July 2-July 7, 2012

University of KwaZulu-Natal

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Program

July 1

Arrival of guests and local program

July 2 (Pre- Conference)

8:30	**WELCOME & OPENING**
8:45- 9:15	Farai Chirove: Mathematical Modeling of Infectious Diseases: In-host dynamics
9:30-10:00	Kevin Duffy & Bruce Page: Title TBA (see abstract)
10:15-10:45	**Tea**
10:45-11:15	Wayne Getz: HIV Models: Toys or Tools
11:30-12:00	Thomas Achia: Biostatistics and Biometry
12:15-2:00	**Lunch**
2:00- 2:30	Syd Ramdhani: Overview of research activities and interests
2:30-3:00	Corrie Schoeman: Ecological assembly rules in bat assemblages – patterns, processes and prospects
3:00-3:30	Bill Bishai: TBA
3:30-4:00	**Tea**
4:00- 4:30	Hermaine Mambili Mathematical modeling of the impact of growth inhibitory factors on the spatiotemporal growth of solid tumour in an avascular stage
4:45-5:15	Bala Pillay: TBA

July 3

8:30-10:00	Holly Gaff: Agent based modeling segment
10:00-10:30	**Tea**
10:30-11:30	Gregory Kiker: Simulating savanna ecosystems under differing environmental and management scenarios: exploring potential ecosystem management outcomes with a global uncertainty and sensitivity analysis erspective
11:30-12:30	Sood Ndimuligo: Assessment of chimpanzee (pan troglodytes) population and habitat in Kwitanga forest, western Tanzania
12:15-2:00	**Lunch**
2:00-3:00	Wayne Getz: Computational Population Biology: Linking the inner and outer worlds of organisms
3:00-3:30	**Tea**
3:30-4:15	Richard Fynn: Understanding the origins and basis of functional habitat heterogeneity in grazing ecosystems
4:15- 5:00	Sadie Ryan: Living Local in a Larger Landscape: Population, Environment and Climate in the Albertine Rift
5:00-5:30	Anna Stewart Ibarra: El Niño-Southern Oscillation for Dengue Early Warning in Ecuador
5:30 onwards	Social Gathering

July 4

8:30-10:00	Sadie Ryan: Arc GIS Segment
10:00-10:30	**Tea**
10:30-11:30	Barend Erasmus: Spatiotemporal dynamics of fuelwood resources in a rural savanna rangeland
11:30-12:30	Guy Midgely: Improving projections through combinations of models, experiments and observations of dynamic ecosystem change
12:15-2:00	**Lunch**
2:00 pm	Free afternoon (organized outing to aquarium)

July 5

8:30-10:00	Andy Lyons: Animal Movement Segment
10:00-10:30	**Tea**
10:30-11:30	Victoria Goodall: Hidden Markov models: uncovering animal behaviour patterns
11:30-12:30	Joe Chirima: Revisiting the ecological niche: biodiversity conservation challenges under a changing climate in African savannas
12:15-2:00	**Lunch**
2:00-2:30	Miriam Tsalyuk
2:30-3:00	Nancy Barker: Spatial Ecology of Brown Hyenas and Spotted Hyenas in the Madikwe Game Reserve, South Africa
3:00-3:30	**Tea**
3:30-4:00	Michael Hyman and Timothy Fullman: Statistical methods for predicting invasive species distributions at the landscape level
4:00- 4:45	Edward Mwavu: TBA
4:45-5:30	UAV Demonstration

July 6

8:30-10:00	Holly Gaff: Space Time Analysis
10:00-10:30	**Tea**
10:30-11:30	Fred Roberts: Meaningless Statements in Landscape Ecology and Environmental Sustainability
11:30-12:00	Immaculate Mungai: Land-Use Dynamics as Drivers of Degenerating Community-BasedForest Management Systems in the Kenyan Coast.
12:00-12:30	Annalie Melin: Understanding the landscape requirements for pollination services derived from managed honeybees
12:30-2:00	**Lunch**
2:00-2:45	Jennifer Miller: Using simulated data to quantify dynamic interactions between pairs of individuals
3:00-3:30	**Tea**
3:30-5:30	2 minute poster previews and poster session
6:30 onwards	Banquet

July 7

8:30-10:00	Sadie Ryan: Systems Thinking Segment
10:00-10:30	**Tea**
10:30-11:00	Meghan MacLean: Creating land cover maps using a single image or multiple images: which are more accurate?
11:00-11:30	Jana Eggleston: A small mammal community in a changing landscape, southeastern Virginia, 2005 – 2011
11:30-12:00	Adesoji Adeyami: Assessment of Tree species in the Faculty of Agriculture and Forestry, University of Ibadan, Nigeria
12:45-2:00	**Lunch and departure to Game Reserve**

Abstracts (Pre-conference)

Mathematical Modeling of Infectious Diseases: In-host dynamics

Faraimunashe Chirove
Chirovef@ukzn.ac.za

School of Mathematics, Statistics and Computer Science, UKZN, Pietermaritzburg Campus

Abstract

We use an n-strain model to show the effects of replicative fitness of competing viral strains exerting selective density-dependant infective pressure on each other. A two strain model was used to reveal the potential effects of such interactions. Analytic and numerical results were used to discuss HIV prognosis and implications regarding potential control mechanisms.

Title TBA

Bruce Page[1] and Kevin Duffy

brupage@gmail.com

[1]School of Life Sciences, UKZN
[2]Centre for Systems Research, DUT

Abstract

Our focus has been on problems in conservation ecology dealing with the influence of different members of the large mammal browser guild, particularly elephant and impala, on the structure and dynamics of savanna ecosystems. Elephants in particular are perceived as "systems engineers" that negatively influence many other species in the protected areas in which they are confined. We have used paired differential equations, movement models, home range estimation techniques, niche models and computer simulations to examine the interaction between browsers and trees and explore possibilities for facilitating coexistence. We began with simple elephant-tree models, but moved to a systems approach in which we investigate the relative influence of different members of the browser guild, and also differing survival responses and demographic characteristics of trees, on systems structure and dynamics. We present the results of our early models that investigated the likelihood of stable limit cycles in simple elephant-tree systems, that demonstrated that limit cycles are highly unlikely, and that point equilibrium between elephants and trees is possible. In later models we explored the effects of movements on coexistence between elephants and rare, highly selected for trees

vulnerable to herbivory, and showed that particular landscape configurations provided statistical refuges for threatened trees. We used niche modeling to predict potential habitats in a protected area for selected for vulnerable trees, and linked these to home range analyses to better determine how to conserve trees threatened by elephants, and showed that by manipulating water sources we could influence home range use and hence the persistence of threatened tree species. We developed models to determine the relative influence of different members of the browser guild on systems structure, by examining impacts from different guild members on trees with different demographic characteristics and survival responses to herbivory, and showed that both elephants and impala are able to strongly influence the structure of savannas. We then describe our current modeling philosophy and present some of the questions being addressed.

HIV Models: Toys or Tools

Wayne M. Getz
wgetz@berkeley.edu

Department of Environmental Science, Policy and Management
140 Mulford Hall, University of California, Berkeley, CA 94720-3114

School of Mathematical Sciences, University of KwaZulu-Natal
Private Bag X54001, Durban 4000, South Africa

Abstract

In this talk, I will discuss various approaches to developing models to address specific questions related to the HIV pandemic in Africa. These approaches are a selection of studies in which I have been involved over the past several years. They include:

1. Williams, Lloyd-Smith, Gouws, Hankins, Getz, Dye, Hargrove, de Zoysa, Auvert, 2006. *The potential impact of male circumcision on HIV incidence, HIV prevalence and AIDS deaths in Africa.* **PLoS Medicine** 3:e262.
2. Getz, 2008. *HIV dynamics and immuno-senescence.* **AIDS** 22:307-309.
3. Sánchez, Lloyd-Smith, Getz, 2010. *Monitoring linked epidemics: the case of TB and HIV.* **PLoS ONE** doi:10.1371.
4. Bellan, Fiorella, Melesse, Getz, Williams, Dushoff, in review. *The role of extra-couple HIV transmission in sub-Saharan Africa.*

I will focus on assumptions beyond the models, the amount realism included in the models, and what we concluded from the studies using these models.

Biostatistics and Biometry

Thomas Achia and Henry Mwambi
achiat@ukzn.ac.za

School of Mathematics, Statistics and Computer Science, UKZN

Abstract

The use of statistical approaches to describe, draw inference about, and explain random process has evolve tremendously over the past three centuries, and more so over the last two decades. Applications of novel statistical approaches are pervasive in all areas of science and include advance in, but not exclusive to, medicine, public health, epidemiology, agricultural, ecology and the social sciences. The need for evidence-based scientific knowledge and made the need for sound statistical methods and the corresponding skilled manpower, a modern day necessity.

The Statistics group at the School of Mathematics, Statistics and Computer Science, University of KwaZulu Natal, currently carries out multidisciplinary research work aimed at contributing to the global discourse and developing innovative methods in three key areas of focus: Biostatistics; Spatial statistics; and Time-series analysis. *The Biostatistics agenda* currently focuses methods for analysing of missing data, marginal effects modeling, transitional models, survival analysis, multi-state models, Latent model (Hidden markov models) and Longitudinal data analysis. *The Spatial Statistics agenda* ia focused on disease mapping and geostatistical methods for public health and epidemiology and currently studies HIV, TB, HIV/TB (HIV/STI/HSV-2) coinfection and malaria in Africa. Emphasis is currently on the use and development of Bayesian Markov Chain Monte Carlo (MCMC) and Integrated Nested Laplace approximations (INLA) approaches for spatial, spatiotemporal and multivariate disease and animal movement problems. Finally, *Time-series research group* focuses on the GARCH modeling, States space modelling and Multivariate modelling of returns time series and animal movement data.

Through collaborative research initiatives and engagement with other disciplines, the Statistics group endeavours to build manpower capacity for Africa in the area of Statistics and to contribute to the global need for evidence based decision making.

Bill Bishai
wbishai1@jhmi.edu
K-RITH, UKZN

Abstract: TBA

Overview of research activities and interests

Syd Ramdhani
syd_za@yahoo.com

School of Life Sciences (Biological and Conservation Sciences), Westville Campus, University of KwaZulu-Natal, Private Bag X54001, Durban, 4000, South Africa

Abstract

My research interests (with various collaborators) are primarily in the fields of phylogenetics and biogeography. The research spans various ecological levels and lineages, of mostly South African plants. Plant population level studies involve phylogenetic and phylogeographical studies of lineages that are characterised by non-monophyletic species. Consequently, the results cannot usually be interpreted in a strict taxonomic framework. Historical processes (e.g. glacial cycles) have to be invoked to explain results. At the community level, we have examined relationships between physical and phylogenetic distances to understand *in situ* competition dynamics between alien and indigenous plants. Phylogeograpical studies have been used identify Thicket refugia and also to understand historical vegetation dynamics over southern Africa. Research has been initiated on the endangered KwaZulu-Natal Sandstone Sourveld. This will focus on various biogeographical aspects and how this vegetation unit will respond to climate change. Some recent work has been at the global scale namely global zoogeographical regionalization and cosmopolitan tetrapod distributions. Models capable of integrating both an ecological and evolutionary data are needed to gain a better understanding of the spread of biota in space and time.

Ecological assembly rules in bat assemblages – patterns, processes and prospects

M. Corrie Schoeman
schoemanc@ukzn.ac.za

School of life Sciences, University of Kwazulu Natal, Durban 4000, South Africa;

Abstract

One of the principal questions of community ecology is whether local assemblages only exist in certain combinations or are they mere assemblages of species that happen to co-occur. Disentangling the different processes involved in the assembly of co-occurring taxa is not only interesting in itself but is also crucial for understanding how assemblages will behave under future environmental scenarios. The concept of assembly rules can be defined in a general framework where the co-occurrence of species is a product of chance, historical patterns of speciation and migration, dispersal, abiotic environmental factors and biotic interactions, with none of these processes being mutually exclusive. Bats are intriguing

models for assembly rule studies because they play vital roles as primary, secondary and tertiary consumers that support and sustain both natural and human-dominated ecosystems. Moreover, their life history characteristics - low fecundity, long life expectancy, low predation risk and stable populations- indicate that biotic interactions should strongly influence their assemblage structure.

Here I present an overview of four main types of approaches (species co-occurrence, niche limitation, guild proportionality and limiting similarity) used in my lab to test predictions of ecological assembly rules. Observed patterns in bat assemblages are compared with expected patterns derived from null models simulating random patterns of species assembly. Also, niche-based models are used to explore macroecological and biogeographic patterns of bat diversity. As expected, we have found evidence of non-random phenotypic and trophic patterns in bat assemblages in natural environments of southern Africa that may reflect competition and prey defence processes operating in tandem, or separately, at a local scale. Conversely, bat assemblages in urban reserves in Durban exhibit random species composition patterns, but significant nestedness, which suggests that diversity patterns may be driven by abiotic processes rather than competition. Broad-scale analyses, on the other hand, have identified explanatory variables – consistent with habitat heterogeneity and climate/productivity hypotheses - that explain, at least, the proximate determinants of bat richness in southern Africa.

We are conducting more thorough surveys using standardised methods to test for assembly rules in data sets spanning larger geographical scales in natural and human-dominated landscapes. In addition, we are compiling data to test phylogenetic assembly rules, i.e. restrictions on observed assemblages due to historical patterns of speciation and migration.

Mathematical modeling of the impact of growth inhibitory factors on the spatiotemporal growth of solid tumour in an avascular stage

H. Mambili-Mamboundou
Mambilimamboundou@ukzn.ac.za
School of Mathematics, Statistics and Computer Science, UKZN

In this work, we revisit the work by Chaplain on avascular tumour growth by deriving the equations modeling the interaction between tumour cells and Growth Inhibitor Factor (GIF). At first we proved using semi-groups that the steady state solution obtained from the model by Chaplain is globally stable and attracts all the solutions. Then we performed the mathematical analysis on the derived coupled model, and found a semi-trivial equilibrium and non trivial equilibria which could not be determined explicitly. But we showed using spectral analysis that the analysis of the semi-trivial equilibrium reduced to the one of a singular Strurm-Liouville problem, subject to homogeneous Neuman boundary conditions, and used the fortran based program SLEIGN2 to approximate the spectrum of the corresponding operator. In addition, numerical simulations of the coupled model are performed

Abstracts (Lectures)

Dynamics of tick-borne diseases during tick home range expansion

Holly Gaff, Wayne Hynes, Dan Sonenshine, Chelsea Wright and Robyn Nadolny,
Old Dominion University

Mathematical models can be used to explore tick-borne pathogen dynamics,quantify risk of tick-borne disease and identify optimal strategies to reduce that risk. Questing ticks have been collected from May 2009 to the present at ten separate locations in southeastern Virginia. This study identified the invasion of two new tick species from the south. One tick species has exhibited a continuous, diffusive type invasion while the other has a series of long distance dispersal events. An agent-based model has been parameterized using these data to explore the future disease dynamics in the region as a result of each type of invasion

Spatial analysis of movement data: Utilization distributions and behavior maps

Andy Lyons
Department of Environmental Science, Policy and Management
University of California, Berkeley, CA 94720-3114

ajlyons@berkeley.edu

The estimation of animal homeranges and utilization distributions is central to studying a range of ecological questions, and therefore one of the most common types of analysis used on movement data. In this session, we will review several of the 'classic' methods for homerange estimation, then work through a computer exercise using a relatively new method called T-LoCoH. T-LoCoH incorporates time such that the resulting homerange reflects both temporal and spatial partitioning of the landscape. T-LoCoH also extends the concept of utilization distributions beyond simple contours of occurrence, providing tools to generate 'behavior maps' based on time-use and movement metrics.

Abstracts (Didactic talks)

Simulating savanna ecosystems under differing environmental and management scenarios: exploring potential ecosystem management outcomes with a global uncertainty and sensitivity analysis erspective

G. Kiker[1] and R. Muñoz-Carpena[1]

[1] University of Florida – Department of Agricultural and Biological Engineering

carpena@ufl.edu, gkiker@ufl.edu

Abstract

When translating scientific information into adaptive outcomes, it is critical to integrate monitoring and simulation information into functional management plans and institutional learning opportunities. Complex spatial and agent-based models, along with their algorithmic assumptions, play an integral role in exploring potential adaptive responses to uncertain and potentially adverse ecological outcomes. The presence of uncertainty in these ecological models is widely acknowledged but seldom considered in their development and evaluation, specifically the effects of uncertain model inputs on the model outputs.

This talk introduces two ecosystem models, the QnD agent-based simulation model and the SAVANNA spatial ecosystem model and explores their use within the Kruger National Park. The models are linked with global sensitivity and uncertainty analysis (GSA) to achieve two objectives: (1) quantify the contribution of each uncertain input factor to the uncertainty in the output of the ecosystem model which evaluated the effects of climate and management on a range of ecosystem factors such as biodiversity or elephant population distribution and (2) determine the ranges of model inputs that produced a specific output for the purpose of formulating environmental management decisions. This research was carried out by employing GSA using two generic (model independent) methods, the qualitative screening Morris method and a quantitative variance based Sobol method coupled with Monte Carlo filtering. Example performance criteria were generated from SANParks documentation on thresholds of potential concern (TPCs) and recent elephant impacts literature. The coupled model/GSA system points to multiple sets of complex, interactive results that provide significant challenges to developing management alternatives in biodiversity and elephant impacts. One of the most useful functions of this coupled analysis may be to provide a more transparent linkage of Kruger Park ecosystem information into potential management decisions.

Assessment of chimpanzee (pan troglodytes) population and habitat in Kwitanga forest, western Tanzania

Sood A.Ndimuligo
sndimuligo@janegoodall.or.tz

Abstract

This study examined three aspects: estimation of chimpanzee (*Pan troglodytes*) population size, description of the plant community and assessment of human impacts to chimpanzee habitat in Kwitanga forest, western Tanzania. The overall estimated mean chimpanzee population density was 1.2(0.6–2.4) individuals per km^2 and a mean population size of 26(13-52) weaned individual chimpanzees in the forest. The natural vegetation in Kwitanga consists mainly of miombo woodland, dominated by *Brachystegia-Julbernadia* tree species, poorly developed riverine forest, cultivated land and oil palm plantation. Assessment of the abundance of nesting trees in the landscape revealed that tree species composition along transects were significantly different to nesting sites (trees surrounding the actual tree that contains a nest) (Kolmogorov-Smirnov test: KSa = 2.0148; D = 0.3934: P < 0.05). Thirteen tree species supported nests; the most species were *B. bussei*, *B. utilis*, *B. microphylla*, *J. globiflora* and *P. tinctorius*. The assessment on scarcity of nesting tree species in the landscape revealed that such species were abundant by proportion (KSa = 0.5883; D = 0.2308; P > 0.05), and species-specific density (Wilcoxon Z-test: Z = - 1.0265; U1= U2 = 13; p > 0.05). Trees in size classes between 10 cm and 40 cm diameter dominated the forest. The study on size suitability showed that there were significant differences (using ANOVA with Tukey's HSD post hoc test) in tree diameter size among the three groups: transects, nesting sites, and nesting trees. Nesting trees were unique in size to the other two groups. The mean size of nesting trees was larger compared to both nesting sites and transects (27 ± 1.1 cm; 23 ± 0.7 cm and 18 ± 0.5 cm) respectively. Similar differences existed in tree densities between nesting sites and transects (Wilcoxon test: Z = 1.8104; U1 = 46, U2 = 61: P< 0.05), with nesting sites presenting higher tree density. These results indicated scarcity in suitable nesting tree sizes and nesting materials in the landscape. Nesting tree species occur in the landscape, though their sizes and higher tree species density at nesting sites determined nesting location choice and specific nesting tree selection. Tree felling indicated by stumps was the major threat to the habitat, with a higher encounter rate of seven (7) stumps per km and contributed 48 % of total human disturbance, followed by established fields in the forest. The analysis on the direction of the major threat to the habitat revealed that, the main road cutting through the forest is a key to tree felling. Encountered stumps declined with increased distance from the main road towards the forest edge, with more stumps in between 0 -100 m (P< 0.05; log (Y) = 1.7017 - 0.0007(X); R^2 = 0.6705). Such findings implied the prison inside the forest as a major cause of habitat decline. At least 30 tree species constituted the group of stumps. *Julbernadia globiflora* and *Uapaca kirkiana* were the most felled tree species. High human disturbances implied by higher human activities encounter rates, and overlapping tree size classes between felled and standing trees were the major threats to chimpanzee habitat in Kwitanga forest. High chimpanzee density and population size estimates in Kwitanga forest renders this area a potential for conservation in the Greater Gombe Ecosystem Program. The replication of this method to a larger landscape with approximate area of 6000 km^2 indicated presence of higher chimpanzee population density 981 (varying from 501-1921) outside protected areas in western Tanzania. An area with various potential conservation values ranging from chimpanzees as an umbrella species to unique small mammals that are not well known to date. Thus Kwitanga being the largest remaining natural forest near Gombe National Park would increase habitat size to allow chimpanzee dispersal and feeding area. Connecting Kwitanga forest to the southern

chimpanzees 6000 km^2 unprotected landscape would support massive biologically important species while protecting watersheds for healthy Lake Tanganyika as well as adjacent local communities in various forms and functions. However, critical gaps exist among others are: there is no information on how long term climatic changes in the region have modified the Ecosystem we see today and future climate trends, ongoing human population increase and its implications to chimpanzee conservation with focus on land use and cover changes over time, understanding and mapping of chimpanzee ranges beyond known distribution than the current guided by experiences to well inform conservation managers, impacts of resource dynamics that support both cities and rural communities derived from such forests, how ecosystem goods and services have fluctuated over time as a function of human extraction and its implications to chimpanzees and the role of drivers of deforestation in shaping habitat used by the species in long term perspective. Landscape changes caused by both humans and environmental changes are threats to the long term chimpanzee and other biodiversity conservation in the region. Thus a need for collaborative work to enhance its integrity would allow movements across heterogeneous landscapes rendering to survival through reduced competition, increased genetic diversity and ability to absorb environmental shocks.

Reference: Ndimuligo, S.A, Erasmus, B. and Wilson, M (2007). Assessment of Chimpanzee *(Pan Troglodytes*) population and habitat in Kwitanga forest, western Tanzania

Spatiotemporal dynamics of fuelwood resources in a rural savanna rangeland

Prof Barend Erasmus

Abstract

Eighty percent of households across sub-Saharan Africa rely extensively on biomass as the primary energy source. Specifically, in the study area, ~52000 households cook primarily with fuelwood. Using current prices, the direct-value of this wood is US$3.39 million per year, and the generation cost varies between US$ 94000 and US$ 1.38 million, depending on whether coal or gas is used for generation. It is clear then, that changes in the availability of biomass, either in time or space, is of primary importance for sustainable regional management. We follow a multi-scale approach to investigate spatial patterns of biomass change using a combination of remotely sensed imagery: MODIS, Landsat, aerial photography and LiDAR data. The multiscale approach allows us to distinguish between different drivers of change at different scales. The study area is also the focus of long term socio-economic and public health research, which allows for powerful inference to link observed patterns of change with changes in socio-economic conditions. We find that at broader scales, soil nutrient status and rainfall gradients drive overall biomass availability, but these relationships do not take the quality of the biomass into account. Quality and accessibility vary at fine spatial scales as a result of local topography and historical land use, where the latter underlines the importance of long term land use data. Fuelwood use decisions are made at these fine scales, and therefore informed local governance is critical for regional sustainable fuelwood management.

Improving projections through combinations of models, experiments and observations of dynamic ecosystem change

Guy Midgely

Abstract

The complexity of ecosystem response to stimuli of different kinds makes the prediction of climate change impacts on attributes such as biodiversity extremely challenging. Advances in three areas, modelling, experimentation and monitoring, are needed to improve such projections of ecosystem change and identify ways of avoiding adverse outcomes. It is important for practitioners in all three areas to work more closely together to optimise the information value of their work for each other and to accelerate their overall progress. It is also clear that such collaborative networks need to include experts of human societal responses and related drivers of ecosystem change in order to improve their direct relevance to current and future environmental challenges. I will discuss some examples of where cooperative and collaborative work has begun to achieve this greater cooperation, indicating the potential value of building cross-disciplinary networks over the next decade to address a wide range of questions that are both urgent now and that are likely to become much more urgent over time.

Hidden Markov models: uncovering animal behaviour patterns

Victoria Goodall

victoria@saeon.ac.za

South African Environmental Observation Network,

Fynbos Node, Kirstenbosch, Newlands, 7735, South Africa

School of Statistics and Actuarial Science, University of the Witwatersrand, Wits 2050, South Africa

Abstract

Remote sensing of animal movement is becoming a popular technique for investigating the space use of animals in their natural environment. Improvements in the battery life of the collar and the accuracy of GPS location estimates, means that we now have large datasets of the location of the animal at specified time periods, throughout the complete seasonal cycle often spanning a number of years. Independent mixture models are used to infer the behavioural states of the animal from the observed displacement distances. However this technique does not take into account the time series nature of the observations. Extending this theory to dependent mixture models, also known as Hidden Markov models, allows for the autocorrelation between successive observations. Time series analysis has additional complications for movement data, since missing locations need to be included in the model and seasonality should be accounted for. These methods are applied to three species of ungulate and one predator in the Kruger National Park, South Africa. The true behavioural state of the animal is

seldom available in order to validate the model, however direct observation of a lion pride is used to investigate the reliability of the behavioural predictions. There are also considerations about which statistical distribution provides the best fit via the state-dependent distributions and possible extensions to the model.

Revisiting the ecological niche: biodiversity conservation challenges under a changing climate in African savannas

J.G. Chirima

Agricultural Research Council, Institute of soil, climate, and water (ARC-ISCW), Department of GeoInformatics, Pretoria

Abstract

The conservation of biodiversity in the current century is clouded by three critical realities. First, although, ecologists have long recognized the importance of spatial and temporal patterns that characterize heterogeneity in landscapes and that inference about ecological phenomena is scale dependent, little attention has been paid to determining appropriate approaches in studies of landscape dynamics or ecosystem change. Second, conservation efforts in Africa face daunting challenges that include uncertainties surrounding effects of climate change on mammal species including on their distributions and local abundances. Recently, several challenges threatening to reverse decades of successes in conservation have emerged. These include among others the declining of previously abundant species, potential occurrences of allee effects on the declining of particularly species that occur at the edge of their range and for species that commonly occur at low-density. Furthermore, heightened levels of rhino poaching plus the management of elephant -vegetation interactions continues to bog conservation managers. Third, conservationists are overwhelmed by formidable databases of research reports and data sets collected over decades, which they cannot make sense of and thus are not guiding management of biodiversity or helping address in any rigorous way the conservation challenges of the 21st century. This presentation uses several data sources including historical census data available in most conservation areas, telemetry studies, multivariate methods designed for vegetation analyses but applicable to animal research to generate hypotheses/ questions that guide research pertinent at the landscape scale in African savannas with the hope of initiating work that could appropriately address some of the 21st century conservation “headaches”.

Computational Population Biology: Linking the inner and outer worlds of organisms

Wayne M. Getz
wgetz@berkeley.edu

Department of Environmental Science, Policy and Management
140 Mulford Hall, University of California, Berkeley, CA 94720-3114

School of Mathematical Sciences, University of KwaZulu-Natal
Private Bag X54001, Durban 4000, South Africa

Abstract

Computationally complex systems models are needed to advance research and implement policy in theoretical and applied population biology. Difference and differential equations used to build lumped dynamic models (LDMs) may have the advantage of clarity, but are limited in their inability to include fine scale spatial information and individual-specific physical, physiological, immunological, neural and behavioral states. Current formulations of agent-based models (ABMs) are too idiosyncratic and freewheeling to provide a general, coherent framework for dynamically linking the inner and outer worlds of organisms. Here I propose principles for a general, modular, hierarchically scalable, framework for building computational population models (CPMs) designed to treat the inner world of individual agents as complex dynamic systems that pass information to their outer world and to take information from this spatially detailed outer world to drive the dynamic inner world of these agents, simulate their ecology and the evolutionary pathways of their progeny. I also discuss the need for a cultural shift in the way population biologists communicate and share models and their modular components, without which the computational population biology research community will be unable to effectively test, refute, and refine their models and make the progress needed to meet the ecosystems management challenges posed by global change biology.

Meaningless Statements in Landscape Ecology and Environmental Sustainability

Fred S. Roberts
DIMACS, Rutgers University,Piscataway, NJ USA

Abstract

A statement involving scales of measurement is called meaningless if its truth or falsity can depend on the particular versions of scales that are used in the statement. Using examples from the study of landscape ecology and environmental sustainability involving indices of biodiversity, global vegetation indices, metrics of climate change, and others, we will give a variety of examples of meaningless and meaningful statements. We will briefly discuss the mathematical foundations of the theory of meaningfulness, discuss ways to average scores that lead to meaningful statements, and, time permitting, discuss the meaningfulness of statistical tests.

Abstracts (Invited talks)

Understanding the origins and basis of functional habitat heterogeneity in grazing ecosystems

Richard. W.S. Fynn

Okavango Research Institute, University of Botswana, Private Bag 285, Maun, Botswana

Widespread habitat fragmentation in African savanna ecosystems has been responsible for an associated widespread decline of wildlife populations. Habitat fragmentation reduces adaptive foraging options for wildlife in relation to functional heterogeneity of forage resources and increases predation risk. Understanding what constitutes functional heterogeneity in a grazing ecosystems requires an understanding of the relative importance of predation risk and various limiting resources over the year in relation to the body size, digestive anatomy and mouth anatomy of specific herbivore species. During the wet season not only are protein and energy in very high demand but also key minerals needed by pregnant and lactating females. Thus habitats are required during the wet season that provide highest-possible levels of protein, energy and minerals but also provide very good visibility for predator detection and escape when young calves are most vulnerable to predation. During the dry season, when females are no longer lactating, demands for minerals are much lower and only protein and energy remain in demand as grasses dry out and lose quality. At this dry time of the year habitats are required that are able to provide some form of greenery where they can obtain intake rates of protein and energy above maintenance levels to prevent declines in body stores. These types of habitats are especially important during droughts where herbivore body stores would otherwise be exhausted in sub-optimal habitats. Functional dry season habitats almost always have much lower forage quality than functional wet season habitats but they do prevent rapid declines in body stores over the dry season. High-quality short-grass lawns which provide the highest forage quality of all habitat types are vulnerable to drying out, even during short dry patches within the wet season, because short grasses do not have the deep root systems to access deep-layer soil moisture. Consequently, dry-patch resources (different from dry-season resources) within relatively easy reach of the key wet-season grazing lawns are important to enable herbivores to find some high-quality green leaf during short-term dry patches within the wet season. Thus adaptive foraging occurs at an intra-seasonal scale via relatively short-range movements in response to patchy rainfall, grazing or fire events as well as to short-term dry-patches within the wet season and at an inter-seasonal scale via long-range migratory movements between key functional seasonal ranges. Examples are provided of these various functional habitats and the associated herbivore adaptive foraging patterns from various regions of southern and East Africa. In addition, the climate, geological, topographical and anthropogenic drivers of patterns of functional habitat heterogeneity in grazing ecosystems are discussed.

Using simulated data to quantify dynamic interactions between pairs of individuals

Jennifer A. Miller
jennifer.miller@austin.utexas.edu
The University of Texas at Austin.
1 University Station A3100 Austin, TX 78712 USA

Abstract

New developments in GPS and related satellite tracking technologies have facilitated the collection of highly accurate data on moving objects, far surpassing the ability to analyze them. Within geographic information science, 'movement pattern analysis' (MPA) has developed as a subfield that addresses concepts and theories used to explore the spatio-temporal structure in data, although the methodological and analytical framework associated with MPA is new and still evolving. Interactions between individuals can be considered a second order property of movement and have been far less studied. The nature of interactions between individuals of a population is a fundamental aspect of a species' behavioral ecology and information on the frequency and duration of these interactions is vital to understanding mating and territorial behavior, resource use, and infectious disease epidemiology. The focus of this work was to explore how spatially explicit simulated data can be used to analyse dynamic interactions between individuals of the same species. This study used GPS collar data from ten brown hyenas in Northern Botswana. Five different techniques that have been used to quantify dynamic interactions based on GPS data of pairs of individuals were utilised, and all were compared in the context of spatially explicit simulated data intended to represent biologically realistic null models for individual movement, and subsequently paired interactions.

Living Local in a Larger Landscape: Population, Environment and Climate in the Albertine Rift

Sadie J Ryan and Joel Hartter

Abstract

Kibale National Park in western Uganda represents one of the last pieces of intact East African mid-altitude forest. Located in the Albertine Rift, it is in the top five of the list for poverty and conservation conflict in the 31 world biodiversity hotspots, and land surrounding the park is in high demand for small-scale agriculture. Despite this, the park boundary has remained stable since its establishment, and forest within the park is stable, with previously logged areas reverting to older forest. However, the surrounding landscape has become steadily more fragmented, with both forest and wetland patches being used and converted. Layered upon this is a rich political history, and ongoing complexities of climate change. In this work we combine results from social survey data, political history, remote sensing and conservation ecology to create a whole-landscape approach for describing the juxtaposition of resource scarcity and wildlife, and what this means for the future of the park and the neighboring communities. We suggest that the continued stability of this park, and the goals of preservation and conservation in this biodiversity hotspot, are inextricably tied to the perceived and actual food and resource security of the communities surrounding the park.

Abstracts (student talks)

El Niño-Southern Oscillation for Dengue Early Warning in Ecuador

Anna M. Stewart and Rachel Lowe

Department of Environmental and Forest Biology, State University of New York College of Environmental Science and Forestry, Syracuse, NY; The Catalan Institute of Climate Sciences, Barcelona, Spain

We report a statistical mixed model for assessing the importance of climate as a driver of inter-annual variability in dengue fever in southern coastal Ecuador. Climate data from a local meteorology station and anomalies in Pacific sea surface temperatures (Oceanic Niño Index, ONI) were used to predict dengue standardized morbidity ratios (SMR) (1995-2010). Unobserved confounding factors (e.g., population immunity) were accounted for using temporally auto correlated random effects. ONI, rainfall, and minimum temperature were found to be positively associated with dengue SMR, with a lead time of several months. We assessed the influence of non-climatic factors on dengue SMR using a sub-set of data recorded since 2001. Along with ONI, the House Index (% of households infested with *Aedes aegypti* larvae) was also found to be a significant predictor of dengue risk. Due to time lags involved in the climate-disease system, monitoring El Niño / La Niña evolution in the Pacific Ocean could provide some predictive lead for forecasting dengue epidemics. This is the first analysis of dengue fever and climate in this region, providing the foundation to develop a climate-driven early warning system for dengue fever in Ecuador.

Developing remote sensing methodology to uncover key landscape parametersin wildlife movement decision making

Miriam Tsalyuk, PhD Candidate

Dept. of Environmental Science, Policy and Management, University of California, Berkeley.

Abstract

Rangelands cover more than half of the worlds' land surface and provide essential food, income and ecosystem services. Maintaining intermediate grazing levels is pivotal for sustainable rangelands function and diversity. Therefore, it is important to understand how natural and anthropogenic landscape features affect grazers' movement and distribution and to measure the outcome of grazing on rangeland conditions. I am using MODIS and Landsat satellite imagery for two purposes: understanding how detailed landscape parameters influence herbivores' movement decisions and developing an effective method to monitor the impact of herbivores' distribution on rangeland productivity. My research is conducted in Etosha National Park, Namibia, a 22,490 km semi-arid savanna. I have sampled herbaceous and woody vegetation composition, density and biomass, in order to ground truth and calibrate remote sensing models. Grass biomass was assessed in the field using disc pasture meter (DPM) and visual biomass classes, which were calibrated using clipping, weighting and oven-drying of one-square-meter plots. Vegetation sampling was performed in both the dry and the

rainy season. Field sampling has demonstrated distinct woody and grass communities across the reserve. Phonological stages of the reserve's dominant trees species can assist in identifying distinct vegetation classes in the satellite imagery. The vegetation classes corresponded only in 30% to the previous identified classes in Etosha. This enhances the importance of the current classification. My next steps is to combine the information from remote sensing, GIS data, field measurements and GPS telemetry to create movement model for the three most prevalent herbivores species in Etosha: elephant, zebra and springbok. This research will contribute to sustainable wildlife and rangeland management in Namibia.

Land-Use Dynamics as Drivers of Degenerating Community-BasedForest Management Systems in the Kenyan Coast.

Geoffrey M. Wambugu, Simon Onywere and Immaculate Mungai.

Abstract

Intense growth in population coupled with agricultural expansion is causing serious concerns to forest conservation globally. Kenya's population has been growing at an increasing rate, causing serious forest encroachment and fragmentation. We used Landsat and ASTER remotely sensed imagery to analyze land-use interactions and their implications to forest conservation in 1986, 2003 and 2008 in Kwale District of coast Province, Kenya. Satellite imageries were analyzedwith Idrisi Kilimanjaro software using supervised and unsupervised classification to determine land-use type in each of the three time periods. A total of seven land-use categories were isolated. Overall, farmlands increased between 1986 and 2003, but decreased rapidly between 2003 and 2008 as they were replaced by settlement areas as a result of an expanding human population. Forests also decreased between 1986 and 2003, but increased between 2003 and 2008 as a result of increased conservation action. It is anticipated that demand for more settlement areas and agriculture will increase and therefore exert pressure on forests, including the protected ones. A landscape approach to managing land resources is identified as a suitable alternative to sustainable use of land resources and forests

Understanding the landscape requirements for pollination services derived from managed honeybees

Melin, A.[1,2*], Rouget, M.[3] and Donaldson, J.[1,2]

[1] Applied Biodiversity Research Division, South African National Biodiversity Institute
[2] Botany Department, University of Cape Town
[3] Department of Plant Sciences, University of Pretoria
* a.melin@sanbi.org.za

Abstract

The decline in managed honeybees in Europe and America has resulted in a shift in focus towards promotion of the use of other indigenous pollinators offering a potential win-win situation where conservation of indigenous pollinators and their habitats within farmlands is required to safeguard pollination ecosystem services. In South Africa, managed honeybees have not experienced the same dramatic declines, but the sustainability of pollination services requires an understanding of how managed honeybees utilise resources across landscapes. Here we propose to collect and model baseline socio-economic and resource use data in order to better understand the links between farmers, beekeepers and different landscape elements that provide resources for honeybees and the implications for sustaining pollination services. We do this by using a combination of structured interviews with Western Cape apple farmers and beekeepers, analysis of beekeeping data, and ground-truthing to identify how beekeepers use the landscape to maintain hives and provide pollination services. Results of the first round of structured interviews and the initial parameters for a model of pollination dependence on key landscape elements are presented. We discuss the development of the project and the implications of this study for the conservation and management of pollination services and the possible benefits for biodiversity conservation in general.

Creating land cover maps using a single image or multiple images: which are more accurate?

Meghan Graham MacLean, PhD Candidate
Department of Natural Resources & Earth Systems Science
University of New Hampshire
Durham, NH 03824
meghan.maclean@wildcats.unh.edu

ABSTRACT

Quantifying land cover change over time can be extremely important for monitoring the loss and degradation of habitats due to climate change or human expansion pressures. One of the best sources of remotely sensed data for creating land cover maps is Landsat data, since it has phenomenal temporal resolution for most of the United States, as well as being free to the public. However, the 30 m spatial resolution of the Landsat imagery make it difficult to create land cover maps from this imagery when the land cover types in the given study area are complex, such as vegetation classes. Currently, object-based image analysis classification techniques are used to help separate land cover classes. Previous studies have also used multiple images from different times in the growing season to attempt to more accurately classify vegetation. This study combines these two methods by combining multiple images from the growing season of a single year and segmenting the stacked images. The segments are then classified using a classification and regression tree technique and compared to a similarly created map that used only a single image from the same year. In this analysis, the multi-date image map performed significantly better than the single-date map. The 2010 map created using this new method was then used in an analysis of fragmentation of this study area. The fragmentation metrics were compared with known locations of woody invasive species to make a predictive model of possible locations of woody invasive species.

A small mammal community in a changing landscape, southeastern Virginia, 2005 – 2011

Jana Eggleston, Sarah Crawford and Robert K. Rose
Old Dominion University, Norfolk, VA 23529

Abstract

An ongoing monitoring program of the small mammal community on an old field site in southeastern Virginia began on the Stephens tract in 2005. This site is a part of the Nature Conservancy Stewardship of lands adjacent to the Great Dismal Swamp National Wildlife Refuge, a part of a greater wetland habitat restoration plan as a solution to habitat fragmentation. An assortment of trees was planted, drainage was altered, and vegetation succession was allowed

to progress on the site. It was expected that the small mammal community would change from herbivorous old field species to those of forested wetlands, and that the numerically dominant species would change as succession progressed. This study site consisted of 8 x 8 grids, at12.5m intervals, and with two modified Fitch traps per station. We trapped on both grids for three days each month, averaging 4600 trap nights per year. We used historical imagery available for 2005 through 2010, and field surveys for 2011, to map and analyze the changes in vegetation. To date, with the increase in woody vegetation and canopy cover, the Stephens tract has experienced a general decline of all old field species, the virtual disappearance of *Mus musculus* and *Oryzomys palustris*, stable densities of *Reithrodontomys humulis*, a shift in dominance from *Microtus pennsylvanicus* to *Sigmodon hispidus*, and the arrival of *Peromyscus leucopus*, *Ochrotomys nuttallia*, and *Microtus* pinetorum, forest species.

Statistical methods for predicting invasive species distributions at the landscape level

Timothy Fullman, Michael Hyman, Jessica Steele, Cameron Browne, Kristen Sauby

Abstract

Invasive species are appearing around the world at an unprecedented rate and scale. Intentional and accidental introductions of species have lead to devastating consequences for environmental sustainability, from local extinctions to the collapse of ecosystem services. Species distribution models (SDMs) offer a strategic means for understanding the patterns and processes that describe and predict invasive species spread. We evaluate and compare three approaches to distribution modeling of invasive species: presence-only modeling (Maxent), presence-absence modeling (Generalized Linear Models), and machine learning (boosted regression trees). These models vary in their mathematical complexity, ease of use, and types of data inputs required. Models are developed for five invasive plant species of international importance (three are on the IUCN list of the top 100 worst invasive species and two are of concern in South Africa), based on a dataset collected by the US National Park Service for Florida, USA. These five species encompass a range of biological traits, modes of spread, and time since introduction, providing a robust test for model effectiveness. Developed with data from Everglades National Park, these models are designed to be easily transferable and useful to managers around the globe.

Assessment of Tree species in the Faculty of Agriculture and Forestry, University of Ibadan, Nigeria

Adeyemi, A.A. and Adesoye, P.O.
Department of Forest Resources Management, University of Ibadan, Ibadan, Nigeria

**Corresponding Author*
Email: adeyemiadesoji@yahoo.com

Abstract

Sustainable tree and/or forest management require information on the growing stock. Such information guides the resource manager in appropriate valuation and efficient utilization of the resources. However, where the objective of management is not timber production, little or no emphasis has been placed on the adequate assessment of the growing stock. This study assessed the yield, diversity and abundance of tree species in the Faculty of Agriculture and Forestry, University of Ibadan, Nigeria. Total enumeration of all the tree species in the faculty was carried out. Tree species diversity, stem volume and the relationships among growth variables were investigated. All the trees encountered were grouped into species, diameter and height classes, and their basal area and tree stem volume were computed. Stem volume equations were developed for the tree species in the area. The variables used for the equations consisted of basal area; diameters at breast height, merchantable height, crown length and tree total height. The species were distributed among 14 genera and 8 families. *Eucalyptus camadulensis* had the highest population of trees in the area. The *Myrtaceae* family has the highest number of observation (32.7%) with only one species belonging to the group. This is followed by the *Papilionaceae* (12.7%) with five species. The third being *Meliaceae* and *Verbenaceae* families with 12.7% each. The family of *Caesalpiniaceae* had 9.1% of the total observations while *Bignoniaceae*, *Pinaceae* and *Sapindaceae* had 1.8% each. The diameters at breast height (Dbh) ranged between 14.0cm and 128.2cm while tree total height ranged between 7.0m and 30.5m. About 33% of the tree species falls into the middle diameter class (40-60cm) followed by the diameter class 60-80cm with about 24%. The diameter class 20-40cm had about 22%. The fifth diameter class (>80.0m) ranked fourth, with about 18% of trees in the area. The least represented diameter class is 0-20cm with 3.6%. The best volume equation obtained was $InSV = 1.49 + 1.65InD_m + 0.10InTHT$ (R^2 = 95.4%; SEE = 0.3). All the models generated are adequate and are recommended for stand volume assessment in the study area.

Key words: Species; Family; Diameter; Height; Model;

Abstracts (Student Posters)

Conservation status of key players in coral reef ecosystems: the parrotfishes and surgeonfishes

Mia T. Comeros-Raynal, John Howard Choat, Beth A. Polidoro, Kendall D. Clements, Rene Abesamis, Matthew T. Craig, Muhammad Erdi Lazuardi, Jennifer McIlwain, Andreas Muljadi, Robert F. Myers, Cleto L. Nañola, Jr., Shinta Pardede, Luiz A. Rocha, Barry Russell, Jonnell C. Sanciangco, Brian Stockwell Heather Harwell, Kent E. Carpenter

mcome003@odu.edu

Abstract:

Parrotfishes and surgeonfishes are iconic reef inhabitants that perform important functional roles in the dynamics of coral reef systems. This is a consequence of their varied feeding behaviors ranging from targeted consumption of living plant material (primarily surgeonfishes) to feeding on detrital aggregates that are either scraped from the reef surface or excavated from the deeper reef substratum (primarily parrotfishes). Increased fishing pressure and widespread habitat destruction have led to population declines for several species of these two groups. Therefore, species-specific data on global distribution, population status, life history characteristics, and major threats were compiled for each of the 179 known species of parrotfishes and surgeonfishes to determine the likelihood of extinction of each species under the Categories and Criteria of the IUCN Red List of Threatened Species. Due in part to the extensive distributions of most species and the life history traits exhibited in these two families, only three (1.7%) of the species are listed at an elevated risk of global extinction. The majority of the parrotfishes and surgeonfishes (86%) are listed as Least Concern, 10% are listed as Data Deficient and 1% are listed as Near Threatened. The risk of localized extinction, however, is higher in some areas, particularly in the Coral Triangle region. This region of highest biodiversity for the parrotfishes and surgeonfishes is highly impacted by a multitude of threats including overfishing, pollution and rampant coral reef area loss and degradation. Other geographical areas of concern include Oceania and the Western Indian Ocean where a high percentage of species is threatened by exploitation. Globally, the relatively low proportion of species globally listed in threatened Categories is highly encouraging, and some conservation successes are attributed to concentrated conservation efforts. However, with the growing realization of man's profound impact on the planet, conservation actions such as improved marine reserve networks, more stringent fishing regulations, and continued monitoring of the population status at the species and community levels are imperative for the prevention of species loss in these groups of important and iconic coral reef fishes.

An ecology-based landscape conservation prioritization approach to tiger

(*Panthera tigris tigris*) conservation in Nepal

Hemanta Kafley, Graduate student
Department of Fisheries and Wildlife Sciences
University of Missouri-Columbia
hkc5b@mail.missouri.edu

Abstract

Habitat fragmentation and isolation is a major threat to the persistence of wildlife. It can be particularly detrimental to the conservation of large carnivores because their large home ranges make them susceptible to causes of mortality that are especially prevalent towards the edges and outside of protected areas. Nepal's terai habitat has witnessed such severe fragmentation. With an objective to identify functional tiger corridor addressing the issues of landscape permeability, we use a GIS-based modeling approach to evaluate habitat connectivity and identify best movement corridors for tigers in the TAL of Nepal.

The royal bengal tiger is one of the most threatened large carnivores to extinction in the world, and its numbers are decreasing rapidly in many areas. This trend has been attributed to the range collapse that confines tiger in a mere 7 percent of the historic range. As territorial top carnivores, tigers require large, possibly intact, spaces. However severe habitat fragmentation and loss along with the consequent prey depletion coupled with the impact of poaching on tigers have exerted tremendous adverse effect in the existence of tigers. This study attempts to blend ecology-based landscape approach to explore tiger use of corridors in the terai arc landscape (TAL) of Nepal to identify the functional corridors and recommend the strategies to enhance the quality of available but unused habitat.

Ecological data on habitat occupancy for carnivores were collected by the remotely triggered camera traps and Patch occupancy survey based on animal signs. We surveyed 96 grids of size 5km×5km in the Chitwan National Park and adjoining corridor towards the western end of the park. We employed one paired cameras and a single camera in each grid for 7-8 nights. Simultaneously two 2km long transects were walked by 2-3 expert field technicians in each grid. Ground-truth data were collected using hand-held GPS for supervised classification of the image. Point-centered-quarter method was adopted to collect other vegetation data required for incorporating into the final model.

Preliminary analyses shows that probability of occupancy of tiger is very low (<0.5) in the park and even lower (<0.2) in the corridor based on the patch occupancy survey. We hypothesize that the significantly low prey density in the corridor might have rendered corridor unused by tigers in addition to other factors such as habitat fragmentation and various other forms of direct human disturbance. Camera trapping results also did not provide any evidence of tiger using the corridor despite of available habitat. These results also suggest us to consider developing an ecology-based connectivity model. Conventional least-cost corridor analyses models based on mere physical habitat features might produce erroneous results. Therefore, our future work will also include habitat suitability metrics for tigers and its major

prey species, prey density data and certain index for direct human induced disturbances to delineate more plausible tiger movement corridor.

Thus, landscape-scale GIS modeling techniques will be used to evaluate tiger habitat connectivity. Resistance posed to tiger movement due to habitat alteration will be used along with the results of occupancy studies to identify major habitat barriers and delineate best movement corridors. The method we use can be readily adapted to prioritize conservation actions in the landscape to improve conservation strategies for ensuring perpetual existence of Tigers. We believe that the management intervention in the delineated corridor based on this technique will have higher confidence to aid in restoring tiger habitat in the landscape and thus better serves in tiger conservation initiatives.

Evaluation of several interpolation methods for mapping soil organic carbon at the regional scale.

Brian Clough
School of Environmental & Biological Sciences
Department of Ecology & Evolution
Rutgers, The State University of New Jersey
14 College Farm Road
New Brunswick, NJ 08901
bclough84@gmail.com

Abstract

Accurate estimation of soil organic carbon (SOC) stocks at broad spatial scales is crucial to the development of a global carbon accounting effort, but reducing uncertainty in these estimates to a level acceptable to policy makers remains a difficult task. Geostatistical interpolation has received increased attention as a preferred approach for mapping SOC distribution. However, there is no single agreed upon interpolation method, and models may differ substantially in how well they account for spatial error. Our objective is to evaluate the performance of several popular interpolation models in mapping SOC distribution for forests of the coastal plain region of New Jersey. Four interpolation procedures are used: ordinary kriging (OK), universal kriging (UK), maximum likelihood interpolation, and spatial Bayesian hierarchical interpolation (i.e. 'Bayesian kriging'). Both SOC stock and aboveground biomass have been measured for 150 sampling locations across the region, and these data are applied to map soil organic carbon using each of the aforementioned interpolation models. An additional set of sampling locations (n=50) is used for validation, and the models are evaluated by comparing mean, mean squared, and absolute error. By directly comparing the performance of several interpolation methods for a single dataset, the results of this study contribute to the development of a coherent statistical framework for obtaining regional estimates of SOC stocks

Landscape epidemiology of biodiversity-disease risk relationships in a multihost plant pathogen invasion

Sarah E Haas, Mevin B Hooten, David Rizzo, Ross K Meentemeyer
Department of Geography & Earth Sciences
McEniry 324
University of North Carolina
9201 University City Blvd
Charlotte, NC 28223
haaszoology@gmail.com

Abstract

Background/Question/Methods:
Mounting evidence indicates that biodiversity loss can increase infectious disease transmission1. Although effects of species diversity on disease risk have been reasonably well-studied in a range of host-pathogen systems, our understanding of the diversity-disease hypothesis for generalist plant pathogens in natural ecosystems is limited. We use a landscape epidemiological approach with observational data to examine two scenarios regarding species diversity effects on the emerging plant pathogen *Phytophthora ramorum* across a broad, heterogeneous ecoregion of coastal California (n=280 plots): (1) an 'amplification effect' exists in which disease risk is higher in areas with greater plant diversity due to the pathogen's wide host range, or (2) a 'dilution effect' where disease risk is reduced with increasing plant diversity due to lower competency of alternative hosts. *P. ramorum*, etiological agent of the forest disease Sudden Oak Death, is a generalist pathogen that infects dozens of plant species in the Pacific Northwest of the USA, yet varies in its ability to infect, sporulate on, and cause mortality of infected hosts. In addition to species diversity, quantified as both species richness and evenness, we also account for the potentially-confounding effects of host density and landscape heterogeneity on disease risk. To accommodate inherent spatial effects of the invasion process across the landscape, we compare inference among a set of Bayesian hierarchical models with varying complexity: (1) a binomial generalized linear model (GLM), (2) a zero-inflated binomial GLM, and (3) a zero-inflated binomial GLM with a spatial random effect.
Results/Conclusions:
A total of 10152 hosts among 279 plots were assessed for *P. ramorum* symptoms. Of these, 23% of hosts across 152 plots were considered infected following laboratory confirmation of *P. ramorum* in the respective plot. We find evidence for pathogen dilution, whereby disease risk is lower in sites with higher plant diversity, after accounting for host density and landscape context. The zero-inflated binomial GLM with the spatial effect had better model fit based on DIC criterion compared to the simpler zero-inflated binomial GLM and binomial GLM. Our finding of a dilution effect suggests that although nearly all plants in the ecosystem are hosts, the less-competent, alternative hosts may 'dilute' disease transmission by competent hosts, thereby buffering forest health from infectious disease2.
1. Keesing *et al.* (2010). Impacts of biodiversity on the emergence and transmission of infectious diseases. *Nature*, 468, 647–652.
2. Haas et al. (2011). Forest species diversity reduces disease risk in a generalist plant pathogen invasion. *Ecology Letters*, 14: 1108–1116

Urban Eco-Epidemiology of West Nile Virus in Atlanta, Georgia

Rebecca C. S. Levine, Daniel G. Mead, Gabriel L. Hamer, Paula Marcet, David Hedeen, Meghan W. Hedeen, Christopher Showalter, James Ballance, Juanette Willis,
and Uriel D. Kitron

Emory University
Department of Environmental Studies
Math & Science Center, Suite E510:Fifth Floor
400 Dowman Drive
Atlanta, GA 30322
rclevin@emory.edu

Abstract

Since its introduction in 1999, West Nile Virus (WNV) has become the most important mosquito-borne disease in the USA. WNV activity in the mosquito vectors and reservoir hosts (birds) is clustered in space and time, with transmission focused in certain urban centers (in the East and Midwest) during the summer. However, not all urban areas with intensive enzootic activity see corresponding human cases of disease. In Georgia, substantial WNV presence in the vector and host species has not translated into a large number of human cases, reflecting a similar pattern seen throughout the Southeast, one that is in sharp contrast to some urban areas in the Northeast and Midwest. In a study conducted in Atlanta, Georgia's major urban center, we are addressing the question: in the face of abundant reservoir hosts, disease vectors, and viral presence, why is spillover transmission of WNV (beyond the enzootic) suppressed? We perform comprehensive avian and mosquito sampling in a variety of urban microhabitats, over multiple seasons, to determine the distribution, density, and prevalence of WNV infection in the host and vector species of Atlanta. We focus on sampling in four habitat types within the urban center: mixed-use parks, old-growth forest patches, residential areas, and outdoor animal-holding facilities. Fine-resolution aerial imagery is used to characterize habitat types, percent tree cover, and height of the tree canopy. Avian point counts are conducted at each site to estimate bird species richness and abundance. Using these data, we evaluate the role of Atlanta's diverse urban habitats in disease transmission, focusing on differences in percent tree cover and height of the tree canopy in constraining WNV transmission in time and space. We also explore the extent to which the diversity of avian host species in Atlanta contributes to a WNV "dilution effect." This study targets some of the complex ecological factors governing vector-borne disease transmission in urban settings, combining ecological, epidemiological, and general public health approaches.

The influence of habitat fragmentation in urban environments: A phylogeographic analysis of northern two-lined salamanders in New York City

1. James MacCarthy, ***Graduate Student****, State University of New York – College of Environmental Science and Forestry (SUNY-ESF)*
2. Dr. Sadie Ryan, ***Assistant Professor****, SUNY-ESF*
3. Dr. Ellen Pehek, ***Principal Research Ecologist****, New York City Parks and Recreation*
4. Dr. Jason Munshi-South, ***Assistant Professor****, City University of New York – Baruch College*

james.maccarthy@gmail.com

Abstract

As cities across the world continue to increase in terms of population size, the importance of studying the effects of urbanization on wildlife becomes ever more important. Working in collaboration with NYC Parks and Recreation scientists at the Urban Field Station, I will use existing genetic data from 25-35 salamanders in two historically isolated populations in Queens and two in the Bronx this summer. Fieldwork will be conducted to collect another 25-35 samples from up to four recently isolated populations on Staten Island for genetic analysis at Baruch College, City University of New York (CUNY). Salamanders from which samples are taken will also be marked in the field to determine if their movement corresponds to genetic differences. Using spatially explicit data in a Geographic Information System (GIS)—maps of historical streams, habitat variables such as tree cover, stream quality measures, and the results of genetic analyses I will evaluate how patterns of connectivity in the urban environment have shaped the evolutionary history of these populations and influenced urban biodiversity.

Landscape scale analysis of vegetation structure preference by early successional and mature forest breeding birds using lidar

1. Orion Weldon, ***Graduate Student,***
2. *Rutgers University – Ecology and Evolution GraduateProgram*
3. Dr. Olaf Jensen, ***Assistant Professor,***
4. *Rutgers University - Institute of Marine and Coastal Sciences*
3. Dr. Julie Lockwood, ***Professor I,***

Rutgers University - Ecology and Evolution Graduate Program

orion.weldon@gmail.com

Abstract

Forest breeding birds are a highly threatened group in the Northeast US, with many species such as Golden-winged Warbler (Vermivora chrysoptera) and Cerulean Warbler (Dendroica cerulea) suffering from habitat loss. Conservation and restoration efforts have been hindered by our poor understanding of the forest structure and composition required by these species. Previously, exploring such relationships at a landscape scale would have required a prohibitively large data collection effort. Here we combine vegetation structure metrics extracted from lidar data that were collected across northern New Jersey and eastern Pennsylvania with abundance data for twelve species from the Breeding Bird Survey. Of these, six species were early successional breeding birds, and six were mature forest breeding birds. We used a bayesian hierarchical model to define relationships between habitat characteristics and abundance. Lidar data allowed us to define forest vegetation structure in much greater detail than would have been possible from the available coarse land-use land-cover maps. Lidar-based habitat descriptions resulted in substantially improved habit models for several species with respect to structural resolution and spatial extent. These results provide specific guidance on ways that land-owners might manage forest characteristics to benefit threatened forest breeding bird species.

Forest Fragmentation And Increased Vulnerability To Hurricane Impacts In The Sian Ka'an-Calakmul Biological Corridor In The Yucatán Peninsula, Mexico

Irene Zager, Rutgers University izager@eden.rutgers.edu
Laura C. Schneider, Rutgers University
John Rogan, Clark University

izager@eden.rutgers.edu

Abstract:

The Sian Ka'an-Calakmul biological corridor in the Yucatán Peninsula connects two of Mexico's main Biosphere Reserves and contains one of the largest areas of continuous seasonally dry forest left in Mesoamerica. However, land use and land cover changes are still common both within and outside the reserves, and ongoing deforestation and fragmentation are a main concern for the persistence of the corridor. Here, we explore the changes in forest extent and spatial configuration within the Sian Ka'an Calakuml corridor over the last four decades. We conducted a morphological spatial pattern analysis using land cover maps from 1976, 2000 and 2007. Results show that since 1976, over 400,000 ha of contiguous forest have been transformed into non forested areas (including agriculture, pastures and urban land use) across the corridor. Furthermore, the proportion of forest edge and number of isolated forest patches has increased in detriment of the areas of contiguous forest, a process that has occurred at a much higher rate in the last decade. This high rate in forest fragmentation might severely increase the forests vulnerability to both hurricanes and agricultural wildfires that seasonally affect the region, as well as compromise their effectiveness as a biological corridor and their ability to provide ecosystem services. Ongoing efforts aim to explore the effect of the fragmentation patterns on forest damage and initial recovery after hurricane Dean hit in 2007, based on field data recorded within 28 permanent plots of 500 m2 each, distributed across the corridor.