University of Northern British Columbia

SPATIAL AND TEMPORAL ANALYSES (NRES 712) – FALL 2015

Course Syllabus

Instructor: **Dr. Chris Johnson**
Email: johnsoch@unbc.ca
Phone: 960-5357
Office: 10-4522
Office hours: Wednesday 11:00-12:00

Class Meeting Rooms and Timing
Lecture room: Teaching and Learning Centre 10-4034
Lecture time: Monday & Wednesday 1:00-2:20
Lab room: TBD
Lab time: TBD

Course Description
This course is designed to expose graduate 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; analysis in the context of autocorrelation/pseudoreplication; applications of remote sensing and GIS; spatially-explicit (predictive) models; and sensitivity/uncertainty analyses. In addition to techniques, we will discuss the philosophy of effectively working with and defending 'messy' spatiotemporal data. 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 (and beyond, including your research!). 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 GIS and statistical software for analysis of spatiotemporal data;
- appreciation for assumptions or limiting factors that confound spatiotemporal analyses;
- exercise and develop critical thinking skills relative to your own research as well as the 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%	TBD
Participation in class	15%	semester
Completion of individual research paper	35%	Dec 2
Presentation of individual research	10%	Nov 30, Dec 2
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 2015-2016 UNBC Graduate Calendar 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 the Access Resource Centre early in the semester (http://www.unbc.ca/access-resource-centre).

Schedule of Course Topics and Labs

Date	Lecture Type	Topic	Paper
Sep 9	Course Intro	Introduction to spatiotemporal data and analyses and course expectations	
Sep 14	Topic Intro	Inference – conducting 'rigorous' science in the real world	Pigliucci 2001
Sep 16	**Discussion**	How good is the science of spatial ecologists?	Hargrove & Pickering 1992; Lechner et al. 2012
Sep 21	Topic Intro	Scale: what is it and why should we care?	Dungan et al. 2002
Sep 23	**Discussion**	The importance of scale in ecology	Benoit-Bird et al. 2013
Sep 28	Lecture	Confronting spatiotemporal data with classical statistics –issues, philosophy, and methods.	Diniz-Filho et al. 2003; Johnson & Omland 2004
Sep 30	Lecture	Confronting spatiotemporal data with classical statistics – Generalised linear models	Nielsen et al. 2005; Gillies et al. 2006
Oct 5	Lecture	Confronting spatiotemporal data with classical statistics – Generalised linear models – continued	
Oct 6	Lab	Introduction to generalised linear models and AIC	
Oct 7	**Discussion**	Multi-model inference, hypothesis tests or information theory?	Stephens et al. 2005; Whittingham et al. 2006
Oct 12	**Thanksgiving**	Take a day-off!	
Oct 14	Topic Intro	Animal and plant distribution: theory and models	Johnson & Gillingham 2005
Oct 19	**Discussion**	Evaluating and applying distribution models	Moran-Lopez et al.2005; Malahlela et al. 2015
Oct 20	Lab	Introduction to Idrisi – raster GIS	
Oct 21	Topic Intro	Using expert knowledge in spatial ecology	Drescher et al. 2013
Oct 26	**Discussion**	Expert knowledge – science or opinion?	Poor et al. 2012; Hamilton et al. 2015
Oct 27	Lab	Introduction to ArcMap – more raster GIS	
Oct 28	Topic Intro	Theoretical and empirical movements: Brownian motion, cellular automata, random walks, and fractals	Nathan et al. 2008; Moorcroft 2012
Nov 2	**Discussion**	Relating observed and real movements to animal behaviour	Brillant et al. 2015; Cristescu et al. 2015
Nov 4	Topic Intro	Pattern analysis in spatial ecology	Baskent & Jordan 1995; Rosenberg & Anderson 2011
Nov 9	Guest Lect	Dr. Matt Mumma – challenges of measuring gene flow across space and time	Sawaya et al. 2014
Nov 10	Lab	Introduction to PASSAGE – pattern analysis software	
Nov 11	Remembrance D.	Start working on your paper!	
Nov 16	Guest Lect	Dr. Mark Dale – understanding and applying spatial autocorrelation to patterns of plant distribution Advancing our measures of pattern	
Nov 18	Topic Intro	Temporal variability, cycles, transitions, and stochasticity	Lundberg et al. 2000; Forrest et al. 2004
Nov 23	**Discussion**	Applying multiple methods to understand population cycles	Zalatan et al. 2006
Nov 25	Guest Lec	Dr. Mark Dale – Modelling the process of connectivity – Graph Theory	
Nov 30		Project presentations	
Dec 2		Project presentations	

Course Readings

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.

Brillant, S.W., A.S.M. Vanderlaan, R.W. Rangeley, C.T. Taggart, and T. Christopher. 2015. Quantitative estimates of the movement and distribution of North Atlantic right whales along the northeast coast of North America. Endangered Species Research 27:141-154.

Cristescu, B., G.B. Stenhouse, and M.S. Boyce. 2015. Predicting multiple behaviors from GPS radiocollar cluster data. Behavioral Ecology 26:452-464.

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.

Drescher, M., A.H. Perera, C.J. Johnson, L.J. Buse, C.A. Drew, and M.A. Burgman. 2013. Toward rigorous use of expert knowledge in ecological research. Ecosphere 4.

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.

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.

Hamilton, S.H., C.A. Pollino, and A.J. Jakeman. 2015. Habitat suitability modelling of rare species using Bayesian networks: Model evaluation under limited data. Ecological Modelling 299:64-78.

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

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, and 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.

Malahlela, O.E., M.A. Cho, and O. Mutanga. 2015. Mapping the occurrence of *Chromolaena odorata* (L.) in subtropical forest gaps using environmental and remote sensing data. Biological Invasions 17:2027-2042.

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.

Moorcroft, P.R. 2012. Mechanistic approaches to understanding and predicting mammalian space use: recent advances and future directions Journal of Mammalogy 93:903-916.

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.

Nathan, R. W.M. Getz, E. Revilla, M. Holyoak, R. Kadmon, D. Saltz, and P.E. Smouse. 2008. A movement ecology paradigm for unifying organismal movement research. Proceedings of the National Academy of Sciences of the USA 105:19052-19059.

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.
Poor, E.E., C. Loucks, A. Jakes, and D.L. Urban. 2012. Comparing habitat suitability and connectivity modeling methods for conserving pronghorn migrations. PLOS ONE 7:e49390.
Rosenberg, M.S., and C.D. Anderson. 2011. PASSaGE: Pattern Analysis, Spatial Statistics and Geographic Exegesis. Version 2. Methods in Ecology and Evolution 2:229-232.
Sawaya, M.A., S.T. Kalinowski, and A.P. Clevenger. 2014. Genetic connectivity for two bear species at wildlife crossing structures in Banff National Park. Proceedings of the Royal Society B 281:20131705.
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.