty of land cover classifications typically entail estimation of various measures of accuracy obtained from error matrices. Little attention has been paid to construction of confidence intervals for population parameters associated with classifications. For this study, deforestation was estimated using a post-classification approach consisting of a comparison of separate, independent forest/non-forest classifications for two dates. The probability-based, model-assisted difference estimator was used to obtain estimates of deforestatation adjusted for misclassification and to estimate variance of the estimate of deforestation.

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ORAL PRESENTATION

THE RELIABILITY OF MILLENNIAL MULTI-PROXY TEMPERATURE RECONSTRUCTIONS.

McShane, Blakeley[1]; Wyner, Abraham[1]
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Predicting historic temperatures based on tree rings, ice cores, and other natural proxies is a difficult endeavor. The relationship between proxies and temperature is weak and the number of proxies is far larger than the number of target data points. Furthermore, the data contain complex spatial and temporal dependence structures which are not easily captured with simple models. / In this paper, we assess the reliability of such reconstructions and their statistical significance against various null models. We find that the proxies do not predict temperature significantly better than random series generated independently of temperature. Furthermore, various model specifications that perform similarly at predicting temperature produce extremely different historical backcasts. Finally, the proxies seem unable to forecast the high levels of and sharp run-up in temperature in the 1990s either in-sample or from contiguous holdout blocks, thus casting doubt on their ability to predict such phenomena if in fact they occurred several hundred years ago. / We propose our own reconstruction of Northern Hemisphere average annual land temperature over the last millennium, assess its reliability, and compare it to those from the climate science literature. Our model provides a similar reconstruction but has much wider standard errors, reflecting the weak signal and large uncertainty encountered in this setting.

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ORAL PRESENTATION

MODELING A SPATIALLY EXPLICIT TIME SERIES OF WOODY BIOMASS.

Nelson, Mark[1]; McRoberts, Ronald[1]; Stueve, Kirk[1]; Healey, Sean[1]
[1]*U.S.D.A. Forest Service, Forest Inventory and Analysis, Northern Research Station*

We used a Landsat Time Series Stack (LTSS) of satellite imagery, USA national forest inventory plot data, a vegetation change tracker algorithm, and a non-parametric Random Forests-based approach to model a twenty five year time series of above-ground live tree biomass in northern Lower Michigan, USA. The study area encompasses almost the entire historical breeding range of Kirtland's warbler (Dendroica kirtlandii), a federally endangered neotropical migratory songbird that nests only in young (5-23 years old) jack pine (Pinus banksiana) forest. Older jack pine forest is unsuitable as warbler habitat and is commercially harvested at 40 years of age for pulpwood utilization, generating revenue that partially offsets costs of warbler habitat management practices, including re-initiation of young forest for future habitat. Uncertainty over future pulpwood markets and growing interest in potential utilization of woody biomass for bio-energy applications illustrate a need for tracking woody biomass across time, including forests younger than are harvested for traditional products. Model outputs were used to produce a time series of maps of woody biomass, which were combined with ancillary datasets in a geographic information system to delineate biomass trends for jack pine forests within and surrounding Kirtland's warbler management areas, prior to, during, and following occupancy by Kirtland's warblers.

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Supporting Grant: NASA Applied Science Program, North American Forest Dynamcis (NAFD) project

ORAL PRESENTATION

THE NATIONAL RESOURCES INVENTORY: DESIGN AND ESTIMATION FOR CREATING A LONGITUDINAL DATABASE.

Nusser, Sarah[1]
[1]*Iowa State University*

Statistical procedures used in conducting the National Resources Inventory (NRI) are designed to produce longitudinal data for evaluating gross change in land cover/use, soil erosion and other natural resources. The theme of this session is to discuss examples of accommodating changes in objectives and available methodologies in the context a longitudinal survey. In this talk, we provide an overview of NRI sample design and estimation procedures developed in response to a need for annual NRI data. We begin by describing the annual supplemented panel design, which balances trend with status estimation, and explain how a generalized method of moments approach is used to mitigate the losses in sample size associated with smaller, more frequent surveys. We also discuss how imputation is used to integrate data from multiple observation units and develop a complete time series for each point included in the data set.

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Supporting Grant: USDA NRCS - ISU Cooperative Agreement 683A754122

ORAL PRESENTATION

NATIONAL AQUATIC RESOURCE SURVEYS: MULTIPLE OBJECTIVES LEADING TO DESIGN COMPLEXITY.

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The US EPA began conducting the National Aquatic Resource Surveys (NARS) in 2007 with a national survey of lakes (NLA 2007) followed by rivers and streams in 2008-9 (NRSA 2008), coastal waters in 2010 (NCCA 2010) and wetlands in 2011 (NWCA). The surveys involve national, regional and state. In addition, since the surveys are implemented jointly by USEPA, states, tribal nations and other federal agencies, additional constraints are present that must be addressed by the design. Typically, the survey designs are stratified by state and within a state unequal probability selection incorporates other design information. Sites are selected using a spatially balanced GRTS design. In addition to the core national surveys, supplemental studies that focus on specific subpopulations are integrated into the design. In some cases this involves sampling sites from historical studies to estimate whether changes have occurred. The NWCA 2011 survey design is a two-stage design with the first stage based on an area frame design by the Fish & Wildlife Service's National Status & Trends monitoring for wetland acreage change and where the second stage design is a stratified, unequal probability survey design selected from wetland polygons identified from the first stage. Beginning in 2012, the second cycle of surveying each of the aquatic resources will begin with the NLA 2012 and includes objectives of estimating status in 2012 and change since 2007. This presentation will provide an overview of these surveys and discuss how the objectives and constraints for each survey were addressed.

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ORAL PRESENTATION

ESTIMATING POPULATION CHANGE OF MOTTLED DUCKS FROM MULTIPLE-PLATFORM SURVEYS.

Otto, Mark C.[1]
[1]*U.S. Fish and Wildlife Service*

We used a Poisson-log normal random effects model to estimate population size and change while accounting for detection from multiple survey platforms (air boat, helicopter, and fixed wing) and blocking on the sample units (segments) that were consistently observed each year. The multi-platform experiment was part of an annual aerial transect survey of breeding mottled ducks in Louisiana and Texas. In 2009-2010 both helicopter and air-boat were used to obtain detection rates, making visibility correction estimation difficult. The densities of total indicated birds (TIBs) were modeled with year-stratum fixed effects. Random segment effects nested within the Marsh-Other strata accounted for sampling consistent segments among years. The platform detection rates were modeled as changes in density observed relative to a reference platform. There was also an order effect between the air boat and the helicopter, where less birds were seen in the helicopter on segments the boat had run first. Observer differences were modeled on all half segments the fixed wing flew. We compared population change estimates and visibility correction factors from the hierarchical model with tradition survey estimates.

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ORAL PRESENTATION

THE CURIOUS CASE OF CAMAS: LESSONS LEARNED FROM AN EDIBLE LILY.

Rodhouse, Thomas J.[1]; Lyon, Jason W.[2]; Irvine, Kathryn M.[3]
[1] National Park Service Upper Columbia Basin Network; [2] National Park Service Nez Perce National Historical Park; [3] USGS Northern Rockies Science Center

Increasingly, environmental monitoring programs are being used to inform the adaptive management process and guide decisions regarding restoration and other active management. Probabilistic models developed from and updated with monitoring data explicitly embrace uncertainty and provide a formal basis for evaluating hypotheses about the system in question. Other less-formal processes such as teamwork and open communication between modelers and managers are also critical. We describe an ongoing land management decision-making process that began in 2005 with the initiation of monitoring of the culturally and ecologically significant wetland plant Camassia quamash (camas) in two western US National Park units. Multiple sources of information, including population trends in camas estimated using spatially-explicit Bayesian hierarchical models, have been brought to bear on decisions concerning livestock grazing and active restoration of old drainage ditches. Models have been updated as new data become available, becoming increasingly complex and information-rich over time. Field trips with team members and outside experts have generated new insights, rounding out the holistic strategy taken to "bridge the gap" between models and management. Our example represents a real-world, albeit messy, example of how data-rich monitoring programs can be harnessed to serve an active land management program.

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ORAL PRESENTATION

BLACK DUCK POPULATION CHANGE IN NORTH AMERICA: ESTIMATION USING INFORMATION FROM SEVERAL SURVEYS.

Sauer, John R.[1]; Zimmerman, Guthrie S.[2]; Link, William A.[1]; Otto, Mark[2]
[1]USGS Patuxent Wildlife Research Center; [2]US Fish and Wildlife Service

Waterfowl have been surveyed in eastern Canada and the northeastern United States using both transect-based surveys from fixed-wing aircraft and plot-based surveys conducted with helicopters. The surveys vary in extent, but overlap exists in a core area of 9 strata covering portions of all provinces from Ontario East to Newfoundland. We estimated population change for American black duck (Anas rubripes) and other species from these surveys using a log-linear hierarchical model that accommodates differences in sample design and visibility associated with these survey methods. Precision of estimates varied widely by species and region, with transect surveys providing less precise results than plot surveys for black ducks in areas of overlap. Using a combined analysis of the surveys based on total indicated birds, we estimated the American black duck population to be 822500 (682600, 1065000) in 2010 in the surveyed area. The composite survey for black ducks in the eastern survey region produced estimates with an average yearly CV of 10.6 %. We describe prospects and approaches for integrating information from other surveys that monitor black duck populations.

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ORAL PRESENTATION

MODELING THE PRESENCE AND ABSENCE OF FISH IN A STREAM NETWORK.

Short, Margaret[1]
[1]University of Alaska Fairbanks

We propose a spatial model for the presence and absence of fish in a stream network. This model extends a moving average approach developed by Jay Ver Hoef and Erin Peterson to binary data. Distances are measured along the stream network rather than straight-line. Our model incorporates covariates. We use a Bayesian approach, implemented via Markov chain Monte Carlo. We illustrate using a Nushagak data set. This represents joint work with the Alaska Department of Fish and Game. /

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ORAL PRESENTATION

INVESTIGATING THE RELATIONSHIP BETWEEN SPATIAL AUTOCOVARIANCE FUNCTION RANGE PARAMETERS AND PATCH SIZES IN ECOLOGICAL LANDSCAPES.

Som, Nicholas A.[1]; Irvine, Kathryn, M.[2]; Ganio, Lisa M.[1]

[1]Department of Forest Ecosystems and Society, Oregon State University; [2]Northern Rocky Mountain Science Center, US Geological Survey

The geostatistical range parameter is often used to describe the size of patches in ecological landscapes, but no theoretical or empirical justification for their relationship exists. We generated simulated landscapes with varying spatial autocorrelation functions and properties, and defined and measured patches within these landscapes, to evaluate how range parameters and patch sizes may be associated. Our results indicate that the association of range parameters and patch sizes is related to both the smoothness of the spatial process and the proportion of total variance (sill) attributed to nugget effects. We present our findings and relate these results to field data to evaluate these patterns in real-world data.

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POSTER PRESENTATION

HIERARCHICAL SPATIAL COUNT MODELS OF MESOCARNIVORE ABUNDANCE: SPATIAL SCALING OF THE RESPONSE.

Thogmartin, Wayne[1]; Hertel, Dan[2]; McKann, Patrick[1]; Johnson, Rex[2]

[1]United States Geological Survey, Upper Midwest Environmental Sciences Center; [2]United States Fish and Wildlife Service, Habitat and Population Evaluation Team

Most species distribution models examining environmental effects at multiple spatial scales vary in spatial extent. Spatial scale, however, is the integration of extent and resolution, or grain. We developed models for 6 mammalian nest predators in the Prairie Pothole Region of the north-central United States, varying model response as a function of spatial resolution. The original counts of predators were systematically collected using track surveys on a 50,873 km^2 grid resolved to a resolution of 16 mi^2. We developed hierarchical spatial count models predicting mammalian abundance at this resolution and at resolutions of 4 mi^2 and 1 mi^2. The models we developed improved prediction of areas of absence as resolution became finer. However, models consistently under-predicted abundance at all scales, and as the resolution became finer, the ability to correctly predict counts declined relative to the models at coarser resolution. Thus, there was a tension between correct prediction of areas occupied at the finest scale and correct prediction of abundance at the coarsest scale. For the most abundant species (raccoon and coyote) we were able to develop scaling relations among model parameters to predict species occurrence and abundance at finer and coarser scales than we modeled. Our models and maps allow managers to focus their conservation resources to finer areas of the region, ostensibly improving the efficacy of conservation action.

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ORAL PRESENTATION

A HIERARCHICAL MULTI-SCALE DOWNSCALING APPROACH FOR EVALUATING THE RESPONSE OF ENDANGERED FISH POPULATIONS TO CLIMATE CHANGE.

Wikle, Christopher[1]

[1]University of Missouri

In order to understand potential climate influences on fish populations in riverine ecosystems, one must consider multiple scales of variability. In particular, one must consider scales from global climate, regional climate and weather, watersheds, river hydrology to individual response. This presentation will consider a framework that attempts to account for the uncertainty across these scales in order to evaluate the impact of potential climate changes on population distributions of the endangered pallid sturgeon in the Missouri River ecosystem.

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ORAL PRESENTATION

A MEASUREMENT STUDY IN A LONGITUDINAL SURVEY WITH ERRORS-IN-VARIABLES.

Yu, Cindy[1]; Riddels, Minsun[1]
[1]*Department of Statistics, Iowa State University*

The National Resources Inventory (NRI) is a large-scale longitudinal survey conducted to assess trends and conditions of nonfederal land. A key NRI estimate is year-to-year change in acres of large urban, small water body and small streams. Data collection is done through photo interpretation. In 2010, a digital photo with options of red, blue and green bands (RBG) or RBG with color infrared (CIR) band was implemented replacing film or analog. Data using film, digital image with RGB bands and digital image with RGB+CIR bands will be compared to examine the effects of the introduction of digital image and inclusion of color infra-red on measurements of NRI variables. A measurement error model is postulated for the relationship, where duplicate measurements are used to estimate one of the error variances. Analyses on the data suggest that the relationship is a line with an intercept of zero and a slope of one, therefore the observations currently used are acceptable. The talk also provides models of the measurement error variances as functions of variables of interest, which is essential for estimating the effect of measurement error for the whole NRI data.

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Supporting Grant: Cooperative Agreement No. 68-3A75-4-122 between the USDA Natural Resources Conservation Service and the Center for Survey Statistics and Methodology at Iowa State University

ORAL PRESENTATION

ADDITIVE HAZARDS REGRESSION AND PARTIAL LIKELIHOOD ESTIMATION FOR ECOLOGICAL MONITORING DATA.

Zhu, Jun[1]; Lin, Feng-Chang[1]
[1]*University of Wisconsin-Madison; University of North Carolina-Chapel Hill*

We develop continuous-time models for the analysis of environmental or ecological monitoring data such that subjects are observed at multiple monitoring time points across space. Of particular interest are additive hazards regression models where the baseline hazard function can take on flexible forms. We consider time-varying covariates and take into account spatial dependence via autoregression in space and time. We develop statistical inference for the regression coefficients via partial likelihood. Asymptotic properties, including consistency and asymptotic normality, are established for parameter estimates under suitable regularity conditions. Feasible algorithms utilizing existing statistical software packages are developed for computation. We also consider a simpler additive hazards model with homogeneous baseline hazard and develop hypothesis testing for homogeneity. A simulation study demonstrates that the statistical inference using partial likelihood has sound finite-sample properties and offers a viable alternative to maximum likelihood estimation. For illustration, we analyze data from an ecological study that monitors bark beetle colonization of red pines in a plantation of Wisconsin.

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ORAL PRESENTATION

CALIBRATION OF SOIL EROSION ESTIMATES UNDER NEW PROTOCOLS.

Zhu, Zhengyuan[1]; Li, Yang[1]
[1]*Iowa State University*

Universal Soil Loss Equation is a model that predicts the long term average annual rate of soil erosion caused by rainfall. It was replaced by the more sophisticated RUSLE2 (Revised USLE 2) model in 2006. Data for computing both USLE soil loss estimates and RUSLE2 estimates were collected between 2002 and 2006 for validation. USLE estimates were used to estimate long term soil erosion trend and as an input to compute weights for other NRI variables. To maintain consistency, it is necessary to impute USLE estimates after 2006 and RUSLE2 estimates before 2002. We first present statistical models to predict soil loss estimates from one soil loss model using the variables from the other one. With the aid of cross validation, we assess three different fitting methods: simple linear regression, multiple linear regression (MLR), and multivariate adaptive regression splines (MARS). Next we investigate methods for imputation of USLE estimates shortly after 2006. Reliable imputation is achieved by modeling the change of USLE estimates between neighboring years.

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POSTER PRESENTATION

ACCURACY ASSESSMENT OF FOREST DISTURBANCE MAPPING.

Zimmerman, Patrick[1]
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Rigorous statistical approaches to assessing the accuracy of thematic maps have become increasingly popular in the field of remote sensing. This talk will present an accuracy assessment of a forest disturbance map of the Lake Superior and Lake Michigan drainage basins as a case study. Issues related to sampling design and estimation procedures including comparisons of the accuracies of different maps will be discussed.

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ADDENDUM TO THE BOOK OF ABSTRACTS

POSTER PRESENTATION

INVESTIGATIONS INTO SPECIES INVASION AND DISEASE TRANSMISSION AT THE INTERFACE BETWEEN MATHEMATICS AND BIOLOGY.

Jansen, Maria[1]; Rittenhouse, Matthew[2]; Soltau, Kari[2]; Van Calster, Kacie[1]; Bennie, Barbara[1]; Haro, Roger J. [2]; Peirce, James P. [1]; Sandland,Gregory J. [2]

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The methods employed by mathematicians and statisticians have emerged as critical tools for modeling complex biological phenomena, predicting biological patterns, and analyzing large amounts of biological data. Unfortunately, collaborations rarely occur between scientists from these different disciplines, which ultimately hampers our ability to investigate important biological patterns. Recently members from the departments of mathematics and biology at the University of Wisconsin – La Crosse were awarded a collaborative grant from the National Science Foundation (NSF) to establish a program in Mathematical Biology. The UBM-Collaboration on Riverine Ecology (UBM-CORE) program is a three-year undergraduate research, learning, and peer-mentoring experience designed to facilitate the development of twenty-first century biologists and mathematicians with broad, interdisciplinary scientific training. To date, four undergraduates are involved in the program which requires student teams to develop research projects at the interface between mathematics and biology. Research investigations are currently centered on species invasions and disease outbreaks in the upper Mississippi River. More specifically, students are using combinations of experimental results and differential equation/statistical models to 1) understand the role of host competition in parasite transmission, and 2) investigate how infected and uninfected hosts allocate resources to different life-history traits. Through this program, we aim to develop students with the knowledge necessary for bridging current gaps between biology and mathematics.

Final Program

3rd North American Regional Meeting, TIES 2011
Radisson Hotel, La Crosse, Wisconsin

July 18-20, 2011

Monday

12:00 – 13:00 Registration

13:00 - 13:15 Opening comments

13:15 - 14:45 **Statistical Problems in Past, Present and Future Climate Studies**
Chair and Organizer: Bo Li, Purdue University

The Reliability of Multiproxy Global Temperature Reconstructions
Blake McShane, Northwestern University

Spatial ANOVA Modeling of High-resolution Regional Climate Model Outputs from NARCCAP
Emily Kang, Statistical and Applied Mathematical Sciences Institute (SAMSI)

Paleoclimate Reconstruction Using Long-Memory Processes
Luis Barboza, Purdue University

14:45 - 15:15 Break

15:15 - 16:45 **Statistical Models for the Analysis of Binary Matrices in Ecological Problems**
Chair and Organizer: Robert M. Dorazio, U.S. Geological Survey and University of Florida

Inference in Food Webs Based on Maximum Likelihood and Bayesian Approaches
Stefano Allesina, The University of Chicago, Chicago

Estimating Abundance-Based Patterns of Species Co-occurrence Using Phylogenetic Data and Spatial Covariates
Robert M. Dorazio, U.S. Geological Survey and University of Florida; Edward F. Connor, San Francisco State University

Horse Racing and the Assembly of Ecological Communities: A Novel Application of the Plackett-Luce Model to Biology
Joshua Ladau, Gladstone Institutes, GICD; Edward F. Connor, San Francisco State University

18:00 - 20:00 Welcome Reception and Poster Presentations, Radisson Ballroom A

Tuesday

7:00 – 8:00 Breakfast

8:00 – 10:00 **Temporal Trend Estimation Using Bird Survey Data**
Chair and Organizer: John Sauer, USGS Patuxent Wildlife Research Center

Black Duck Population Change in Eastern North America: Estimation Using Information from Several Surveys
John R. Sauer, US Geological Survey

Estimating Population Change of Mottled Duck from Multiple-Platform Surveys
Mark C. Otto, US Fish and Wildlife Service

Estimating Population Change from the Breeding Bird Survey Using Open Population N-Mixture Models
Richard Chandler, US Geological Survey

Controlling for Detectability in Count Survey Data: a Comparison of Approaches
William A. Link, US Geological Survey

10:00 - 10:30 Break

10:30 - 12:00 **Forest Inventory and Monitoring Using Time Series of Ground and Remotely Sensed Data**
Chair and Organizer: Ron McRoberts, U.S. Forest Service

Modeling a Spatially Explicit Time Series of Woody Biomass
Mark D. Nelson, U.S. Forest Service; Ronald E. McRoberts, U.S. Forest Service; Kirk M. Stueve, U.S. Forest Service; Sean P. Healey, Rocky Mountain Research Station,U.S. Forest Service

Modeling the Impact of Drought on Tree Mortality Using National Forest Inventory Data
Greg C. Liknes, U.S. Forest Service; Patrick L. Zimmerman, U.S. Forest Service;Charles H. Perry, U.S. Forest Service; Christopher W. Woodall, U.S. Forest Service

Approaches to Remote Sensing-Based Change Detection
Ronald E. McRoberts, U.S. Forest Service; Lisa G. Mahal, University of Nevada, Las Vegas

12:00 - 13:15 Lunch (provided)

13:15 - 15:15 **Integrative Statistical Methods for Design and Analysis of Long-Term Ecological Monitoring Efforts**
Chair and Organizer: Robert A. Gitzen, University of Missouri

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The International Environmetrics Society's (TIES) 3rd North American Regional Meeting
July 18 – 20, 2011 / Radisson Hotel, La Crosse, Wisconsin (Prog. #112-41-01)

Registration Form:

Name: _____

Employer/Organization/Position: _____

Complete Mailing Address: _____

Daytime Phone (including area code):_____ Fax: _____

E-mail address: _____

FEES: Registration fee includes admission to all talks, conference program and abstract book, on-site continental breakfast and lunch on July 19 and 20, morning and afternoon coffee breaks, conference banquet on the La Crosse Queen Tuesday, July 19, and admission to the welcome reception on Monday, July 18. Registration implies permission for photos, publicity & inclusion in a participant list unless Continuing Education and Extension is notified in writing prior to the event.

Cancellation Policy: Full refund less $50 processing fee before July 11, 2011. No refunds on or after July 11. Substitutions will be accepted.

Registration: (Check which applies and circle appropriate fee)

	Postmarked on or before 6/10/11	**after 6/10/11**
☐ TIES Member Fee	**$225.00**	**$260.00**
☐ New TIES Member, developed country	**$260.00**	**$295.00**
☐ New TIES Member, developing country	**$225.00**	**$260.00**
(For listing of developing countries, please visit http://isi-web.org/developing)		
☐ Non- TIES member fee	**$290.00**	**$325.00**
☐ Full-time student Fee	**$120.00**	**$135.00**

Presentation Type: ☐ No Presentation ☐ Oral Presentation ☐ Poster Presentation

****Full-time students – Please provide this additional information:**

Supervisor's Name and E-mail address: _____

Expected Date of Thesis Submission: _____

Presentation Title (if applicable): _____

ACCOMMODATIONS:

Accommodations are available at the conference site, the Radisson Hotel (608.784.6680) and at Reuter Hall on the UW-La Crosse Campus. UW-La Crosse Reuter Hall Rate: $38 per night/per person. Each suite has four individually locked bedrooms, a kitchen, living room and shared bathroom. The rooms are air-conditioned. Internet access and morning and evening shuttles to and from the conference are complimentary. Each bedroom includes blanket, sheets, pillow and pillowcase (towel package available for purchase at time of Reuter Hall check-in or bring your own).

Please indicate your reservation with your conference registration.

☐ $38/night Reuter Hall Room Reservation-July 17
☐ $38/night Reuter Hall Room Reservation-July 18
☐ $38/night Reuter Hall Room Reservation-July 19
☐ $38/night Reuter Hall Room Reservation-July 20

Additional Guests: La Crosse Queen Banquet Cruise on the Mississippi

☐ Number of tickets at $25/person

Dietary requests for guests: _____

$_____TOTAL AMOUNT DUE

Special Needs / Dietary Requests: _____

_____

Registration Deadline: Monday, July 11, 2011

Method of payment:

☐ Check (made payable to UW-La Crosse) ☐ MasterCard ☐ Visa ☐ American Express

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Cardholder's Signature

Return this form along with your method of payment:

Mail: UW–La Crosse
Continuing Education Registration
205 Morris Hall, 1725 State St
La Crosse, WI 54601

Fax: 608.785.6547
Phone: 608.785.6538
On-line: www.uwlax.edu/conted
Toll-free: 866.895.9233

UW-L Continuing Education and Extension

Final Program

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BOOK OF ABSTRACTS

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Brian Gray, U.S. Geological Survey
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Local organizing committee

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Maria Jansen, Kacie Van Calster, Barbara Bennie, James P. Peirce, Department of Mathematics, University of Wisconsin-La Crosse; Matthew Rittenhouse, Kari Soltau, Roger J. Haro, Gregory J. Sandland, Department of Biology, University of Wisconsin-La Crosse

Time-Space Kriging for Large Datasets

Dong Liang, University of Iowa; Kumar, Naresh, University of Iowa

Climate and Life History: Lessons learned for the Indiana Bat

Kezia Manlove, Yellowstone Ecological Research Center; Robert Crabtree, Yellowstone Ecological Research Center; Jennifer Sheldon, Yellowstone Ecological Research Center; Lori Pruitt, Fish and Wildlife Service; Scott Pruitt, Fish and Wildlife Service

Can Extinction and Colonization be Accurately Estimated? Assessment of Dynamic Occupancy Modeling Through Simulation

Patrick McKann, Brian Gray, Wayne Thogmartin, Upper Midwest Environmental Sciences Center, US Geological Survey

Hierarchical Spatial Count Models of Mesocarnivore Abundance: Spatial Scaling of the Response

Wayne Thogmartin, United States Geological Survey, Upper Midwest Environmental Sciences Center; Dan Hertel, United States Fish and Wildlife Service, Habitat and Population Evaluation Team; Patrick McKann, United States Geological Survey, Upper Midwest Environmental Sciences Center; Rex Johnson, United States Fish and Wildlife Service, Habitat and Population Evaluation Team

Accuracy Assessment of Forest Disturbance Mapping

Patrick Zimmerman, USDA Forest Service, FIA

Abstracts

Listed in alphabetic order (by first author)

ORAL PRESENTATION

INFERENCE IN FOOD WEBS BASED ON MAXIMUM LIKELIHOOD AND BAYESIAN APPROACHES.

Allesina, Stefano[1]
[1]*University of Chicago*

Food webs are networks describing who eats whom in an ecosystem. The nodes (species) are connected by directed edges (feeding relations). Recently, I introduced likelihood-based methods to select among probabilistic models for food web structure. Here I give a brief overview of the problem and the methodological challenges. As an example, I show how taxonomic information can inform models for food web structure.

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Supporting Grant: NSF EF 0827493; NIMBioS

ORAL PRESENTATION

PALEOCLIMATE RECONSTRUCTION USING SELF-SIMILAR PROCESSES.

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We use a Bayesian filtering method to reconstruct the temperature anomalies in Celsius degrees in the Northern Hemisphere at the past millennium. Our method is different from the previous ones in that (1) we employed a long memory model to link the temperature and three forcings (greenhouse gases, volcanism and solar irradiance), the evidence of this long-memory behavior is suggested clearly from the data and (2) we carefully studied the proxy data that have been widely used and chose an optimal set according to a Principal Component Analysis. The memory component is fitted using spectral information of the temperature series during the last 100 years. The solution of this Bayesian problem is approximated by using a Markov-Chain Monte-Carlo method. Our results give us a reconstruction of the past unobserved anomalies over the period 998-1899 as well as a full evaluation of the reconstruction's uncertainty.

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POSTER PRESENTATION

SPATIO-TEMPORAL MODELING OF LONG-TERM TRENDS IN THE MARINE MACROFAUNAL COMMUNITY OF PORT VALDEZ, ALASKA.

Blanchard, Arny[1]
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Multidisciplinary oceanographic investigations and environmental monitoring comprise 40 years of research (1971 to 2010) in Port Valdez, Alaska, which is the site of the marine oil terminal where Alaska North Slope crude oil is transferred to oil tankers. Spatio-temporal modeling of environmental and biological variables integrated in a weight-of-evidence approach contributes to understanding effects of natural and anthropogenic stresses on fauna and key sources of variability within the ecosystem. Within the deep basin of the fjord, the sediment-dwelling invertebrate (macrofauna) community took up to 26 years to recover from the 9.2 magnitude Great Alaska earthquake that struck Prince William Sound March 27, 1964. Investigation of sediment characteristics at shallow sites adjacent to the marine oil terminal (1989 to 2010) shows that sediment polycyclic aromatic hydrocarbons (PAH) (from effluent discharged at the marine oil terminal) and trends in the faunal

community are weakly associated. Changes in PAH concentrations had stronger associations with the abundance of two tube-dwelling, marine worms (Galathowenia oculata and Melinna cristata). The worms responded negatively to PAH values much lower than a commonly applied sediment quality criterion (Effects Range-Low). Ecological interactions between biological communities and environmental gradients in flux (recovery of the physical environment from the earthquake and declining PAH concentrations) can be difficult to evaluate but analysis of trends using methods for correlated data was effective for demonstrating such interactions in macrofaunal communities of Port Valdez.

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ORAL PRESENTATION

MODELING POPULATION DYNAMICS AND DETECTION PROBABILITY USING BREEDING BIRD SURVEY DATA.

Chandler, Richard[1]; Royle, J. Andrew[1]; Sauer, John[1]; Pardieck, Keith[1]
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The Breeding Bird Survey (BBS) is the primary source of information on population dynamics of North American birds and is unique in its spatial and temporal coverage. Nonetheless, it has been criticized because it was not designed to estimate detection probability which could bias trend estimates if, for instance, increasing traffic noise has caused a decline in detection probability over time. A recently developed hierarchical model permits estimation of population trend and detection probability using simple repeated count data as collected by the BBS. We extended the model to include random observer effects on detection probability, and applied it to Golden-winged Warbler data. Our results support previous findings that this species has declined rapidly since 1966, and we found no evidence of a trend in detection probability over this time. In addition to yielding estimates of detection probability, this model provides a means of modeling recruitment and apparent survival, and thus it allows for the evaluation of hypotheses regarding the factors affecting long-term population dynamics.

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ORAL PRESENTATION

FILTERED KRIGING FOR SPATIAL DATA WITH HETEROGENEOUS MEASUREMENT ERROR VARIANCES.

Christensen, William F. [1]
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When predicting values for the measurement-error-free component of an observed spatial process, it is generally assumed that the process has a common measurement error variance. However, it is often the case that each measurement in a spatial data set has a known, site-specific measurement error variance, rendering the observed process nonstationary. We present a simple approach for estimating the semivariogram of the unobservable measurement-error-free process using a bias-adjustment of the classical semivariogram formula. We then develop a new kriging predictor which filters the measurement errors. For scenarios where each site's measurement error variance is a function of the process of interest, we recommend an approach which also uses a variance-stabilizing transformation. The properties of the heterogeneous variance measurement-error-filtered kriging (HFK) predictor and variance-stabilized HFK predictor, and the improvement of these approaches over standard measurement-error / filtered kriging are demonstrated using simulation. The approach is illustrated with climate model output from the Hudson Strait area in northern Canada. In the illustration, locations with high or low measurement error variances are appropriately down- or up-weighted in the prediction of the underlying process, yielding a realistically smooth picture of the phenomenon of interest.

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ORAL PRESENTATION

BACK TO THE FUTURE: OLD ALGORITHM + NEW HARDWARE = FAST INDEPENDENT SAMPLING FOR BAYESIAN SPATIOTEMPORAL MODELS.

Cowles, Mary Kathryn[1]
[1]*The University of Iowa*

Bayesian conditional autoregressive models are a popular choice for analyzing environmental data measured at sites on a regular grid and/or at equally-spaced time points. The standard Markov chain Monte Carlo (MCMC) algorithms for fitting these models often suffer from slow convergence. In this talk, a new R package is introduced that harnesses the computing power of graphical processing units (GPUs) -- the ordinary graphics cards that control the displays on our computer screens -- for Bayesian model fitting. The massive parallelism afforded by GPUs makes independent sampling from the Bayesian posterior and predictive distributions feasible for a broad class of CAR models, thereby avoiding the challenges inherent in using MCMC. Use of the new R package is illustrated with an analysis of spatial and temporal trends in Iowa vegetation based on data from satellite images.

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ORAL PRESENTATION

ESTIMATING ABUNDANCE-BASED PATTERNS OF SPECIES CO-OCCURRENCE USING FORAGING GUILDS AND SPATIAL COVARIATES.

Dorazio, Robert[1]; Connor, Edward[2]
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We developed a statistical model to estimate the abundances of species encountered while surveying a set of ecologically relevant locations -- as in a metacommunity of species. In the model we assume that abundances of related species (e.g., species of the same foraging guild) are correlated. We also assume that abundances vary among locations owing to systematic and stochastic sources of heterogeneity. For example, if abundances differ among locations owing to differences in habitat, then measures of habitat can be included in the model as covariates. Naturally, the quantitative effects of these covariates are assumed vary among species. In the model we also account for the effects of detection errors on the observed counts of each species. This aspect of the model is especially important for rare species that may be difficult to detect in multi-species surveys. We illustrate the model using point counts of avian species obtained while sampling a community of forest birds during the breeding season.

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ORAL PRESENTATION

A BAYESIAN HIERARCHICAL OCCUPANCY MODEL FOR TRACK SURVEYS CONDUCTED IN A SERIES OF LINEAR, SPATIALLY CORRELATED, SITES.

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Using river otter (Lontra canadensis) snow track survey data as a motivating example, we develop a 3-level occupancy model with parameters that describe (1) site-level occupancy probabilities, (2) otter movement (and thus, track availability), and (3) recorded presence-absence of tracks (conditional on the availability of tracks for detection). We incorporated several recent developments in occupancy modeling, including the presence of both false negatives and false positives, spatial and temporal correlation, and repeated sampling across distinct observers. We investigated optimal allocation of sampling effort (e.g. within and among snowfall events) using simulations. We also compared models that allowed site-level occupancy and track laying processes to be spatially correlated to models that assumed independence among sites. Both types of models (independence and spatial) performed well across a range of simulated parameter values, but the spatial model resulted in more accurate point estimates for detection parameters and credibility intervals with better coverage rates when data were spatially correlated. When applied to real data, the spatial model resulted in a higher estimate of the

occupancy rate than the baseline model (0.82 versus 0.59). A minimum of 15-20 helicopter flights, distributed among at least three unique snow events, were needed to meet precision goals (standard error of the occupancy estimate < 0:05). The 3-level model offers the potential to account for a significant source of heterogeneity in the detection of animal sign (e.g., scat, scent marks, tracks) and thus has relevance to many surveys conducted by natural resource agencies.

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ORAL PRESENTATION

PREDICTION AND DISCRIMINATION FOR POST-FIRE TREE MORTALITY IN THE WESTERN UNITED STATES.

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The ability to accurately discriminate between live and dead trees following wild and prescribed fires in the western US has important management and forest conservation implications. A recent review of statistical logistic regression models for predicting post-fire tree mortality described over two dozen models developed from tree mortality data from a wide range of geographic regions in the western US. But the ability of these models to accurately discriminate between tree death and survival across the range of conditions and species is largely unknown. We examined the discriminatory ability of 6 previously published models on 5 large datasets compiled from different regions of the western United States. We used traditional receiver operating characteristic curves to compare model sensitivity over all possible false positive rates. In addition we examined the sensitivity for specific false positive rates that are of interest to forest managers. A lack of consistent behavior for any single model across regions led us to describe the general features of tree populations and explanatory variables that produce good discriminators.

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ORAL PRESENTATION

INTEGRATING ECOLOGISTS AND STATISTICIANS IN LONG-TERM MONITORING.

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Integrating expertise of statisticians and ecologists is crucial for developing monitoring programs that produce relevant, useful information. We offer perspectives on three general "needs" related to quantitative considerations in monitoring. First, there is a high demand for strategies that meet multiple purposes and offer flexibility for dealing with changes in objectives and funding. Ecologists need to track broad-scale resource changes as well as address re-occurring and changing management questions. Some experts suggest that a monitoring framework optimized for one of these purposes could be combined with supplemental monitoring to meet other objectives; further applications of hybrid static/dynamic, probability/model-based designs may be especially valuable. Second, monitoring design continues to require more effective integration of statistical- and subject-matter expertise. Ecologists typically need significant help in thinking conceptually about general study design options, including thorough identification of relevant sources of bias and variance. Often ecologists are unclear about the importance of quantitative survey design and their primary role in setting quantitative objectives based on some intended uses of monitoring data and potential resource changes of concern. In addition to identifying sample sizes and trade-offs, power/precision examinations often serve as an unintended test of whether a monitoring study has a clear idea of its purpose. Finally, widespread development of complex monitoring designs means

there will be a continued high demand for expertise in complex design-based analyses, hierarchical modeling, and structural equation modeling.

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ORAL PRESENTATION

USING THE NATIONAL RESOURCES INVENTORY TO ANALYZE TRENDS IN RESOURCE CONDITION.

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The National Resources Inventory (NRI) is a longitudinal survey conducted by the U.S. Department of Agriculture's Natural Resources Conservation Service, in cooperation with the Center for Survey Statistics and Methodology (Iowa State University). The NRI utilizes a two-stage unequal probability area sampling approach. The NRI survey program provides data at 5-year intervals for the period 1982 to 2007; the data have assisted in the development of agri-environmental policies and programs at national and regional levels, starting with the 1985 Farm Bill. Data were collected every five years for the period 1982 to 1997; data collection has been annual since 2000. Numerous challenges have been encountered in developing a longitudinal data base covering this 25 year period. For example, budgets fluctuate, data collection technicians and technologies constantly change, and natural resource issues of interest evolve. Analysis of trends using NRI data is discussed in relation to these and other statistical and operational challenges.

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ORAL PRESENTATION

INTEGRATING DRIVERS AND RESPONSES IN CAUSAL NETWORKS USING STRUCTURAL EQUATION MODELING.

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Structural equation modeling (SEM) is a multiequational framework for studying causal networks. Two aspirations are distinctive for the method, (1) a desire to learn about causal relationships and (2) disentangling multiple interacting processes through the analysis of networks. SEM incorporates two major features (1) the inclusion of latent variables and (2) the analysis of path relations. SEM is best understood as an analysis framework and can be contrasted with the univariate model. While historically based on maximum likelihood procedures, Bayesian methods are starting to be incorporated in SEM practice, expanding the range of applications. Longitudinal data obtained through long-term monitoring can be analyzed in a number of ways within the SEM tradition. Currently, there is much interest in the style of analysis referred to as "latent trajectory models" (LTMs). LTMs build upon the latent variable modeling tradition within SEM, thereby capitalizing on the capabilities of SEM for (1) handling covariates, (2) nonlinear specification, (3) model testing, (4) model fit diagnostics, and (5) handling missing data. Within LTMs, trajectory intercepts and slopes are treated as random variables represented using latent variables; thus, the implementation is multi-level and incorporates random effects. This approach allows for each unit that is repeatedly observed to have an individual intercept and trajectory that differs from the group. The method also incorporates networks of relationships at multiple levels. In this paper, an introduction to this methodology including its strengths and limitations, will be presented using ecological examples.

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ORAL PRESENTATION

ESTIMATING VARIANCE COMPONENTS AND VARIANCE PARTITION COEFFICIENTS ON THE INVERSE LINK SCALE USING ESTIMATES FROM GENERALIZED LINEAR MIXED MODELS OF CROSS-CLASSIFIED DATA.

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Long-term environmental and ecological monitoring data are often be classified by two or more factors (e.g., data may derive from both multiple lakes and multiple years). We focus on cases where levels of each factor are treated as random, data will be modeled using a generalized linear mixed model (GLMM) with nonlinear link, and interest is in variance components (VCs) and relative variance components (variance partition coefficients, VPCs) on an inverse link scale. Previous studies of the estimation of VCs and VPCs on the inverse link scale from GLMM estimates have been limited to outcomes from nested designs. We propose an approach for calculating VCs and VPCs on the inverse link scale for discrete outcomes from two-way cross-classified random effects designs, and evaluate this method using Monte Carlo simulations of grouped binomial data. GLMMs were fitted using first-order marginal and penalized quasi-likelihood (PQL1), the REML analogue of PQL1 (RPQL1), Laplace estimation and Markov chain Monte Carlo. Bias and precision in VC and VPC estimates improved as group (cluster) size for both random main effects increased and, for a given main effect, when the number of groups associated with the alternate main effect increased. The influence of estimation method on bias and precision of VC and VPC estimates was typically slight when numbers of groups for both main effects were 10 and 20 but when numbers of groups equaled 5 were best under RPQL1.

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ORAL PRESENTATION

TRANSLATION: MOVING FROM DATA TO DECISIONS THROUGH STATISTICAL INFERENCE.

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The importance of aligning research questions with study design and statistical inference is important for any study, but particularly critical for when results are directly linked to management decisions. In reality, the level of sophistication of research questions and statistical methods can quickly exceed that justified by the data collected. For economic, statistical, and social reasons, it can be difficult to deviate from historic monitoring programs. However, a critical look at the information available in current monitoring data relative to the research and management goals is crucial for successful decision making. When there are substantial costs and/or significant resistance to updating existing protocol, the statistician must creatively communicate the importance of collecting new data to an audience with little, if any, statistical knowledge. We must build an accessible bridge between the data collected and the uncertainty in management decisions. Relatively simple computer simulations, coupled with graphical displays, provide one strategy for communicating the importance of aligning data collection with decision making to a wide audience of stake holders. I will provide an example related to the management decision of setting mortality limits.

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POSTER PRESENTATION

SPACE-TIME MODELING OF THE DIURNAL BEHAVIOR OF THE ATMOSPHERIC HYDROLOGIC CYCLE.

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Over time scales of hours to days, the atmospheric branch of the hydrologic cycle is strongly impacted by transport of water vapor and subsequent precipitation. Coupled through the water balance equation, both processes vary with the passage of large-scale weather systems but also exhibit characteristic diurnal cycles. The spatial variability of these day-to-night patterns provides important insight about the hydrologic cycle. / A multi-scale spatio-temporal model is developed to characterize the joint behavior of the water vapor transport and precipitation over central North America. The approach aims to identify the space-time variation of the mean behavior of both fields and their space-time coherence. Day-to-day changes are characterized at different spatial scales to distinguish scales at which systematic propagation is preferred. Model behavior is illustrated through a Bayesian analysis of regional reanalysis products and observed precipitation datasets.

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ORAL PRESENTATION

MODEL-BASED MONITORING OF SPATIO-TEMPORAL ECOLOGICAL PROCESSES.

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Static sampling designs for collecting spatial data are being used readily by ecologists, however, most ecological systems involve a multivariate spatial process that evolves dynamically over time. Efficient monitoring of such spatio-temporal systems can be achieved by modeling the dynamic system and reducing the uncertainty associated with the effect of design choice on unknown quantities of interest. Inherent dependence in the underlying process is critical for developing intelligent models that enable the specification of optimal designs for future monitoring efforts. We present a review of model-based monitoring methodology and examples of both adaptive and dynamic designs in plant and animal ecological studies.

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POSTER PRESENTATION

USING GRAPHICAL MODELS TO INCORPORATE EMPIRICAL EVIDENCE INTO THE EVALUATION OF LONG-TERM MONITORING EFFORTS.

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One facet of developing a successful long-term effectiveness monitoring program is formulating a conceptual model that outlines anthropogenic stressors and their hypothesized impacts on biological integrity. Benthic macroinvertebrates (BMI) are one of the primary tools for quantifying the cumulative impacts of land management activities on the biological integrity of stream ecosystems. While BMIs have been found to be extremely effective at characterizing chemical and physical conditions within lowland, urban, and some forested applications, to date no validation of the hypothesized responses of BMIs to management activities across a large spatial extent has been done. Additionally, the reliance on collecting macroinvertebrate data can be cost prohibitive for long term monitoring, thus verifying their utility as biondicators is imperative. We use data from the Pacific Anadromous Fish Strategy and Inland Fish Strategy Biological Opinions (PIBO) program to verify whether there is empirical evidence for the a priori hypothesized causal relationships using graphical models. Specifically, it is thought that macroinvertebrate assemblages will be negatively impacted by grazing and roads indirectly via within stream habitat degradation (more fine sediments), higher in stream temperatures, riparian habitat alterations (lower canopy cover). Possible moderating factors are watershed-level variables such as forest

type and slope. Incorporating empirical evidence into the evaluation of the conceptual model underpinning a monitoring program is a necessary step to provide a critical evaluation of whether the a priori set of measurable variables is appropriate for continued measuring.

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ORAL PRESENTATION

SPATIAL ANOVA MODELING OF HIGH-RESOLUTION REGIONAL CLIMATE MODEL OUTPUTS FROM NARCCAP.

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We consider current (1971-2000) and future (2041-2070) average seasonal surface temperature fields from two regional climate models (RCMs) driven by the same atmosphere-ocean general circulation model (GCM) in the North American Regional Climate Change Assessment Program (NARCCAP). We analyze the differences between future and current temperature fields and include the factor of season, the factor of RCM, and their interaction in a two-way ANOVA model. Noticing that classical ANOVA approaches doesn't include "spatial" modeling and can't account for the spatial variability across the domain, we propose to use the Spatial Random Effects (SRE) model for the main effects and interactions and build a spatial two-way ANOVA model hierarchically. Using the SRE model also enables us to model the spatial dependence through the spatial basis functions, and the computation associated with analyzing the high-resolution RCM outputs can be carried out efficiently, due to the fixed number of spatial basis functions in the SRE model and the resulting dimension reduction.

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ORAL PRESENTATION

BUILDING A BRIDGE TO MANAGEMENT: MAKING SCIENCE COUNT IN MANAGEMENT DECISION MAKING.

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Resource management decision making is a complex endeavor that incorporates science as well as social values. From a sociological and organizational standpoint, the enterprises of science and resource management tend to operate in different spheres. Scientists and managers have different fundamental objectives. Scientists want to understand how the world works. Managers want to manage land to achieve some conservation outcome. They want to use what is known about how the world works to help them make good decisions that increase the likelihood of achieving their desired outcomes. A common dilemma facing resource managers is how to best incorporate scientific information into the decision making process and how to employ monitoring information to help improve future management decisions. The challenge for both scientists and managers is how to work together to reduce the uncertainty that is associated with management decision making. Fortunately, corporate managers also want to make smarter decisions and to that end, decision analysis tools were developed. These tools were adapted to a resource management context and are now poised to revolutionize the practice of conservation on the ground. We will show some examples of how decision analysis tools are used for one-time and iterative resource management decisions (adaptive management). We will argue that explicitly tailoring monitoring to inform decision making in a modeling framework puts the hard thinking on the front end rather than the back end of the learning process and equips resource managers to meet the escalating conservation challenges that they face.

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POSTER PRESENTATION

TIME-SPACE KRIGING FOR LARGE DATASETS.

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Time-space Kriging (TSK) is an important development for multi-level spatiotemporal research and for addressing the problems of mismatch in the spatiotemporal scales, missing values across space and time and misalignment in the spatiotemporal datasets. Due to the convergence of spatial and temporal domains, TSK poses both modeling (non-separable and non-stationarity covariance) and computation (big n problem) challenges. Markov Cube (or spatiotemporal voxel) Kriging (MCK) is developed and its comparison is presented with the local TSK (LTSK). / / Like the classical Kriging methods, TSK requires a separable and stationary covariance assumption. Since the covariance structure across space and time varies differently, separable and stationary covariance assumptions are difficult to satisfy. The proposed MCK incorporates both non-stationary and non-separable covariance at multi-level spatiotemporal scales. Since TSK involves a O(n3) matrix decomposition, implementing TSK is computationally prohibitive using the traditional methods, especially for large datasets. The proposed MCK is a Bayesian hierarchical model that utilizes Gaussian Markov Random Fields (GMRF) priors to achieve the model richness and also spatiotemporal structures within GMRF priors for developing an efficient solution to the big n problem. MCK was implemented with- and with-out the local spatiotemporal random effects (MCK(l)) and MCK(0)), respectively. Cross-validation suggests that MCK(l) and LTSK outperformed MCK(0), but MCK(l) was computationally less efficient as compared to LTSK. The use of MCK(l) and LTSK are likely to advance exposure science to the next level by providing robust estimates of environ

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ORAL PRESENTATION

MODELING THE IMPACT OF DROUGHT ON TREE MORTALITY USING NATIONAL FOREST INVENTORY DATA.

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Numerous recent studies link widespread tree mortality to drought conditions. Because of concerns that climate change may be increasing the frequency, intensity, and duration of drought events, it is desirable to improve our understanding of the relationship of tree mortality to drought. The decline spiral model proposes tree mortality is frequently the result of inciting, predisposing, and contributing factors that work in concert. We examined the relative contributions of a host of factors that could lead to mortality using linear models. Data from the Forest Inventory and Analysis program of the USDA Forest Service were analyzed for the Great Lakes states of Minnesota, Wisconsin, and Michigan for the period 2000-2009, a time in which significant droughts were experienced in parts of the study area. The fate of individual trees was tracked on a five-year return interval, and the proportion of trees that died was modeled as a response to drought information, stand age, stand density, topography, and damage agents. Drought information included both the traditional Palmer Drought Severity Index as well as the Vegetation Drought Response Index, derived in part from satellite observations of vegetative conditions. Results indicate substantial spatial variability in the relative contributions of factors that lead to mortality. Future work exploring alternative modeling approaches that help identify causality and lead to better prediction of mortality patterns is suggested.

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ORAL PRESENTATION

CONTROLLING FOR DETECTABILITY IN COUNT SURVEY DATA: A COMPARISON OF APPROACHES.

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It has long been recognized that counts of animals can be unreliable as a basis for inference: not all animals are counted, and variation in the proportion of animals counted can be confounded with changes in abundance. For example, in the North American Breeding Bird Survey (BBS), new observers tend to be better birders than the observers they replace; change in the observer pool can be confounded with population change. / / Mark-capture-recapture (MCR) studies obtain information about individual animals, thus providing a basis for estimating detection probabilities. There is no question that MCR data are of greater inferential value than count survey data such as generated by the BBS. Nor can there be any question of the importance of accounting for factors influencing detection rates. However it seems that many analysts assume that to control for detectability one must be able to estimate detection rates. This is not true – analyses of the BBS, for instance, control for differences among and within observers. One result of this misconception is the application of closed population models in situations where there either is no closed population or the notion of a closed population can only be invoked by allowing for extreme individual heterogeneity in detection probabilities, with its inherent failings (Link 2003). Among analysts favoring estimation of detection probabilities, the N-mixture models developed by Royle (2004) and extended by Dail and Madsen (2010) have been enthusiastically received. This paper compares methods for count surveys, providing caveats regarding untestable modeling assumptions implicit in various approaches.

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ORAL PRESENTATION

ESTIMATING CHANGE IN SPECIES RICHNESS FROM REPEATED SAMPLING OF INCIDENCE DATA.

Magnussen, Steen[1]
[1]*Canadian Forest Service, Natural Resources Canada*

Four estimators of species richness are evaluated for estimation of change when data comes from a repeated survey of species incidence in a fixed set of forest inventory plots (quadrats). The evaluation is done with Monte Carlo simulations of simple random sampling from four case study populations with repeat observations of species incidence. Change estimated as the difference between the numbers of species observed on two sample occasions had the lowest root mean squared error, but it was frequently more biased than alternative model-based estimators of change. The bias issue and a poor coverage of computed confidence intervals dissuade the use of this estimator. An urn-type estimator - capable of capturing the temporal correlation in the incidence data - was, overall, a better choice in terms of bias and coverage of computed confidence intervals.

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POSTER PRESENTATION

CLIMATE AND LIFE HISTORY: LESSONS LEARNED FOR THE INDIANA BAT.

Manlove, Kezia[1]; Crabtree, Robert[1]; Sheldon, Jennifer[1]; Pruitt, Lori[2]; Pruitt, Scott[2]
[1]*Yellowstone Ecological Research Center;* [2]*Fish and Wildlife Service*

Migratory species present a unique problem for managers, in that changes in resources and conditions at any space-time combination in a species's life history may drive population decline. Efficient allocation of conservation resources relies on identifying the spatiotemporal life history "window" within which environmental thresholds are limiting. In this investigation, we propose a protocol for identifying these critical windows, and then apply the protocol in an effort to characterize the relationship between climate and population trends in the Indiana bat (Myotis sodalis), an endangered migratory insectivorous bat that has declined substantially in the last century. This analysis relies on a twenty-three year, multilocation response dataset, used in tandem with climate data derived from the NASA Terrestrial Observation and Prediction System (TOPS). Our protocol relies on a

strong understanding of the spatiotemporal life history of the species of interest to generate a set of potential physiological drivers, identification of proxy covariates for drivers that are not directly measurable (where appropriate), and then refinement of the proposed covariate set through the use of AIC variable importance and model selection. In the end, we find evidence that the critical climate driver for the Indiana bat is hibernacula temperature during the winter months.

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POSTER PRESENTATION

CAN EXTINCTION AND COLONIZATION BE ACCURATELY ESTIMATED? ASSESSMENT OF DYNAMIC OCCUPANCY MODELING THROUGH SIMULATION.

McKann, Patrick[1]; Gray, Brian[1]; Thogmartin, Wayne[1]
[1]*USGS-La Crosse*

Occupancy estimation is a method of determining the probability (psi) that a randomly selected site in an area of interest is occupied by a species during a survey event, given imperfect detection (p) of that species. Occupancy models may be extended to multi-year surveys, and, in this case, the dynamic probabilities of colonization (gamma), persistence (phi), and extinction (1-phi) can also be estimated. We used simulated dynamic occupancy data to investigate the performance of a published dynamic occupancy model written for WinBUGS (Royle and Kery, 2007). In the simulation, p, psi, gamma, and phi were varied in 135 plausible combinations. In an attempt to decrease the number of varying parameters, and to represent a reasonable size for a field study, the number of sites, the number of visits per site per year, and the number of years were fixed at 30, 5, and 5, respectively. All data were simulated using R; WinBUGS 1.4 was used for the analyses. While we found complex interactions among estimated parameters, some generalizations can be made. Low p had a major effect on the bias and precision of the estimation of all parameters. Neither p nor psi was affected by gamma and phi. Gamma was generally overestimated, and phi was generally underestimated. A fifth parameter, growth rate, defined as psi[year]/psi[year-1], was shown to have erratic behavior at lower levels of psi, and was grossly overestimated at low p and low psi.

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ORAL PRESENTATION

INCORPORATING RANDOM EFFECTS INTO CLASSIFICATION AND REGRESSION TREES FOR MODELING PRESENCE/ABSENCE OF A SPECIES.

McKelvey, Mark[1]; Dixon, Philip[1]
[1]*Iowa State University*

Classification and regression trees (CART) are a flexible, frequently-used method for modeling occupancy probabilities. Many studies include a cluster-type sampling design where there is a clear spatial correlation between sampling locations. This correlation causes the variance of the node occupancy estimates in CART to be biased. We suggest a generalized estimating equation (GEE)-based approach in which the naïve variance estimates (calculated as if all locations were independent) are "corrected" based on the data available in each parent node of the tree. The corrected variance estimates are then used to revise the binary-split decision criterion of the tree. We demonstrate this method using data from a study on bird occurrence in Oregon.

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ORAL PRESENTATION

CONSTRUCTING CONFIDENCE INTERVALS FOR REMOTE SENSING-BASED ESTIMATES OF DEFORESTATION.

McRoberts, Ronald E.[1]
[1]*Northern Research Station / U.S. Forest Service*

Estimation of deforestation, particularly for tropical developing countries, has become a priority activity in the context of climate change research and programs focused on reducing deforestation and forest degradation (REDD). Although the national forest inventories of countries with boreal and temperate forests typically have adequate ground sample data for this purpose, such is not the case for many tropical developing countries for which forest areas are remote and often inaccessible. For the latter countries, the Good Practice Guidance of the International Panel on Climate Change recommends the use of a combination of ground data from a sparse array of sample plots and satellite imagery as the most feasible and cost-effective sources of data for estimating deforestation. Within the remote sensing community, assessments of uncertainty of land cover classifications typically entail estimation of various measures of accuracy obtained from error matrices. Little attention has been paid to construction of confidence intervals for population parameters associated with classifications. For this study, deforestation was estimated using a post-classification approach consisting of a comparison of separate, independent forest/non-forest classifications for two dates. The probability-based, model-assisted difference estimator was used to obtain estimates of deforestatation adjusted for misclassification and to estimate variance of the estimate of deforestation.

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ORAL PRESENTATION

THE RELIABILITY OF MILLENNIAL MULTI-PROXY TEMPERATURE RECONSTRUCTIONS.

McShane, Blakeley[1]; Wyner, Abraham[1]
[1]*Northwestern University / University of Pennsylvania*

Predicting historic temperatures based on tree rings, ice cores, and other natural proxies is a difficult endeavor. The relationship between proxies and temperature is weak and the number of proxies is far larger than the number of target data points. Furthermore, the data contain complex spatial and temporal dependence structures which are not easily captured with simple models. / In this paper, we assess the reliability of such reconstructions and their statistical significance against various null models. We find that the proxies do not predict temperature significantly better than random series generated independently of temperature. Furthermore, various model specifications that perform similarly at predicting temperature produce extremely different historical backcasts. Finally, the proxies seem unable to forecast the high levels of and sharp run-up in temperature in the 1990s either in-sample or from contiguous holdout blocks, thus casting doubt on their ability to predict such phenomena if in fact they occurred several hundred years ago. / We propose our own reconstruction of Northern Hemisphere average annual land temperature over the last millennium, assess its reliability, and compare it to those from the climate science literature. Our model provides a similar reconstruction but has much wider standard errors, reflecting the weak signal and large uncertainty encountered in this setting.

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ORAL PRESENTATION

MODELING A SPATIALLY EXPLICIT TIME SERIES OF WOODY BIOMASS.

Nelson, Mark[1]; McRoberts, Ronald[1]; Stueve, Kirk[1]; Healey, Sean[1]
[1]*U.S.D.A. Forest Service, Forest Inventory and Analysis, Northern Research Station*

We used a Landsat Time Series Stack (LTSS) of satellite imagery, USA national forest inventory plot data, a vegetation change tracker algorithm, and a non-parametric Random Forests-based approach to model a twenty five year time series of above-ground live tree biomass in northern Lower Michigan, USA. The study area encompasses almost the entire historical breeding range of Kirtland's warbler (Dendroica kirtlandii), a federally endangered neotropical migratory songbird that nests only in young (5-23 years old) jack pine (Pinus banksiana) forest. Older jack pine forest is unsuitable as warbler habitat and is commercially harvested at 40 years of age for pulpwood utilization, generating revenue that partially offsets costs of warbler habitat management practices, including re-initiation of young forest for future habitat. Uncertainty over future pulpwood markets and growing interest in potential utilization of woody biomass for bio-energy applications illustrate a need for tracking woody biomass across time, including forests younger than are harvested for traditional products. Model outputs were used to produce a time series of maps of woody biomass, which were combined with ancillary datasets in a geographic information system to delineate biomass trends for jack pine forests within and surrounding Kirtland's warbler management areas, prior to, during, and following occupancy by Kirtland's warblers.

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Supporting Grant: NASA Applied Science Program, North American Forest Dynamcis (NAFD) project

ORAL PRESENTATION

THE NATIONAL RESOURCES INVENTORY: DESIGN AND ESTIMATION FOR CREATING A LONGITUDINAL DATABASE.

Nusser, Sarah[1]
[1]*Iowa State University*

Statistical procedures used in conducting the National Resources Inventory (NRI) are designed to produce longitudinal data for evaluating gross change in land cover/use, soil erosion and other natural resources. The theme of this session is to discuss examples of accommodating changes in objectives and available methodologies in the context a longitudinal survey. In this talk, we provide an overview of NRI sample design and estimation procedures developed in response to a need for annual NRI data. We begin by describing the annual supplemented panel design, which balances trend with status estimation, and explain how a generalized method of moments approach is used to mitigate the losses in sample size associated with smaller, more frequent surveys. We also discuss how imputation is used to integrate data from multiple observation units and develop a complete time series for each point included in the data set.

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Supporting Grant: USDA NRCS - ISU Cooperative Agreement 683A754122

ORAL PRESENTATION

NATIONAL AQUATIC RESOURCE SURVEYS: MULTIPLE OBJECTIVES LEADING TO DESIGN COMPLEXITY.

Olsen, Anthony R.[1]; Kincaid, Thomas A.[1]
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The US EPA began conducting the National Aquatic Resource Surveys (NARS) in 2007 with a national survey of lakes (NLA 2007) followed by rivers and streams in 2008-9 (NRSA 2008), coastal waters in 2010 (NCCA 2010) and wetlands in 2011 (NWCA). The surveys involve national, regional and state. In addition, since the surveys are implemented jointly by USEPA, states, tribal nations and other federal agencies, additional constraints are present that must be addressed by the design. Typically, the survey designs are stratified by state and within a state unequal probability selection incorporates other design information. Sites are selected using a spatially balanced GRTS design. In addition to the core national surveys, supplemental studies that focus on specific subpopulations are integrated into the design. In some cases this involves sampling sites from historical studies to estimate whether changes have occurred. The NWCA 2011 survey design is a two-stage design with the first stage based on an area frame design by the Fish & Wildlife Service's National Status & Trends monitoring for wetland acreage change and where the second stage design is a stratified, unequal probability survey design selected from wetland polygons identified from the first stage. Beginning in 2012, the second cycle of surveying each of the aquatic resources will begin with the NLA 2012 and includes objectives of estimating status in 2012 and change since 2007. This presentation will provide an overview of these surveys and discuss how the objectives and constraints for each survey were addressed.

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ORAL PRESENTATION

ESTIMATING POPULATION CHANGE OF MOTTLED DUCKS FROM MULTIPLE-PLATFORM SURVEYS.

Otto, Mark C.[1]
[1]*U.S. Fish and Wildlife Service*

We used a Poisson-log normal random effects model to estimate population size and change while accounting for detection from multiple survey platforms (air boat, helicopter, and fixed wing) and blocking on the sample units (segments) that were consistently observed each year. The multi-platform experiment was part of an annual aerial transect survey of breeding mottled ducks in Louisiana and Texas. In 2009-2010 both helicopter and air-boat were used to obtain detection rates, making visibility correction estimation difficult. The densities of total indicated birds (TIBs) were modeled with year-stratum fixed effects. Random segment effects nested within the Marsh-Other strata accounted for sampling consistent segments among years. The platform detection rates were modeled as changes in density observed relative to a reference platform. There was also an order effect between the air boat and the helicopter, where less birds were seen in the helicopter on segments the boat had run first. Observer differences were modeled on all half segments the fixed wing flew. We compared population change estimates and visibility correction factors from the hierarchical model with tradition survey estimates.

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ORAL PRESENTATION

THE CURIOUS CASE OF CAMAS: LESSONS LEARNED FROM AN EDIBLE LILY.

Rodhouse, Thomas J.[1]; Lyon, Jason W.[2]; Irvine, Kathryn M.[3]
[1] National Park Service Upper Columbia Basin Network; [2] National Park Service Nez Perce National Historical Park; [3] USGS Northern Rockies Science Center

Increasingly, environmental monitoring programs are being used to inform the adaptive management process and guide decisions regarding restoration and other active management. Probabilistic models developed from and updated with monitoring data explicitly embrace uncertainty and provide a formal basis for evaluating hypotheses about the system in question. Other less-formal processes such as teamwork and open communication between modelers and managers are also critical. We describe an ongoing land management decision-making process that began in 2005 with the initiation of monitoring of the culturally and ecologically significant wetland plant Camassia quamash (camas) in two western US National Park units. Multiple sources of information, including population trends in camas estimated using spatially-explicit Bayesian hierarchical models, have been brought to bear on decisions concerning livestock grazing and active restoration of old drainage ditches. Models have been updated as new data become available, becoming increasingly complex and information-rich over time. Field trips with team members and outside experts have generated new insights, rounding out the holistic strategy taken to "bridge the gap" between models and management. Our example represents a real-world, albeit messy, example of how data-rich monitoring programs can be harnessed to serve an active land management program.

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ORAL PRESENTATION

BLACK DUCK POPULATION CHANGE IN NORTH AMERICA: ESTIMATION USING INFORMATION FROM SEVERAL SURVEYS.

Sauer, John R.[1]; Zimmerman, Guthrie S.[2]; Link, William A.[1]; Otto, Mark[2]
[1]USGS Patuxent Wildlife Research Center; [2]US Fish and Wildlife Service

Waterfowl have been surveyed in eastern Canada and the northeastern United States using both transect-based surveys from fixed-wing aircraft and plot-based surveys conducted with helicopters. The surveys vary in extent, but overlap exists in a core area of 9 strata covering portions of all provinces from Ontario East to Newfoundland. We estimated population change for American black duck (Anas rubripes) and other species from these surveys using a log-linear hierarchical model that accommodates differences in sample design and visibility associated with these survey methods. Precision of estimates varied widely by species and region, with transect surveys providing less precise results than plot surveys for black ducks in areas of overlap. Using a combined analysis of the surveys based on total indicated birds, we estimated the American black duck population to be 822500 (682600, 1065000) in 2010 in the surveyed area. The composite survey for black ducks in the eastern survey region produced estimates with an average yearly CV of 10.6 %. We describe prospects and approaches for integrating information from other surveys that monitor black duck populations.

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ORAL PRESENTATION

MODELING THE PRESENCE AND ABSENCE OF FISH IN A STREAM NETWORK.

Short, Margaret[1]
[1]University of Alaska Fairbanks

We propose a spatial model for the presence and absence of fish in a stream network. This model extends a moving average approach developed by Jay Ver Hoef and Erin Peterson to binary data. Distances are measured along the stream network rather than straight-line. Our model incorporates covariates. We use a Bayesian approach, implemented via Markov chain Monte Carlo. We illustrate using a Nushagak data set. This represents joint work with the Alaska Department of Fish and Game. /

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ORAL PRESENTATION

INVESTIGATING THE RELATIONSHIP BETWEEN SPATIAL AUTOCOVARIANCE FUNCTION RANGE PARAMETERS AND PATCH SIZES IN ECOLOGICAL LANDSCAPES.

Som, Nicholas A.[1]; Irvine, Kathryn, M.[2]; Ganio, Lisa M.[1]

[1]Department of Forest Ecosystems and Society, Oregon State University; [2]Northern Rocky Mountain Science Center, US Geological Survey

The geostatistical range parameter is often used to describe the size of patches in ecological landscapes, but no theoretical or empirical justification for their relationship exists. We generated simulated landscapes with varying spatial autocorrelation functions and properties, and defined and measured patches within these landscapes, to evaluate how range parameters and patch sizes may be associated. Our results indicate that the association of range parameters and patch sizes is related to both the smoothness of the spatial process and the proportion of total variance (sill) attributed to nugget effects. We present our findings and relate these results to field data to evaluate these patterns in real-world data.

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POSTER PRESENTATION

HIERARCHICAL SPATIAL COUNT MODELS OF MESOCARNIVORE ABUNDANCE: SPATIAL SCALING OF THE RESPONSE.

Thogmartin, Wayne[1]; Hertel, Dan[2]; McKann, Patrick[1]; Johnson, Rex[2]

[1]United States Geological Survey, Upper Midwest Environmental Sciences Center; [2]United States Fish and Wildlife Service, Habitat and Population Evaluation Team

Most species distribution models examining environmental effects at multiple spatial scales vary in spatial extent. Spatial scale, however, is the integration of extent and resolution, or grain. We developed models for 6 mammalian nest predators in the Prairie Pothole Region of the north-central United States, varying model response as a function of spatial resolution. The original counts of predators were systematically collected using track surveys on a 50,873 km^2 grid resolved to a resolution of 16 mi^2. We developed hierarchical spatial count models predicting mammalian abundance at this resolution and at resolutions of 4 mi^2 and 1 mi^2. The models we developed improved prediction of areas of absence as resolution became finer. However, models consistently under-predicted abundance at all scales, and as the resolution became finer, the ability to correctly predict counts declined relative to the models at coarser resolution. Thus, there was a tension between correct prediction of areas occupied at the finest scale and correct prediction of abundance at the coarsest scale. For the most abundant species (raccoon and coyote) we were able to develop scaling relations among model parameters to predict species occurrence and abundance at finer and coarser scales than we modeled. Our models and maps allow managers to focus their conservation resources to finer areas of the region, ostensibly improving the efficacy of conservation action.

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ORAL PRESENTATION

A HIERARCHICAL MULTI-SCALE DOWNSCALING APPROACH FOR EVALUATING THE RESPONSE OF ENDANGERED FISH POPULATIONS TO CLIMATE CHANGE.

Wikle, Christopher[1]

[1]University of Missouri

In order to understand potential climate influences on fish populations in riverine ecosystems, one must consider multiple scales of variability. In particular, one must consider scales from global climate, regional climate and weather, watersheds, river hydrology to individual response. This presentation will consider a framework that attempts to account for the uncertainty across these scales in order to evaluate the impact of potential climate changes on population distributions of the endangered pallid sturgeon in the Missouri River ecosystem.

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ORAL PRESENTATION

A MEASUREMENT STUDY IN A LONGITUDINAL SURVEY WITH ERRORS-IN-VARIABLES.

Yu, Cindy[1]; Riddels, Minsun[1]
[1]*Department of Statistics, Iowa State University*

The National Resources Inventory (NRI) is a large-scale longitudinal survey conducted to assess trends and conditions of nonfederal land. A key NRI estimate is year-to-year change in acres of large urban, small water body and small streams. Data collection is done through photo interpretation. In 2010, a digital photo with options of red, blue and green bands (RBG) or RBG with color infrared (CIR) band was implemented replacing film or analog. Data using film, digital image with RGB bands and digital image with RGB+CIR bands will be compared to examine the effects of the introduction of digital image and inclusion of color infra-red on measurements of NRI variables. A measurement error model is postulated for the relationship, where duplicate measurements are used to estimate one of the error variances. Analyses on the data suggest that the relationship is a line with an intercept of zero and a slope of one, therefore the observations currently used are acceptable. The talk also provides models of the measurement error variances as functions of variables of interest, which is essential for estimating the effect of measurement error for the whole NRI data.

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Supporting Grant: Cooperative Agreement No. 68-3A75-4-122 between the USDA Natural Resources Conservation Service and the Center for Survey Statistics and Methodology at Iowa State University

ORAL PRESENTATION

ADDITIVE HAZARDS REGRESSION AND PARTIAL LIKELIHOOD ESTIMATION FOR ECOLOGICAL MONITORING DATA.

Zhu, Jun[1]; Lin, Feng-Chang[1]
[1]*University of Wisconsin-Madison; University of North Carolina-Chapel Hill*

We develop continuous-time models for the analysis of environmental or ecological monitoring data such that subjects are observed at multiple monitoring time points across space. Of particular interest are additive hazards regression models where the baseline hazard function can take on flexible forms. We consider time-varying covariates and take into account spatial dependence via autoregression in space and time. We develop statistical inference for the regression coefficients via partial likelihood. Asymptotic properties, including consistency and asymptotic normality, are established for parameter estimates under suitable regularity conditions. Feasible algorithms utilizing existing statistical software packages are developed for computation. We also consider a simpler additive hazards model with homogeneous baseline hazard and develop hypothesis testing for homogeneity. A simulation study demonstrates that the statistical inference using partial likelihood has sound finite-sample properties and offers a viable alternative to maximum likelihood estimation. For illustration, we analyze data from an ecological study that monitors bark beetle colonization of red pines in a plantation of Wisconsin.

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ORAL PRESENTATION

CALIBRATION OF SOIL EROSION ESTIMATES UNDER NEW PROTOCOLS.

Zhu, Zhengyuan[1]; Li, Yang[1]
[1]*Iowa State University*

Universal Soil Loss Equation is a model that predicts the long term average annual rate of soil erosion caused by rainfall. It was replaced by the more sophisticated RUSLE2 (Revised USLE 2) model in 2006. Data for computing both USLE soil loss estimates and RUSLE2 estimates were collected between 2002 and 2006 for validation. USLE estimates were used to estimate long term soil erosion trend and as an input to compute weights for other NRI variables. To maintain consistency, it is necessary to impute USLE estimates after 2006 and RUSLE2 estimates before 2002. We first present statistical models to predict soil loss estimates from one soil loss model using the variables from the other one. With the aid of cross validation, we assess three different fitting methods: simple linear regression, multiple linear regression (MLR), and multivariate adaptive regression splines (MARS). Next we investigate methods for imputation of USLE estimates shortly after 2006. Reliable imputation is achieved by modeling the change of USLE estimates between neighboring years.

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POSTER PRESENTATION

ACCURACY ASSESSMENT OF FOREST DISTURBANCE MAPPING.

Zimmerman, Patrick[1]
[1]*USDA Forest Service, FIA*

Rigorous statistical approaches to assessing the accuracy of thematic maps have become increasingly popular in the field of remote sensing. This talk will present an accuracy assessment of a forest disturbance map of the Lake Superior and Lake Michigan drainage basins as a case study. Issues related to sampling design and estimation procedures including comparisons of the accuracies of different maps will be discussed.

Patrick Zimmerman, 995 Montana Ave W, Saint Paul, MN 55117
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ADDENDUM TO THE BOOK OF ABSTRACTS

POSTER PRESENTATION

INVESTIGATIONS INTO SPECIES INVASION AND DISEASE TRANSMISSION AT THE INTERFACE BETWEEN MATHEMATICS AND BIOLOGY.

Jansen, Maria[1]; Rittenhouse, Matthew[2]; Soltau, Kari[2]; Van Calster, Kacie[1]; Bennie, Barbara[1]; Haro, Roger J. [2]; Peirce, James P. [1]; Sandland,Gregory J. [2]

[1]Department of Mathematics, University of Wisconsin-La Crosse;[2] Department of Biology, University of Wisconsin-La Crosse

The methods employed by mathematicians and statisticians have emerged as critical tools for modeling complex biological phenomena, predicting biological patterns, and analyzing large amounts of biological data. Unfortunately, collaborations rarely occur between scientists from these different disciplines, which ultimately hampers our ability to investigate important biological patterns. Recently members from the departments of mathematics and biology at the University of Wisconsin – La Crosse were awarded a collaborative grant from the National Science Foundation (NSF) to establish a program in Mathematical Biology. The UBM-Collaboration on Riverine Ecology (UBM-CORE) program is a three-year undergraduate research, learning, and peer-mentoring experience designed to facilitate the development of twenty-first century biologists and mathematicians with broad, interdisciplinary scientific training. To date, four undergraduates are involved in the program which requires student teams to develop research projects at the interface between mathematics and biology. Research investigations are currently centered on species invasions and disease outbreaks in the upper Mississippi River. More specifically, students are using combinations of experimental results and differential equation/statistical models to 1) understand the role of host competition in parasite transmission, and 2) investigate how infected and uninfected hosts allocate resources to different life-history traits. Through this program, we aim to develop students with the knowledge necessary for bridging current gaps between biology and mathematics.

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