University of Northern British Columbia

SPATIAL AND TEMPORAL ANALYSES (NRES 712) – FALL 2013

Course Syllabus

Instructor: **Dr. Chris Johnson**
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Office: 8-215
Office hours: Friday 2:30-330

Class Meeting Rooms and Timing
Lecture room: Library 5-405 (Videoconference)
Lecture time: Wednesday & Friday 1:00-2:20
Lab room: 10-3034
Lab time: Tuesday ~9:00-10:50

Course Description
This course is designed to expose students to the concepts, issues, techniques, and assumptions one might consider or encounter when studying or interpreting spatial or temporal components of ecological phenomena. Topics will include scale; spatiotemporal correlation; analysis of spatial patterns; application of generalised linear models to spatiotemporal data; model construction and validation; experimental design and analysis in the context of autocorrelation/pseudoreplication; applications of remote sensing and GIS; and sensitivity/uncertainty analyses. This is not a statistics course, thus, the focus will be on application not mathematical derivation. Through lecture, discussion, and lab work we will critically review application, assumptions, and limitations of contemporary ideas and techniques found in the ecological literature. Students will be given an opportunity to work with, problem solve, and present their data in the context of the course objectives.

The learning objectives for the course are:

- introduction to contemporary topics and analytical developments for researchers working with spatial, temporal, or spatiotemporal data describing ecological processes or patterns;
- understand use and application of software for analysis of spatiotemporal data;
- appreciation for assumptions or limiting factors that confound spatiotemporal analyses;
- exercise and develop critical thinking skills relative to peer-reviewed published literature; and
- prepare and analyse data, write, and present a research paper.

Evaluation
The grade for this course will be based on a number of participatory and individual assignments. There will be no midterm or final exams. Students will be expected to present a published research paper and direct a critical review of that work (25%). During these seminars the class will be expected to read the assigned paper(s) and participate in the discussion (15%). Each student will have an opportunity to apply their own or a suitable data set to a method or question with a spatial or temporal component. Final research papers (35%) will be presented at the end of the semester (10%). To assist with this last task, I will provide a series of laboratory sessions and assignments describing data and techniques (15%).

Assignment	Grade	Due Date
Presentation of research paper(s)	25%	TBA
Participation in class	15%	semester
Completion of individual research paper	35%	Dec 2
Presentation of individual research	10%	Nov 27, 29
Lab assignments	15%	TBA

Dishonesty and Professional Conduct
Purposeful dishonesty and plagiarism is a serious offence both in the class room and the work place. If you are unsure of what constitutes ***Plagiarism*** or ***Cheating*** please consult the 2013-2014 UNBC Graduate Calendar (P.56) or instructor for definitions, explanation, and potential consequences. Ignorance is not a valid excuse.

Other Details
- The schedule of topics and assignments, as currently outlined in the syllabus, are subject to change with notification.
- Persons with disabilities requiring special learning approaches should contact the instructor and Disability Services early in the semester (http://www.unbc.ca/disabilities/index.html).

Schedule of Course Topics and Labs

Date	Lecture Type	Topic	Paper
Sep 6		Introduction to spatiotemporal data and analyses and course expectations	
Sep 11	Topic Intro	Inference – conducting 'rigorous' science in the real world	Platt 1964
Sep 13	**Discussion**	How good is the science of spatial ecologists?	Hargrove & Pickering 1992; Pigliucci 2001; Lechner et al. 2012
Sep 18	Topic Intro	Scale: what is it and why should we care?	Dungan et al. 2002
Sep 20	**Discussion**	The importance of scale in ecology	Benoit-Bird et al. 2013
Sep 25	*No class*		
Sep 27	*No class*		
Oct 2	Lecture	Autocorrelation: identification and solutions	Diniz-Filho et al. 2003; Dale & Fortin 2002
Oct 4	Lecture	Statistical techniques for observational data	Nielsen et al. 2005; Gillies et al. 2006
Oct 8	Lab	Introduction to generalised linear models and AIC	
Oct 9	Lecture	Statistical techniques for observational data and AIC	Johnson & Omland 2004
Oct 11	Guest Lec	Dr. Dan Ryan – Experimental design and time-series data	
Oct 14	Thanksgiving	Take a day-off!	Stephens et al. 2005; Whittingham et al. 2006
Oct 16	**Discussion**	Hypothesis tests or information theory?	Stephens et al. 2005; Whittingham et al. 2006
Oct 18	Topic Intro	Animal and plant distribution: theory and models	Johnson & Gillingham 2005
Oct 22	Lab	Introduction to Idrisi – raster GIS	
Oct 23	Topic Intro	Using expert knowledge in spatial ecology	Perera *et al*. 2012 – Book chapter S:/
Oct 25	**Discussion**	Evaluating and applying species distribution models	Moran-Lopez et al.2005; Martin et al. 2011
Oct 29	Lab	Introduction to ArcMap – more raster GIS	
Oct 30	Topic Intro	Relating theoretical to empirical movements: Brownian motion, cellular automata, random walks, and fractals	Mulder & Ruess 2001; Hansen et al. 2013
Nov 1	**Discussion**	Plant and animal dispersal, movement, and scale	Nams & Bourgeois 2004
Nov 5	Lab	Introduction to PASSAGE – pattern analysis software	
Nov 6	Topic Intro	Describing patterns in space and time	Baskent & Jordan 1995; Dale et al. 2002
Nov 8	**Discussion**	Advancing our measures of pattern	Hou & Walz 2013; Arnot et al. 2004
Nov 11	Remembrance D.	Start working on your paper!	
Nov 13	Topic Intro	Temporal cycles, stochastic events, and chaos theory	Lundberg et al. 2000
Nov 15	**Discussion**	Describing and understanding population cycles	Zalatan et al. 2006
Nov 20	Guest Lec	Dr. Mark Dale – Pattern analysis in ecology	
Nov 22	Lecture	Predicting change with time - Markov chains and transition matrices	Forrest et al. 2004
Nov 27		Project presentations	
Nov 29		Project presentations	

Course Readings

Arnot, C., P.F. Fisher, R. Wadsworth, and J. Wellens. 2004. Landscape metrics with ecotones: pattern under uncertainty. Landscape Ecology 19:181-195.

Baskent, E.Z., and G.A. Jordan. 1995. Characterizing spatial structure of forest landscapes. Canadian Journal of Forest Research 25:1830-1849.

Benoit-Bird, K.J., B.C. Battaile, C.A. Nordstrom, and A.W. Trites. 2013. Foraging behaviour of northern fur seals closely matches the hierarchical patch scales of prey. Marine Ecology Progress Series 479:283-302.

Dale M.R.T., and M.-J. Fortin. 2002. Spatial autocorrelation and statistical tests in ecology. Ecoscience 9:162-167.

Dale M.R.T., P. Dixon, M.-J. Fortin, P. Legendre, D.E. Myers and M.S. Rosenberg. 2002. Conceptual and mathematical relationships among methods for spatial analysis. Ecography 25:558–577.

Diniz-Filho, J.A.F., L.M. Bini, and B.A. Hawkins. 2003. Spatial autocorrelation and red herrings in geographical ecology. Global Ecology and Biogeography 12:53-64.

Dungan J., J.N. Perry, M.R.T. Dale, P. Legendre, S. Citron-Pousty, M.-J. Fortin, A. Jakomulska, M. Miriti, and M.S. Rosenberg. 2002. A balanced view of scale in spatial statistical analysis. Ecography 25:626–640.

Eycott, A.E., M. Marzano, and K. Watts. 2011. Filling evidence gaps with expert opinion: The use of Delphi analysis in least-cost modeling of functional connectivity. Landscape and Urban Planning 103:400-409.

Forrest, H.M., J.D. Witman, and H. Caswell. 2004. Markov chain analysis of succession in a rocky subtidal community. American Naturalist 164:E46-E61.

Gillies, C.S., M. Hebblewhite, S.E. Nielsen, M.A. Krawchuk, C.L. Aldridge, J.L. Frair, D.J. Saher, C.E. Stevens, and C.L. Jerde. 2006. Application of random effects to the study of resource selection by animals. Journal of Animal Ecology 75:887-898.

Hansen, I-J, C.J. Johnson, and H.D. Cluff. 2013. Synchronicity of movement paths of barren-ground caribou and tundra wolves. Polar Biology 36: 1363-1371.

Hargrove, W.W., and J. Pickering. 1992. Pseudoreplication: a *sine qua non* for regional ecology. Landscape Ecology 6:251-258.

Hou, W., and U. Walz. 2013. Enhanced analysis of landscape structure: Inclusion of transition zones and small-scale landscape elements. Ecological Indicators 31: 15-24.

Johnson, C.J., and M.P. Gillingham. 2005. An evaluation of mapped species distribution models used for conservation planning. Environmental Conservation 32:1-12.

Johnson, J.B., and K.S. Omland. 2004. Model selection in ecology and evolution. Trends in Ecology and Evolution 19:101-108.

Lechner, A., W.T. Langford, S.A. Bekessy, S.D. Jones. 2012. Are landscape ecologists addressing uncertainty in their remote sensing data? Landscape Ecology 27: 1249-1261.

Lundberg, P., E. Ranta, J. Ripa, and V. Kaitala. 2000. Population variability in space and time. Trends in Ecology and Evolution 15:460-464.

Martin, R.D., L. Brabyn, and M.A. Potter. 2011. Sensitivity of GIS-derived terrain variables at multiple scales for modeling stoat (*Mustela ermine*) activity. Applied Geography 31:770-779.

Moran-Lopez, R., J.L. Perez-Bote, E. Da Silva Rubio, C. Corbacho Amado. 2005. Summer habitat relationships of barbels in south-west Spain. Journal of Fish Biology 67:66-82.

Mulder, C.P.H. and R.W. Ruess. 2001. Long-term effects of changes in goose grazing intensity on arrowgrass populations – a spatially explicit model. Journal of Ecology 89:

Nams, V.O., and M. Bourgeois. 2004. Fractal analysis measures habitat use at different spatial scales an example with American marten. Canadian Journal of Zoology 82:1738-1747.
Nielsen, S.E., C.J. Johnson, D.C. Heard, and M.S. Boyce. 2005. Modelling species occurrence and abundance: does probability of occurrence reflect population density? Ecography 28:197-208.
Pigliucci, M. 2002. Are ecology and evolutionary biology "soft" sciences?" Annales Zoologici Fennici 39: 87-98.
Platt, J.R. 1964. Strong inference – certain systematic methods of scientific thinking may produce much more rapid progress than others. Science 146:347.
Stephens, P.A., S.W. Buskirk, G.D. Hayward, and C.M. Del Rio. 2005. Information theory and hypothesis testing: a call for pluralism. Journal of Applied Ecology 42:4-12.
Whittingham, M.J., P.A. Stephens, R.B. Bradbury, and R.P. Freckleton. 2006. Why do we still use stepwise modeling in ecology and behavior? Journal of Animal Ecology 75:1182-1189.
Zalatan, R., A. Gunn, and G.H.R. Henry. 2006. Long-term abundance patterns of barren-ground caribou using trampling scars on roots of *Picea mariana* in the Northwest Territories, Canada. Arctic, Antarctic, and Alpine Research 38:624-630.