International Biogeography Society

Conservation Biogeography

Program & Abstracts

Biennial Meetings, January 5-9, 2005
US National Conservation Training Center
Shepherdstown, West Virginia

Second biennial meeting of

THE INTERNATIONAL BIOGEOGRAPHY SOCIETY

an international and interdisciplinary society contributing to the advancement of all studies of the geography of nature

IBS website – www.biogeography.org

Vice-President for Meetings: Michael Douglas
Local Meetings Coordinator: Mark V. Lomolino

IBS 2005 Meetings Committee Members:
Lois Alexander, Daniel Brooks, Marlis Douglas, Vicki Funk, David R. Perault, Brett Riddle and Dov F. Sax

National Conservation Training Center Meetings Coordinator: BethAnn Ring
NCTC Lodging, Meals and Shuttle Information: (877) 706-6282

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IBS Mission Statement

Biogeography, the study of the geography of life, has a long and distinguished history, and one interwoven with that of ecology and evolutionary biology. Traditionally viewed as the study of geographic distributions, modern biogeography now explores a great diversity of patterns in the geographic variation of nature — from physiological, morphological and genetic variation among individuals and populations to differences in the diversity and composition of biotas along geographic gradients. Given its interdisciplinary and integrative nature, biogeography is now broadly recognized as a unifying field that provides a holistic understanding of the relationships between the earth and its biota. Our abilities to develop more general theories of the diversity of life, and to conserve biological diversity may well rest on insights from the field of biogeography. Therefore, the International Biogeography Society (IBS) was founded as a non-profit organization in 2000 with the following mission:

- Foster communication and collaboration between biogeographers in disparate academic fields - scientists who would otherwise have little opportunity for substantive interaction and collaboration.
- Increase both the awareness and interests of the scientific community and the lay public in the contributions of biogeographers.
- Promote the training and education of biogeographers so that they may develop sound strategies for studying and conserving the world's biota.

Program Schedule

January 4, 2005 (Tuesday)

Officers arrive and meet formally at 7 PM (informally thereafter)
Dinner 5:30 – 7:30 PM (meal plan begins with dinner of day of arrival)

January 5, 2005 (Wednesday)

Breakfast 6:30 – 8:00 AM
Workshop participants and first meeting attendees/IBS members arrive
Lunch 11:30 AM – 1:00 PM
Workshop I – *Historical Biogeography*, Dan Brooks (9 AM to 6 PM)
Tours by Conservation Historian Mark Madison – Starts at Registration Area (1, 2 3 PM)
Dinner 5:30 – 7:30 PM (meal plan begins with dinner of day of arrival)

Welcoming Mixer 7:30 – 10 PM (Commons Lounge, includes cash bar)

January 6, 2005 (Thursday) – First Day of Symposia (Auditorium)

Breakfast 6:30 – 7:30 AM

Welcome by the President – 7:50 AM
Plenary Symposium I: <u>Biogeographic Responses to Global Change</u> (Felisa Smith, Organizer)
(8:00 AM) 1. Felisa Smith- *Mammalian Responses to Climate Change over the last 10,000 Years*
(8:30 AM) 2. David Currie – *Scale-dependence of the Relationship between Richness and Climate*
(9:00 AM) 3. Jim Clark – *Ecological Inference and Prediction in the context of Global Change*
(9:30 AM) Break and view of posters
(10:30 AM) 4. Lesley Hughes – *Climate Change and Biodiversity: Trends and Impacts*
(11:00 AM) 5. Camille Parmesan – *Species Range Shifts under Modern Climate Change: Are there Any Patterns?*

Lunch 11:30 AM – 1:00 PM

Plenary Symposium II: <u>Geography of Parasites and Infections Disease</u> – Dan Brooks and Kate Smith (Organizers)
(1:30 PM) 6. Dan Brooks - *Historical Biogeographic Analysis of Parasite-Host Systems*
(2:00 PM) 7. Eric Hoberg - *Host Switching, Geographic Colonization and Diversification of Host-Parasite Systems*
(2:30 PM) Break and view of posters
(3:00 PM) 8. Jean Francois Guegan - *Macroecology of Population Dynamics of Parasitic and Infectious Diseases*
(4:00 PM) 9. Uriel Kitron - *Geographic and Spatial Studies of Vector-borne Diseases in the Americas*
(4:30 PM) 10. Leslie Real – *Geographic Dynamics of Rabies in the US and UK*

Dinner 5:30 – 7:30 PM, View Posters and Socialize (Posters to be removed at 9 PM)
*** Possible Panel Discussion and Presentations** – NSF (S. Schenier

January 7, 2005 (Friday) – Second Day of Symposia (Auditorium)

Breakfast 6:30 – 7:30 AM

Plenary Symposium III: <u>Biogeography of Exotic Species</u> (Dov Sax, Organizer)
(8:00 AM) 11. Dov Sax - *Exotic Species and Net Change in Biodiveristy*
(8:30 AM) 12. Matt McGlone - *Past Invasions and the Future of the New Zealand Biota*
(9:00 AM) 13. Peter Pysek - *On Geographical Aspects of Naturalization in Plants*
(9:30 AM) Break and view of posters
11:00 ~~(10:30 AM)~~ 14. Julian Olden - *Biotic Homogenization - The Importance of Variety in the Spice of Human Life*
11:30 ~~(11:00 AM)~~ 15. George Gilchrist – *Time Flies along Evolving Clines: Evolution during Biological Invasions*

Lunch 11:50 AM – 1:00 PM

(January 7, continued)

Plenary Symposium IV: <u>Geography of Extinction: From Paleo- to Recent Periods</u> (Mark V. Lomolino, Organizer)

(1:30 PM) 16. Rob Channell – *A Geography of Extinction: Range Contraction in Declining Species*
(2:00 PM) 17. Gerardo Ceballos - *Global Patterns of Population and Species Extinctions in Mammals*
(2:30 PM) Break and view of posters
(3:00 PM) 18. Sandy Harcourt - *Rarity in the Tropics - the Distribution-Abundance Relationship in Primates*
(4:00 PM) 19. Hartmut Walter – *A Geography of Human Folly and Animal Angst*
(4:30 PM) 20. David Jablonski - *The Geography of Extinction in the Fossil Record*

Dinner 5:30 – 7:30 PM, View Posters and Socialize (Posters to be removed at 9 PM)

January 8, 2005 (Saturday) – Third (last) Day of Symposia (Auditorium)

Breakfast 6:30 – 7:30 AM

Plenary Symposium V: <u>Biogeography and Ecological Impacts of Human Civilizations</u> (Mark V. Lomolino, Organizer)

(8:00 AM) 21. Robert J. Whittaker – *Conservation Biogeography: Assessment and Prospect*
(8:30 AM) 22. Stuart Pimm – *Using Biogeography to Set Practical Priorities for Conservation*
(9:00 AM) 23. Terry Root – *Biodiversity and Global Warming: Present and Possible Future Changes*
(9:30 AM) Break and view of posters
(10:30 AM) 24. Mark Ritchie - *The Biogeography of Interactions between Plants and Large Mammals*
(11:00 AM) 25. John Terrell – *The Evolution of Human Ecology and Biogeography since the 1960s*

Lunch 11:30 AM – 1:00 PM

Business Meeting I: (1:30 – 2:30 PM)

Break and view of posters (2:30 PM)

Business Meeting II: (4:00 – 5:00 PM)

Dinner (5:30 – 7:30 PM) View Posters and Socialize (Posters to be removed at 9 PM)

Keynote Lectures (Charles Smith on A. R. Wallace), Awards and "Closing Ceremonies" (8:00 – 9:00)

January 9, 2005 (Sunday)

Breakfast (6:30 – 7:30 AM)

Members depart after breakfast or lunch (meal plan ends with lunch of day of departure)

Post-meeting Field Trip to Smithsonian Institution (Vicki Funk, Organizer)
- bus leaves from <u>Entry Auditorium Circle</u> at TBA

WORKSHOP I: HISTORICAL BIOGEOGRAPHY

Organizer: Dan Brooks, University of Toronto

Date: January 2005 (9 AM to 6 PM)

Purpose and Scope: This workshop is intended to give participants an overview of recent developments in phylogenetic biogeography, including (1) the need for a complex, rather than simple, theory of historical biogeography, (2) introduction to a new algorithm and computer program for analyzing complex biogeographic data, including reticulated area relationships, (3) methodological unification of phylogeography and historical biogeography, (4) methodological approaches in paleobiogeography, and (5) methodological formalization of the Taxon Pulse Hypothesis as an alternative to either maximum dispersal or maximum vicariance, aimed at integration of phylogenetic biogeography with the Equilibrium Theory of Biogeography.

Place: U.S. National Conservation Training Center, Shepherdstown, West Virginia

Hosted By: U.S. National Conservation Training Center in conjunction with the second international conference of *The International Biogeography Society* (5-9 January 2005)

Workshop Information: Each participant will receive a copy of PACT 1.0, the first general release version of the computer program implementing the new algorithm PACT (Phylogenetic Analysis for Comparing Trees) for generating area cladograms from complex data.

Preliminary Agenda:

9:00 – 9:30	Welcome and introductions
9:30 – 10:30	Dan Brooks (University of Toronto): Historical Biogeography in the Age of Complexity: Ontological and Epistemological Considerations
10:30 – 11:00	Coffee break
11:00 – 12:00	Maggie Wojcicki (Queensland University): PACT
12:00 – 1:30	Lunch
1:30 – 2:30	Brett Riddle (University of Nevada-Las Vegas): Phylogeography
2:30 – 3:00	Coffee break
3:00 – 4:00	Bruce Lieberman (University of Kansas): Paleobiogeography
4:00 – 5:00	Dan Brooks (University of Toronto): The Taxon Pulse Hypothesis – Integrating Historical and Ecological Biogeography
5:00 – 6:00	General Discussion

Poster Abstracts

1

HOMOGENIZATION AND URBANIZATION - COMPARING RURAL AND URBAN FLORAS IN GERMANY

Kühn, I. and *Klotz, S.

Urbanization is one of the most important activities that facilitates alien plant species and threatens rare native species. These two processes promote biotic homogenization. It is therefore likely that urbanization will lead to biotic homogenization as well. We explored the relationship between urbanization and homogenization for plant species in Germany using (i) all plant species, (ii) only native species, (iii) all alien species and only those introduced (iv) before or (v) after 1500, respectively. We used a database on species distribution on a c. 130 km² scale. We calculated mean similarities for the 60 "most urbanized grid cells" (> 1/3 urban land cover). We then resampled 60 randomly drawn grid cells with < 1/3 urban land cover and 60 grid cells with < 1/20 urban land cover 999 times and compared these results to the "most urbanized grid cells". Urbanization does not have an overall effect on homogenization of all species, but native species as well as pre 1500 alien plant assemblages show effects of homogenization while post 1500 alien plant assemblages show the opposite effect. On a regional scale, urbanization does not lead unequivocally to homogenization. This might be different when extending the analysed range across several bioclimatic regions.

2

COUPLED GLOBAL OCEAN MODEL AND GENETIC ANALYSES IDENTIFY MULTIPLE INTRODUCTIONS WORLD-WIDE OF CRYPTOGENIC JELLYFISHES

***Dawson, M. N., Sen Gupta, A., and England, M. H.**

Anthropogenic species introductions are one of the greatest modern threats to marine biodiversity (Costello & Solow 2003; Hewitt et al. 2004) but they remain generally unpredictable (Heger & Trepl 2003) and misunderstood (Costello & Solow 2003) because knowledge of natural dispersal patterns (Mora & Sale 2002; Cowen et al. 2003), species diversity (Knowlton 2000), and biogeography (Fukami et al. 2004) is often insufficient to identify non-indigenous species or their sources. We compare a global molecular phylogeny of the moon-jellyfish, Aurelia, with natural dispersion patterns predicted by a global bio-physical ocean model. Despite assumed high dispersal ability (Arai 1997) the phylogeny shows many cryptic species and predominantly regional structure with one notable exception: the globally distributed Aurelia sp.1 which, molecular data suggest, may occasionally traverse the Pacific unaided. This is refuted by the ocean model which shows much more limited dispersion that is broadly consistent with modern biogeographic zones.

3

PONDEROSA PINE SNAG DYNAMICS AND USE BY CAVITY-NESTING BIRDS FOLLOWING WILDFIRE IN NORTHERN ARIZONA

***Mast, J. N. and Chambers, C.**

With crown fires increasing in size, frequency, and intensity in southwestern ponderosa pine forests, documentation of vegetation and bird community recovery following wildfire at the landscape scale becomes critical to managers. Many factors can influence bird use of snags, including spatial dispersion, tree species, diameter, height, density, decay, age, and cause of death. Snag spatial pattern may affect use by cavity-nesting species on the landscape since some bird species select clumps of snags; however, other species use scattered snags. Our specific goals are to: (1) describe spatial patterns and characteristics of snags in pairs of burned and unburned ponderosa pine forests of Arizona in four recent (<10 yrs) wildfires, (2) document bird response to wildfires, and (3) link these patterns to snag monitoring plots and cavity-nesting bird use to predict the probability of snag use based on snag characteristics. From our research, longest lasting snags in burned areas would be large diameter snags in denser clumps. The best model to predict snags with excavated cavities is diameter at breast height plus top condition; specifically large broken snags are used more for cavities. The results offer guidelines for retention of snags that provide habitat for wildlife in southwestern ponderosa pine forests.

4

MULTI-DIMENSIONAL LANDSCAPE AND VEGETATION STRUCTURE IN BIOGEOGRAPHY AND BIODIVERSITY INFORMATICS

***Bergen, K. M., Gilboy, A. M., and Brown, D. G.**

In the context of biogeography and biodiversity informatics, landscape and vegetation structure – its multi-dimensional components – is a primary basis for distributions and ranges of a number of taxonomic groups, for example, bird species. Landscape spatial composition, heterogeneity, variability, and scale are among the variables contributing to the horizontal structure, while vegetation height, layering, and biomass are examples of variables in the volumetric dimension. Current spatial data used in growing biogeography informatics databases and modeling are largely limited to describing vegetation type and horizontal landscape structure. These two-dimensional models are artifacts of technology (i.e., remote sensing and contemporary geographic information science), but not necessarily sufficient to fulfill the conceptual needs for biogeographic analyses in changing landscapes. Remote sensing data from Landsat can now be combined with data from radar and lidar sensors to provide multi-dimensional structure. We present: 1) the theoretical basis of multi-dimensional structure and species distributions in changing landscapes, 2) the results of our case study in Northern Michigan to evaluate the potential improvement in mapping for biogeography and biodiversity informatics when multi-dimensional structure derived from remote sensing instruments is included versus vegetation type alone, and 3) future directions for incorporating multi-dimensional structure into biogeography and biodiversity informatics.

5

PHYLOGENETIC PATTERN AND THE MID-DOMAIN EFFECT

Davies, T. J., Gittleman, J. L., and *Grenyer, R.

The mid-domain effect (MDE), a bias in species richness towards the midpoint of a given geographic dimension, has been used as a null model in macro-ecological studies. Departures from a MDE are often thought of as interesting. The MDE is a product of the interaction between geometric boundaries and range locations, with species being forced to occupy more central positions in proportion to their range size. We criticise this mechanism for assuming species' locations to be wholly independent from their evolutionary past. We present a simple simulation model that shows how range locations arising as part of a phylogenetic process depart from a MDE. We show the amount of departure from a MDE is positively correlated with phylogenetic tree shape (imbalance), but also that a departure from an equal-rates Markov speciation model is not necessary to negate a MDE. We suggest that the MDE is only an appropriate null model when phylogenetic influence on range location is demonstrably low or non-existent.

6

IS DISEASE A MAJOR CAUSE OF SPECIES EXTINCTIONS?

***Smith, K. F. and Sax, D. F.**

Diseases can extirpate local populations, mediate community dynamics, contribute to the contraction of geographic ranges, and expedite species extinctions. Recently, it has been argued that infectious diseases in wildlife populations are emerging at unusually high rates, raising concern that disease may pose a serious threat to biological diversity. However, the majority of available data supporting this contention is largely anecdotal. Here, we establish an evidence-based understanding of the role of disease in global species loss using the most comprehensive data available. We posit two questions; to what extent have parasites and pathogens played a causal role in the known species extinctions that have occurred in the last 500 years, and what is the relative role of parasites and pathogens as a contributing threat to species groups that are currently at risk of extinction? The existing evidence does not support the conjecture that disease has been, or is currently, a significant threat to global biodiversity. We also note an apparent shift between the distribution and type of species driven to extinction by disease and those currently threatened by disease. We suggest that future efforts to understand and manage the role of disease in species extinction should focus on those assemblages that, based on the evaluation of available evidence, are most critically at risk of extinction.

7

INVASIVE (AND NON-INVASIVE) ALIENS IN COASTAL SHINGLE AND CLIFF HABITATS: MODELING, MONITORING AND MANAGEMENT

***Randall, R. E.**

The term invasion is frequently used to describe geographic range extensions that are caused by the introduction of exotic species by humans. The changes in range boundaries that occur due to dispersal and establishment in new locations are an important part of understanding the geographic distribution of species. Invading species often spread at low population levels and initially are difficult to detect. Once established, they may increase logarithmically and eradication then becomes costly and difficult. They are usually most successful in those environments to which they are physically well suited. Invaders usually have short generation times and produce large quantities of seed or rapidly rooting vegetative material that is easily dispersed. Invading species often have no natural predators, parasites or pathogens in their new habitat and native competitors are usually less efficient. Two coastal locations in southern England are being studied where alien species have impacted on the native vegetation, in order to assess the significance of vegetative reproduction, short generation times and seed production in euoceanic habitats. These are the Isles of Scilly, Cornwall and the shingle spits of West Sussex.

8

GIS AS AN EFFECTIVE TOOL IN ISLAND BIOGEOGRAPHY ANALYSES: ISLAND ISOLATION IN MASSASAUGA PROVINCIAL PARK

***Diver, K. C.**

A geographic information system (GIS) is a powerful analysis tool in understanding the spatial variability of species richness among islands. Island biogeographers have implemented numerous measures of island isolation (e.g. straight-line distances, stepping-stone distances, effective distances, land-water ratios). GIS can be used to accurately quantify and assess the relative isolation of an island. In this study, multiple isolation variables that potentially affect spatial variation of plant species richness among freshwater islands were compared using a GIS. The study encompassed 35 islands within Ontario's Massasauga Provincial Park, Georgian Bay (Lake Huron), Canada.
In the Massasauga Park, the ratio of land to water within a 500 meter buffer of an island was the most influential isolation measure on the variability of plant species richness. The results of this research can help inform management decisions regarding the conservation of island ecosystems in the Laurentian Great Lakes. It is apparent through this case study that GIS, combined with field data, is indispensable to island biogeography studies. GIS spatial analysis tools are readily applicable to the efforts of island biogeographers and their application can help inform ongoing attempts to update and revise prevailing methodologies and models for predicting species richness on islands.

9

THE BROAD SCALE ECOLOGY OF ENERGY EXPENDITURE OF ENDOTHERMS

***Anderson, K. A. and Jetz, W.**

Energy expenditure in animals scales allometrically with body mass, but residual variation is not well understood. We examine the existing data on field metabolic rates (FMR) in endotherms for the potential role of environmental conditions. Across latitude, mass-corrected field metabolic rates of 248 bird and mammal populations fall between two constraint lines: a lower bound that increases towards the poles and is driven by environmental factors and an upper bound that is invariant with latitude and may represent physiological limitations. This triangular pattern can be explained statistically with a multi-predictor model that combines environmental conditions and species biology (including phylogeny). Lower environmental temperature and longer potential daily activity period increase FMR, while taxonomy and diet explain much of the remaining variation. Combined, these effects appear to form a diversity of "metabolic niches" that overall decreases from the tropics to the poles. The potential of factors related to latitude acting as constraints on the ecology and evolution of metabolic strategies in endotherms is discussed.

10

THE TYPOLOGY OF OLIVE CULTIVATION: INTEGRATING LIDAR WITH VEGETATION FIELD SURVEYS

***Allen, H. D., Randall, R. E., Amable, G. S., and Devereux, B. J.**

Olive cultivation has been integral to the landscape ecology of Crete, Greece for thousands of years. Olive groves may exhibit high levels of biodiversity, via a rich ground flora, and provide habitat for large numbers of mammalian, insect and bird species. However, traditionally managed groves are amongst those habitats regarded as particularly threatened by land-use changes resulting from agricultural intensification and abandonment of more marginal land.

This paper presents results from a study which integrates ecological field surveys with airborne LiDAR imagery. Classification of vegetation and environmental data, in combination with ordination techniques, results in a good discrimination of the differing management practices of olive cultivation, in particular their relation to ground flora. This is complemented by the LiDAR imagery which is able to differentiate the 3-dimensional structure of the different types of vegetation canopies within olive groves. Such a combined approach provides comparative data for understanding the impact of land-use changes and opens up the possibility of detailed mapping of such threatened vegetation communities and the ability to monitor land-use changes.

11

PATTERNS OF GENETIC VARIATION WITHIN AN ENDEMIC ARBOREAL VOLE, ARBORIMUS POMO, IN NORTHERN CALIFORNIA

***Blois, J. L. and Arbogast, B. S.**

Biodiversity is threatened world-wide, yet we still lack much information necessary for effective conservation. Traditional conservation approaches have often failed to address the conservation of genetic diversity, which may be an important measure of the evolutionary viability of a species. Mitochondrial DNA has been extensively used in mammals to assess population structure and genetic diversity, but increasingly, multi-locus approaches are necessary to fully understand processes underlying the evolutionary history of a species. I investigated the evolutionary history and genetic variation of an endemic, arboreal vole (*Arborimus pomo*) using both mitochondrial and nuclear (AFLP) markers. Additionally, I assessed the utility of AFLP as a measure of mammalian genetic diversity. The mitochondrial gene tree recovered two monophyletic clades corresponding to two separate populations. Most of the mitochondrial genetic variation in the species was due to variation between the two clades, and haplotype diversity was high in both clades. AFLP detected no genetic structure within the species. The AFLP data provided a better picture of the overall genetic diversity because it assessed diversity at 55 nuclear loci rather than one mitochondrial locus. The pattern of genetic diversity within the species suggests that the two populations be considered separate MUs rather than full ESUs.

12

LAND-USE HISTORY AND FOREST PLANT METAPOPULATIONS IN DYNAMIC LANDSCAPES

***Vellend, M., Verheyen, K., Jacquemyn, H., van Calster, H., Kolb, A., Peterken, G., and Hermy, M.**

In fragmented landscapes, habitat patches are often destroyed and created through time, though most metapopulation models treat patch networks as static. Here we present a generally-applicable, modified version of Hanski's Incidence Function Model (IFM) that incorporates landscape dynamics (i.e., habitat patch turnover), and we parameterize the model with data on patch occupancy patterns for forest plants in central Lincolnshire, UK. Estimated colonization and extinction rates varied significantly among species with different life-history traits. For example, species with low seed production and predominantly short-distance seed dispersal showed lower rates of colonization and extinction than species with the opposite set of traits. Model simulations demonstrate a profound negative influence of habitat turnover rate on metapopulation dynamics and persistence, particularly for slow-colonizing species. Comparison of patch-occupancy patterns in Lincolnshire where forest cover that has been constantly low (~5%) vs. a landscape in Flanders, Belgium where forest cover has been recently reduced from 25-5% revealed a signature of extinction debt for slow-colonizing species in the recently fragmented landscape.

13
SPARTA (SIMULATION PACKAGE FOR AREA-TAXON ANALYSIS): TESTING ROBUSTNESS AND SENSITIVITY AMONG CLADISTIC BIOGEOGRAPHIC METHODS
***Upchurch, P., McGowan, A. J.**

Over the past 30 years, numerous analytical biogeographic methodologies have been devised. The robustness of these methodologies has received limited study, and data on the performance of the techniques are critical in selecting appropriate method(s) for future biogeographic studies. SPARTA (Simulation Package for Area-Taxon Analysis) is a computer simulation that generates coupled area-taxon evolutionary histories. Many user-variable geographic and biological parameters have been incorporated into the model to make it applicable to fields ranging from host-parasite co-evolution to historical biogeography. Rapid generation of large numbers of replicate data sets is a major advance over 'hand-built' data sets. SPARTA can also degrade data to simulate sampling problems associated with the fossil record. A program implementing the modified version of Brooks Parsimony Analysis proposed by Lieberman has also been written, to allow detailed analysis of the performance of this relatively new technique. Comparative tests of the ability of the various cladistic biogeographic methods to accurately recover "known" area-taxon histories generated by SPARTA are now underway. The outcome of these tests will give clear guidance as to which method(s) are optimal for particular classes of evolutionary problems.

14
APPLYING FUZZY LOGIC TO THE CONCEPT OF CHOROTYPE: AN EXAMPLE WITH ARGENTINEAN MAMMALS
***Real, R., Márquez, A. L., Guerrero, J. C., Justo, E. R., Merino, M. L., Kin, M. S., Abba, A. M., de las Heras, M., and Vargas, J. M.**

A chorotype is a distribution pattern shared by several species, and simplifies the analysis of the main biodiversity patterns when many species are involved. However, slight misrepresentation of distributions may lead to significant differences in the sets of species resulting from this type of analysis. We applied fuzzy logic to the concept of chorotype and used the distribution of mammals in Argentine to assess its heuristic power in this context. We used two independently obtained lists of species on three lattices: one list (255 species) on phytogeographic districts (n=29) and administrative provinces (n=23), and another (265 species) on phytogeographic districts (n=11). When the chorotypes were considered as traditional sets, the main distribution patterns, defined by the highest number of species, did not coincide in the three databases used. However, after considering the distribution types as fuzzy sets, the main distribution patterns were highly coincident among the three databases, and unions and intersections of fuzzy chorotypes detected complementary distribution types. These results suggest that fuzzy logic is able to identify general distribution patterns even in zones where the sampling level is uneven, as it is usually the case in areas that are very large and rich in species, as Latin-America.

15
EFFECT OF SPECIES INTERACTIONS ON LANDSCAPE ABUNDANCE PATTERNS
***Buckley, L. B. and Roughgarden, J.**

The interaction of species along an elevational gradient modifies population responses to climate and topography. A model of population dynamics based on foraging energetics predicts how the abundance of Anolis lizards will decline with increasing elevation on the Lesser Antilles islands. We test the model predictions on islands with and without species interactions and with differential topography. The empirical trends showing how abundance declines on northern and southern one-species islands have similar slopes but different intercepts at sea-level. Species interactions cause abundance patterns to diverge from those of solitary anoles. One species is more abundant at sea level and the other more abundant at higher elevations compared to the trend for solitary anoles. Topography additionally influences landscape scale abundance patterns. On two-species islands with a more even distribution of habitat types, habitat specialization results in spatially patchy distributions at low elevations. Accounting for species interactions, thermal physiology, and prey size in the population dynamic model enables prediction of landscape-scale patterns of Anolis abundance.

16
SPECIES TURNOVER AND MID-DOMAIN ON ELEVATIONAL GRADIENTS IN RODENTS
***Vázquez-Domínguez, E. and Mena, J. L.**

Studies about species turnover (i.e. beta diversity) on elevational gradients are limited, a relationship we aimed to evaluate in rodents. Based on 13 studies from the literature that evaluated the relationship between elevation and species richness, we constructed presence/absence matrices of species occurring at 500 m intervals and measured species turnover (Bw and Bsim indices) for pair-wise comparisons between each pair of elevation intervals along the gradient (local scale), and for each elevational gradient (regional scale). At the local scale the relationship was evaluated with a LOWESS regression analysis, and with a linear regression for the regional scale. The expected distribution of species turnover-elevational gradient under a mid-domain null model was evaluated for both indices. At the local scale, the species turnover curves demonstrated midelevational peaks for both indices (LOWESS: curvilinear pattern for most of the gradients, with cubic or quadratic fits). The expected distribution of species turnover by the null mid-domain model showed a U-shaped pattern for Bw, while no change (zero values) was predicted with Bsim. At the regional scale, a positive and significant linear relationship was found. Thus, 1) a common asymmetric hump-shaped pattern of species turnover and elevation was found, evident only for elevational gradients exceeding 1900m; 2) the expected species turnover distribution contrasted with the empirical results, confirming that the extent and location of the species elevational ranges that overlap along the gradient determine the peaks in species turnover; 3) larger mountains showed higher beta diversity values compared to smaller ones.

17
CONTINENTAL AND REGIONAL RANGES OF NORTH AMERICAN MAMMALS: RAPOPORT'S RULE IN REAL AND NULL WORLD
Arita, H., *Rodríguez, P. and Vázquez-Domínguez, E.

We assess the relationship between species diversity and distribution within regions arranged along a latitudinal gradient, using the North American mammalian fauna as a study case for testing theoretical models. We propose a conceptual framework based on a fully stochastic mid-domain model to explore geographic patterns of range size and diversity that emerge when the size and position of species ranges along a one-dimensional latitudinal gradient are randomly generated. We also analyze patterns for the mammal fauna of North America by comparing empirical results from a biogeographic database with predictions based on randomization null models. Our results confirm the validity of Rapoport's rule for the mammals of North America, by documenting gradients in the size of the continental ranges of species. Additionally, we also show gradients of mean regional range size that parallel those of continental range. Our data also demonstrate that mean range size, measured both as a continental or a regional variable, is significantly correlated with the geographic pattern in species diversity. All these patterns deviate sharply from null models. We conclude that Rapoport's statement of an areographic relationship between species distribution and diversity is highly relevant in modern discussions about ecological patterns at the geographic scale.

18
UPLAND POOL HABITATS: SPATIAL DISTRIBUTION AND HUMAN IMPACTS
***Griffin, D. A.**

Ephemeral pools are rare in the unglaciated uplands of the Appalachian Ridge and Valley region, but are critical habitat for obligate amphibian, invertebrate, and plant species. Despite their importance for maintaining regional biodiversity, we know little about the distribution, ecology, or how human activities affect these wetland habitats. Based on aerial photography, field studies, and GIS analysis, I identified, mapped, and censused plant species and habitat characteristics of upland pools in a 1200 km2 area of central Pennsylvania. Pools form in a variety of geomorphic settings, most commonly in isolated clusters associated with relict ground ice scars within low-gradient drainage divide saddles. The two most readily identifiable human impacts on these pools are roads and precipitation-related acidification. Plant species richness is weakly correlated
(positively) with pH, light availability, and pool area. Pools receiving runoff directly from roads have higher values for pH and plant species richness, harbor more exotic species and have more uniform composition than non road-impacted pools. Roads do not seem adversely affect amphibian larvae, which may benefit from the buffering effect of high pH runoff from limestone gravel.

19
INTERACTING EFFECTS OF FRAGMENTATION AND INVASION ON THE GEOGRAPHICAL GENETICS OF COASTAL SAGE SCRUB ARTHROPODS
***McPhee, M. V. and Tsutsui, N.D.**

Because habitat fragmentation reduces habitat area and has the potential to reduce migration, it is expected to reduce genetic diversity and gene flow within and between populations that were more contiguously distributed in the past. Due to extensive development, fragmentation of coastal sage scrub in southern California is severe, and its effect on bird, mammal, and arthropod communities has been well documented. Here, we present preliminary data from a study of the effect of this fragmentation on the geographic structure of genetic diversity in several coastal sage scrub arthropods. These species are expected to respond differently to fragmentation, due to differences in their population and life histories and their susceptibility to the Argentine ant (*Linepithema humile*), whose invasion is facilitated in part by fragmentation. Using genetic markers to infer population processes in a comparative framework, we hope ultimately to understand the traits of organisms that make them susceptible, or resilient, to the impacts of fragmentation and invasion.

20
USE OF THE VICARIANCE MODEL OF BIOGEOGRAPHY AS A HEURISTIC TOOL
***Heaney, L. R.**

The Vicariance Model of historical biogeography has, as its primary objective, helping us to understand pattern and process in biogeography. Like all models, it is based on a set of assumptions and makes a set of predictions. It is clear that the assumptions and predictions are sometimes not met, and this has led to criticism of vicariance as a general predictive model. I suggest that the model may be effectively used as a conceptual point of reference or heuristic tool, with the assumptions and predictions taken as the basis for asking a set of important questions that help us to understand the dynamics of biogeographic patterns and processes. This approach is similar to the manner in which the Hardy-Weinberg Equilibrium is used in population genetics; the issue is not whether such a genetic equilibrium exists in an actual population, but rather the reason why it does not. Similar approaches to using the Dynamic Equilibrium Model of MacArthur and Wilson have been productive. A set of 12 assumptions and predictions will be identified, and examples of how the Vicariance Model may be used as a heuristic tool will be presented.

21
REALITY CHECK: PITFALLS AND CHALLENGES OF USING HISTORICAL MUSEUM SPECIMENS IN BIOGEOGRAPHIC ANALYSES
*** Rowe, R. J.**
Much of the fundamental data on biodiversity comes from specimens in museums and associated databases. The recent union of bioinformatics and biodiversity has increased the accessibility of both historical and contemporary museum specimen data. Networked database initiatives incorporating a georeferencing component, such as the Mammal Networked Information System (MaNIS), provide the opportunity to expand research projects temporally and spatially by increasing the functionality and usage of historical specimens and associated collection information. However, access to georeferenced localities alone does not ensure that they are suitable for use. The research question and spatial extent of the study will determine the applicability of the georeferenced data.
I discuss complications associated with applying localities georeferenced under MaNIS guidelines to studies of biodiversity patterns along elevational gradients. For example, uncertainty (in mileage) associated with latitude and longitude is not tightly correlated with associated errors in elevation. Since it is inappropriate to just grab the data and use it, I propose suggestions for evaluating georeferenced localities based on a combination of uncertainty measures and additional collection information. Because of the multiple sources of imprecision, no protocol can be prescribed that will eliminate the need to reexamine or regeoreference a subset of data points.

22

GEOGRAPHIC RANGE SIZE AND THE EXPLANATION OF SPATIAL DIVERSITY PATTERNS OF NEW WORLD PALMS

***Kreft, H., Sommer, J. H., and Barthlott, W.**

Searching for general explanations of large-scale diversity patterns, conventional macroecological approaches focus on correlations between species richness and environmental predictors. We investigated the effect of range size in these types of analyses using distribution data for all 550 Neotropical palm species. We evaluated the contribution of range-restricted and widespread species to patterns of species richness analyzed the impact of range size differences on the predictive value of commonly used predictor variables (e.g. latitude, rainfall, AET, NPP, habitat heterogeneity). According to their geographic range size, species sequences were produced in ascending, descending, and random order. Sequential correlations between cumulative species richness patterns and environmental predictors were performed. Despite the higher proportion of species with small geographic ranges, species richness patterns are dominated by the ~20% widespread species which contain 80% of the geographic distribution records. Climatic factors related to energy and water availability account for much of the spatial variation of species richness of widespread species but are much poorer predictors for range-restricted species. In contrast, species richness of range-restricted species is to a larger extent determined by topographical complexity. The predominance of widespread species highlights the difficulties to approximate causal explanations for the majority of species with small geographic ranges.

23

MULTIPLE MIGRATION PATTERNS IN A MIGRATORY DRAGONFLY SPECIES

***Matthews, J. H.**

The benefits of a dispersal strategy at local spatial scales are clear: dispersing individuals avoid inbreeding depression and hedge fitness bets by distributing their genes across multiple patches in a metapopulation. The disadvantages of dispersing typically stem from trade-offs in fecundity and lifespan and from the need to be habitat generalists in order to cope with the diversity of habitats encountered. In contrast, residents often possess higher fecundity and lifespan than dispersers and are more likely to be habitat specialists with traits conferring high fitness in a particular locality. At very large spatial scales, however, the relative benefits of dispersal or residency are less clear: why would some individuals migrate thousands of kilometers while other conspecifics overwinter in situ? In such cases the dispersed distance far exceeds the scale over which (a) the presumed benefits of avoiding inbreeding depression could be reaped, and (b) the local and regional scales at which most metapopulation models are applied. *Anax junius* is a dragonfly with two sympatric phenotypic strategies — dispersal over hundreds/thousands of kilometers versus natal residency. The relationship between these phenotypes is explored using mitochondrial and microsatellite DNA techniques.

24

THE INDIRECT EFFECT OF HABITAT AREA ON ELEVATIONAL SPECIES RICHNESS PATTERNS

***Romdal, T. S.**

Elevational band area is expected to decline with altitude and direct influence of area on number of species in bands has been demonstrated in regional studies. If sampled area is standardised, local species richness (data from small plots or sites) may be indirectly influenced by the available area of an elevational zone. This is a consequence of the regional-local species richness relation, but the effect on elevational richness patterns has not been quantitatively assessed in any study to date. The present study uses published studies on local elevational richness patterns in forest habitats to evaluate the indirect effect of regional area. Forest is readily defined, species found here tend to be habitat specialists, and the elevational distribution of forest varies among mountain ranges. Regional forest area was extracted from the global MODIS VCF 500m resolution dataset. Preliminary results are presented for both unimodal and monotonically decreasing species richness gradients. The sensitivity of the effect to definitions of forest habitat and forest extent is evaluated. The results so far indicate a considerable and robust effect, and habitat area bias should be considered in the design of future local-scale elevational studies.

25
IMPACTS OF CLIMATIC CHANGE ON THE PHENOLOGY OF SPRING BIRD MIGRATION IN THE GREAT LAKES, USA
***MacMynowski, D. P. and Root, T. L.**

Climatic change is likely to emerge as a significant, if not dominant force, in ecosystem change over the next several decades. While the potential impacts of discordant range shifts have generated considerable interest, asynchronies in phenology have received less attention. Migrating birds are of particular concern given their need of multiple habitats, which often involve large spatial scales. Time is of the essence for migrating birds: it is critical for departures with favorable weather conditions, intersecting adequate resources to fuel further flight, and for spring migrants, arrival on the breeding grounds in concert with the flush of food to feed offspring.
We assess changes in the spring phenology of migrant birds in the Great Lakes region using observations in Germfask, MI, USA (49°17'N, 85°57'W) from 1965-1994 and Fairfield Township, WI (43°30' N, 89°30' W) from 1976-1999. We correlate the species temporal changes with abiotic and biotic variables to understand how migrants' behavior is associated with spring green-up (plant phenology) and multi-scalar climate/weather variables, such as the North Atlantic Oscillation, and local and regional temperature. We assess the observed changes and correlations in light of migrant life history factors to understand which species, or groups of species, are particularly at risk.

26
APPLICATION OF AIRBORNE LIDAR IN MAPPING DECIDUOUS WOODLAND STRUCTURE IN WOODWALTON FEN NATURE RESERVE, ENGLAND.
Amable, G. S., Devereux, B. J., *Allen, H. D., Randall, R. and Cockerell, T. F.

Although remotely sensed images have found widespread application in the environmental sciences their use in providing detailed characterisation of the form and composition of vegetation communities has been limited. In recent years airborne terrain mapping LiDAR systems have presented environmental scientists with a new way of studying the properties of forests and other vegetation communities. The use of such data has been largely in forest mensuration. In this paper, we present the results of the analysis of LiDAR data collected over Woodwalton Fen, a deciduous woodland nature reserve in the southern England. Data collected from sample plots for four woodland communities, show that the LiDAR data provide a unique characterisation of the vertical structure of the canopies. Such canopy characterisation also reveals the pattern of light interaction with the surface of the canopies as well as the patterns of light penetration to lower levels of the canopies. We discuss the potential use of the results of this analysis in mapping the distribution of energy interactions within canopies and the implications for the mapping of distributions of lower storey vegetation communities and associated distributions of potential bird and insect habitats.

27
COMBINING CONSERVATION SCIENCE AND SOCIOECONOMIC CONSIDERATIONS IN CONSERVATION INITIATIVES: CASE STUDIES IN HONDURAS AND INDONESIA
***Field, R., Banin, L. and Coles, T.**

Conservation of biological diversity has a social and a financial context. Many conservation attempts fail because of socioeconomic factors in local/stakeholder communities. Frequently we cannot evaluate a conservation scheme's success because of non-existent or inadequate monitoring schemes – often resulting from financial limitations. Scientific monitoring involving both biological/ecological and socioeconomic research is rare indeed. We examine a model for conservation management and research that aims to address all these issues, with case studies in Indonesia and Honduras. Operation Wallacea uses grant and paying-volunteer funding sources to set up conservation schemes in conjunction with local communities in tropical forests and coral reefs. These schemes aim to ensure that it is in the interests (including financial) of local people/stakeholders to conserve the target ecosystems in the short- and long-term. Scientists are involved at every stage and there is heavy emphasis on scientific research – primarily for monitoring, but also for spin-off 'blue-skies' research. We argue that this model has potential for achieving its aims, as shown in Indonesia, though there are limitations. Issues include the use of buffer zones and the need for careful management. We also comment on this framework in relation to the emerging sub-discipline of Conservation Biogeography, as described by Whittaker et al. (2005).

28
COMPLEX HISTORIES OF CORAL REEF ORGANISMS IN THE INDO-WEST PACIFIC REGION
***Halas, D.**

An explanation of the high biodiversity of coral reefs in the Indo-West Pacific region, and particularly the Indonesia-Philippines archipelago, or Indonesian Triangle (IT) has been sought since Wallace's time. Two key theories to account for this biodiversity are the centre of origin hypothesis, postulating higher rates of sympatric speciation within the IT than in other areas, and the bioaccumulation hypothesis, which explains higher biodiversity in the IT due to its complex geological history of accretion of multiple terranes. Santini and Winterbottom (2000), a BPA study of thirteen Indo-West Pacific clades, found that the IT is a highly derived region, thus supporting the bioaccumulation hypothesis. A reanalysis of this data set using the PACT algorithm (Wojcicki and Brooks 2004) instead finds strong evidence for largely independent histories of speciation and dispersal for each clade; the bioaccumulation hypothesis is poorly supported at best. Complex data sets which include many species with widespread distributions can produce results which are positively misleading, due to the nature of the BPA algorithm; the current study suggests that many more well-supported clades are required even to determine whether there are general patterns to IT biodiversity at all.

29
THE ROLE OF HUMANS IN SIZE-BIASED EXTINCTIONS
***Boyer, A. G. and Brown, J. H.**

Numerous anthropological and ecological hypotheses have been proposed to explain the extinction of endemic animals on Pacific Islands coincident with prehistoric human colonization. We find that body size distributions of terrestrial vertebrates in Australia and Pacific Islands before and after human colonization show a similar large-size selectivity of extinctions across landmasses, despite differences in timing. In addition, the threshold size affected by the extinction on each landmass is correlated with area. Globally, large-bodied vertebrates are threatened by human hunting practices, whereas small-bodied species are not. Extinctions caused by climate change, disease, or habitat alteration do not show a size bias. We conclude that the prehistoric extinctions were caused primarily by human hunting, whereas more recent extinctions were due mostly to habitat alteration and exotic species introductions.

30
STABLE ISOTOPE ANALYSIS REVEALS FOOD WEB COMPLEXITY AT DIFFERENT SPATIAL SCALES IN A PATCHY ENVIRONMENT
***Gaines, K. H.**

The Bitter Lake National Wildlife Refuge in southeastern New Mexico contains dozens of saline sinkholes in a desert scrub and grassland matrix. Most of these sinkholes support aquatic macroinvertebrate communities dominated by larval dragonflies and damselflies (Order Odonata), and some sinkholes also contain populations of two rare fish species. Samples of fish, larval odonates, other aquatic insects, snails, amphipods, macroalgae, and macrophytes were collected from pairs of sinkholes with and without fish in three locations in the sinkhole complex. Results from carbon and nitrogen stable isotope analyses suggest that superficially similar habitat patches separated by as little as 20 meters can support communities with significantly different species diversities and trophic structures, and that the spatial scale at which food webs are examined may determine the degree of complexity perceived in a landscape.

31
ASSEMBLING THE GREATER YELLOWSTONE ECOSYSTEM: INSIGHTS FROM SPECIES GEOGRAPHIC RANGES AND THEIR BIOGEOGRAPHIC AFFINITIES
***Bruzgul, J. E. and Hadly, E. A.**

Extant species ranges reveal historical events and processes that lead to predictions about species persistence and range shifts in the future. In this study, we capitalize on the recent glacial history of the Greater Yellowstone Ecosystem (GYE) to improve our understanding of mammalian and avian community assembly. We utilize GIS technology to determine community composition and to calculate the proportion of the resident mammal and bird species ranges from three neighboring, yet distinct, biogeographic regions (Great Plains, Great Basin, Northern Rocky Mountains). Our results demonstrate the role of the GYE, and in particular Yellowstone National Park, in providing habitat for a community composed of species from all three biogeographic regions. Our data show a high percentage of species whose ranges are

not dominated by any one biogeographic region, which reinforces the idea that the GYE provides core habitat for wide-ranging species. The GYE contains few endemics and the number of species that demonstrate fidelity to a single biogeographic region varies depending on taxonomic class. Our spatially explicit results allow us to define deglacial colonization corridors of the GYE, and lead to predictions about the corridors critical to biodiversity conservation under future environmental change scenarios.

32
A PHYLOGENETIC PERSPECTIVE ON MAMMALIAN GEOGRAPHIC RANGE SIZE
***Spaeth, P. A., Ceballos, G., and Hadly, E. A.**

We investigated the influence of phylogeny on the relationship between mammalian body size and geographic range size using a global database of over 4,500 mammalian species. Our analyses revealed major differences between Eutheria and Marsupialia. Specifically, marsupial range sizes are not related to body size (slope = -0.10). In contrast, eutherian range sizes increase with body size (slope = 0.27). This pattern may reflect differences in life history, biogeographic history, or extinction between super-orders. We investigated the influence of historical events by examining the influence of the continent of origin on the body size-range size relationship between super-orders. We used the continent of South America, home to diverse marsupial and eutherian faunas as our testing ground. South American eutherians were found to be similar to global eutherians; however, South American marsupials clearly displayed a positive relationship between body size and range size (slope = 0.29), which was indistinguishable from the eutherian slope. Closer analysis of the phylogenetic patterns of body size-range size relationships within Marsupialia revealed significant differences between orders. Specifically, the Dasyuromorphia exhibit a strong negative correlation between body size and range size (slope = -0.96). Diprotodontia show a non-significant negative trend as well. We propose that the negative relationship seen in these orders (both confined to Australian and New Guinea) strongly influences the global Marsupialia pattern and reflects recent extinctions of large-bodied Australasian endemic marsupials.

33
IS THERE A RELATIONSHIP BETWEEN SPECIES' FUNDAMENTAL ECOLOGICAL NICHE AND GEOGRAPHIC RANGE?
***Munguía, M., Rodríguez, P., Ochoa, L., Lira, A., Sánchez-Cordero,V., and Soberón, J.**

The relationship between species ecological niche and geographic range is poorly known. We used the Genetic algorithm for rule-set prediction (GARP) to model the fundamental niche (FN) of 94 Mexican endemic mammals projected as potential distributions using point occurrence data and environmental variables (temperature and precipitation). The geographic ranges of endemics (GR) were based on known distributional maps (Hall, 1981); we overlaid the GR on the FN for each endemic. There was a significant correlation between the FN and GR of endemic mammals ($r^2 = 0.97$, $p < 0.0001$). We discuss how ecological and biogeographic factors might influence the observed patterns and is affected this relationship by comparing the GR/FN ratio for each species. Volant endemics showed higher FN/GR values compared to non volant endemic perhaps due to their dispersal capabilities. Endemics showing restricted distributions showed high GR/FN values compared with endemics showing wide distributions. This allows to elucidate one of the factors that limit species' GR from the many factors that have been proposed as limits: history, biotic interactions and climate; in this case climate is the controlled variable and is the reason why we focus on species with radio values equal to 1.

34
ESTIMATING SUBTERRANEAN INVERTEBRATE FAUNA
***Schneider, K. and Culver, D. C.**

Biodiversity mapping is a key component to understanding subterranean ecosystems in the face of increasing threats. However, the subterranean habitat is difficult to sample and diversity estimates for cave species are usually extrapolated from a small number of well-studied caves, which tend to be the largest and most accessible. These sampling biases may clearly affect what is known about subterranean biodiversity and biogeography. To determine the accuracy of currents methods of biodiversity estimation, we surveyed all caves (65) in a high cave density, species rich area of West Virginia (2002). As a result of intensive sampling that included visual censuses and trapping, 18 obligate cave species were collected. Only 7 caves were needed to collect 95% of the species, and by sampling only the largest 7 caves, 89% of the species could be recovered. However, the species accumulation curve did not reach an asymptote, and estimates of richness based on frequency of rare species predicted that we did not detect half of the species present. Repeated

sampling (2004) reveals that false negatives are in fact an issue when quantifying subterranean biodiversity. Multiple visits are essential to predicting the occurrences of cave species and determining the processes that underlie their distribution.

35

DISTRIBUTION-ABUNDANCE RELATIONSHIPS IN DANISH BREEDING BIRDS – THE INFLUENCE OF COMMONNESS AND RARITY

***Borregaard, M. K. and Rahbek, C.**

A positive relationship between the distribution and density of species is ubiquitous. Most hypotheses proposed to explain this pattern necessitate intraspecific relationships and imply that individual species exhibit greater local density when they are more widespread. A positive relationship between distribution and population size within species is also often implicitly assumed in many monitoring programs. This study compares the intra-specific distribution-abundance relationships between range size classes of Danish birds using data from two national breeding bird atlases (grain-size 5x5 km). We found an overall relationship between population change and change in range size, strongest for the first two range-size quartiles of species whereas the relationship for the last two range-size quartiles is relatively poor.

Species with simultaneously declining populations and increasing ranges were all insectivores. We found no relationship between changes of local densities and changes in national range sizes. It is likely that populations of small-ranging species are more sensitive to availability of habitat, while populations of wide-ranging species are more sensitive to food availability. Our results also support the proposition that interspecific distribution-abundance relations result from interspecific interactions rather than population processes within species.

36

NEW HIGH RESOLUTION LAKE SEDIMENT RECORDS OF SIERRA NEVADA CLIMATOLOGICAL, HYDROLOGICAL AND VEGETATION CHANGE FOR THE PAST 15,000 YEARS

***MacDonald, G. M. and Moser, K. A.**

We are utilizing lake sediment surface samples, cores from small lakes and instrumented lake and watershed data to develop and apply paleolimnological tools for reconstruction of pact climate change and ecosystem response in the eastern Sierra Nevada Mountains of California. The study sites are located along the crest and east slope of the Sierra Nevada. Surface sediment samples and water samples have been analyzed from 57 lakes extending across an altitudinal gradient of 1360 m. From these sites we produced quantitative transfer functions that estimate water temperature, salinity and depth on the basis of lake diatom flora or chironomid fauna. We obtained long cores from 8 lakes that provide a transect from above treeline at the crest of the Sierra down to the sagebrush dominated Great Basin lowlands in the east. The lake records extend back between 9000 and 15,000 calendar years before present. Pronounced warming and development of modern conifer forest initiated by ~13,800 Cal years BP. At ~11,000 Cal years BP temperatures were as warm or warmer than today. Transfer function models indicate minimum summer warming of approximately 4.5 degrees C at both high and mid elevation lakes occurred during this period. However, high resolution analysis shows that the general glacial to interglacial warming pattern was interrupted by a climatic reversal at approximately 13,000 Cal year BP during which time summer temperatures at mid-elevation lakes cooled by 4 to 6 degrees C. There was only a muted response to this episode at higher elevations and in the terrestrial vegetation. The cooling is synchronous with the Younger Dryas Stadial. Between ~8000 and 4000 cal years BP there was pronounced drying and lake drawdown at lower elevations. The period from 4000 to the present has been typified by shifts between relatively moist conditions, like the present, and drier multi-decadal intervals.

37

GEOGRAPHICAL PATTERNS OF SPECIES RICHNESS AND THE 'SWISS CHEESE EFFECT': CONSEQUENCES OF PATCHILY OCCUPIED SPECIES RANGES

***Hurlbert, A. H. and White, E. P.**

Species richness patterns are generated either by overlaying species range maps or by compiling geographically extensive survey data for multiple local communities. Although, these two approaches are clearly related, they need not produce identical richness patterns because species do not occur everywhere in their geographic range. Using North American breeding birds, we present the first continent-wide comparison of survey and range map data. On average, bird species were detected on 40.5% of the surveys within their range. As a result of this range porosity, the geographical richness

patterns differed markedly, with the greatest disparity in arid regions and at higher elevations. Environmental productivity was a stronger predictor of survey richness, while elevational heterogeneity was more important in determining range map richness. In addition, range map richness exhibited greater spatial autocorrelation and lower estimates of spatial turnover in species composition. Our results highlight the fact that range map richness represents species coexistence at a much coarser scale than survey data, and demonstrate that the conclusions drawn from species richness studies may depend on the data type used for analyses.

38

RE-APPROACHING SMALL ISLAND EFFECT

***Triantis, K. A., Vardinoyannis, K., Tsolaki, E., Botsaris, I., Lika, K., and Mylonas, M.**

The main feature of the small island effect is that an increase of species number along with the increase of area in small islands is not observed. Our aim is to propose a new approach to the small island effect (SIE) and a simple mathematical procedure for the estimation of its upper limit. Sixteen different data sets from 12 studies studying species richness patterns from different taxa and insular systems are analysed. Path analysis was used for the estimation of the upper limit of SIE. For the cases where SIE was detected, a log-log plot of species number versus area is presented and the R2 of the relationship between habitat diversity and area is calculated. In seven out of the 16 studied cases, a significant SIE was detected. The upper limit of SIE varies depending on the characteristics of the taxon and the archipelago in question. In general, the values of the upper limit of SIE calculated, differ from the ones calculated in previous studies. The SIE appears when area ceases to influence species richness and this definition is ecologically more realistic compared to the past approaches. There are two distinct patterns of SIE, the classical and the cryptic one. SIE cannot be considered as general pattern with a fixed behavior and should be recognized as a genuine idiosyncratic phenomenon.

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LONG-TERM DYNAMICS AND LOCAL SATURATION OF SPECIES RICHNESS IN SMALL MAMMAL COMMUNITIES

***Goheen, J. R., White, E. P., Ernest, S. K. M., Brown, J. H., Merritt, J. F., Meserve, P. L., and Slade, N. A.**

The extent to which species interactions limit richness in local communities is a topic of considerable interest in community ecology and biogeography. Interspecific interactions (e.g., competition) may play a key role in constraining the number of species that can coexist locally over time. Alternatively, membership in local communities may be limited primarily by colonization from the regional species pool, the composition of which is determined largely by historical processes. Using long-term data from four small mammal communities, we use randomization methods to test the null hypothesis that colonization and extinction events occur randomly with respect to the number of species in the local community. For three of the four communities (Chihuahuan desert, eastern deciduous forest, Kansas oldfield), we found that dynamics of species richness differ significantly from a random process. Further, these non-random dynamics occur mainly within feeding guilds, suggesting that competition can restrict the number of species that coexist locally. However, we found no evidence of intrinsic regulation in the remaining community (Chilean semi-arid scrubland). Finally, we propose a general framework for assessing the importance of species compensation in maintaining biodiversity within local communities.

40

VERTEBRATE MOVEMENT PATTERNS AND CONSERVATION ALONG MAJOR HIGHWAYS: ROAD PERMEABILITY AT THE LANDSCAPE LEVEL

***LaPoint, S. D. and Lomolino, M. V.**

The preservation of corridors to facilitate movements of terrestrial vertebrates can reduce the effects of habitat fragmentation by removing barriers to dispersal and migrations, including the millions of kilometers of roadways that permeate the landscape. Conservation biologists and transportation officials have developed several ways to mitigate the barrier effects of roadways, including the construction of underpasses. The efficacy of these mitigation techniques, however, is rarely rigorously tested at the landscape to regional scale.

This project attempts to quantify and evaluate the permeability of an interstate highway (I – 87) to movements and migrations of terrestrial vertebrates in the Adirondack wilderness region of New York State, USA. Our study has two main components. First, we are evaluating alternative designs of road underpasses in order to identify the design that best facilitates vertebrate movements. In the second component, we are conducting repeated winter tracking and road-kill

surveys along the entirety of this 95 mile stretch of highway. These surveys will let us evaluate the relative importance of movements through underpasses versus those across roads, and will let us test whether cross-road movements are random or whether they tend to be clustered and spatially associated with key features of the adjacent landscape.

41

BIODIVERSITY OF AFRICA-LARGE SCALE PATTERNS AND CONSERVATION PRIORITIES

***Küper, W., Rahbek, C., Sommer, J.H., Mutke, J., and Barthlott, W.**

The success to achieve the CBD 2010 targets will largely depend on credible and timely information about, for example, a) where centers of biodiversity are, b) where biodiversity is most threatened and c) where it can be most efficiently protected.
In the framework of BIOTA-AFRICA (www.biota-africa.org), the Nees Institute for Biodiversity of Plants (University of Bonn, Germany), in collaboration with international partners, has established the International Biogeographical Information System on African Plant Diversity (BISAP). Based on distribution data for 6500 plant species, patterns of plant diversity in Africa are investigated in respect to applied aspects of conservation, as exemplified by four maps:
1. Plant species richness per 10.000 km²
2. Data deficient areas in which plant diversity is not adequately represented by the currently available information on species distributions and diversity
3. Biodiversity hotspots, where high plant endemism is most threatened due to high human impact
4. Important Biodiversity Areas which cover only 1% of the sub-Saharan area, but host one third of the restricted-range species of plants and vertebrates in Africa.

42

PHYLOGEOGRAPHY OF BERINGIA: A SYNTHETIC ANALYSIS

***Waltari, E. and Cook, J.**

The effects of historical dramatic climate change in the Arctic have direct implications for predicting the impact of current climate change in the North. Phylogeographic studies on Arctic organisms are beginning to test hypotheses concerning the Beringian refugium. We explored phylogeographic variation in two Holarctic species complexes and reviewed 25 other phylogeographic studies of 22 trans-Beringian, terrestrial and freshwater taxa to assess the nature of colonizations, and evidence for differentiation and speciation in Beringia. We found that colonization across Beringia was primarily from west to east. We also found extensive evidence that Beringia was an important center of endemism. In addition, our data and two other studies of tundra-associated taxa corroborate a developing synthetic paradigm of Beringian paleoecology, that Beringia was primarily an arid steppe during glacial maxima, but with a narrow region of lowland mesic tundra in the center.

43

DUNG DEAL: MASTODON DIGESTA AS A PALEOBIOGEOGRAPHIC PROXY RECORD

***Teale, C. and Miller, N.**

Studies of mastodon (*Mammut americanum*) remains note deposits of twigs and other plant fragments identified as gastrointestinal or fecal contents. Fossil assemblages found in this digesta reflect mastodon diet and can be used as paleobiogeographic proxies to determine plant distributions at the time of deposition. Macrofossil and palynological analyses of a dispersed dung deposit in western New York (Hiscock Site, 45°05'04"N, 78°04'57"W) and of molar socket contents from the Hudson Valley (near Hyde Park, 40°46'45"N, 78°04'57"W) were used to determine paleobiogeography and the spatial extent of early proboscidean diet. Dates of twigs and associated skeletal remains identify the deposits as late Pleistocene. Pollen and plant macrofossils recovered from the samples indicate the presence of white spruce (*Picea glauca*), tamarack (*Larix*), jack pine (*Pinus banskiana*) and balsam fir (*Abies balsamea*), corresponding to post-glacial coniferous forest. Modern assemblages of plant material from boreal treed fens differ in composition and are therefore taphonomically informative. Relatively high concentrations of *Picea* at both sites indicate dominance of *Picea* in the forest community, preferential browsing, or differential digestion. High herb pollen counts – though minimal macrofossil evidence – may reflect browsing behavior and poor preservation. Very high alder (*Alnus*) pollen in the molar socket (80%, versus 15% in the surrounding sediment) establishes that alders were browsed by the Hyde Park mastodon before its death. Similarities between samples suggest that *Picea, Larix, Pinus* and herbs were widely consumed by mastodons rather than as isolated local, seasonal or starvation diets.

44
GLOBAL CENTRES OF VASCULAR PLANT DIVERSITY
Mutke, J., *Kreft, H., Kier, G., Rafiqpoor, D., Küper, W. and Barthlott, W.

The diversity of vascular plants is very unevenly distributed on the globe. A review of the 20 centers of vascular plant diversity with more than 3,000 spp. /10,000 km^2 regarding their most prominent climatic, geologic, and floristic features is presented and their overlap with priority setting schemes such as the biodiversity hotspots or the ecoregions by WWF is analyzed. The five centers where species richness is higher than 5,000 spp./ 10,000 km^2 (Northern Borneo, New Guinea, Atlantic Brazil, Tropical Eastern Andes, Chocó-Costa Rica) cover only 0.2% of the terrestrial surface. On the other hand at least 6.2% of all vascular plant species are endemic to these regions. Most of the global centers are located in mountainous regions within the humid tropics, where suitable climatic conditions and high level of geodiversity, i.e. the diversity of abiotic conditions, coincide.

45
THE TROPICAL ECOLOGY ASSESSMENT AND MONITORING INITIATIVE: MONITORING BIODIVERSITY THROUGH A GLOBAL SCIENTIFIC NETWORK
***Batra, P., Brandes, S., Hewson, J., Kierulff, C., Kuebler, C., Lacher, T., and Sanderson, J.**

Responding to the need for a coordinated network for biodiversity monitoring, Conservation International's Tropical Ecology Assessment and Monitoring (TEAM) Initiative was formed to monitor long-term trends in biodiversity through a global network of tropical field stations, providing an early warning system on the status of biodiversity that can effectively guide conservation actions. Over the next few decades, TEAM Initiative aims to track how ecosystem processes may be altered, and species assemblages may undergo changes, range shifts, phenological shifts, and extinctions, all believed to be possible effects of global change on biodiversity. Current TEAM sites are located in the Neotropics in several biodiversity hotspots and tropical wilderness areas. TEAM Network participants use standardized protocols to assess and monitor climatic variables, soils, ecosystem processes such as biomass change and phenology, and community composition of several taxa. Additionally, the use of satellite imagery allows monitoring of landscape change at large spatial scales. Data archiving and management are crucial considerations in a global network that is dependent on standardized data. Furthermore, the success of the TEAM Initiative relies on the conviction of participating scientists that global collaboration through data sharing will provide a powerful means to answer conservation science's most pressing questions.

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RANGE SIZE DISTRIBUTIONS AND THE LATITUDINAL DIVERSITY GRADIENT IN NEW WORLD WOODY PLANTS
***Weiser, M., Boyle, B., and Enquist, B.**

Diversity gradients arise from differences in one or more of rates of speciation, extinction, and dispersal/recruitment. Here we test predictions of how these three processes structure the latitudinal distribution of species richness and latitudinal extents of 12,980 species of New World woody plant species (trees, shrubs, lianas, woody vines). Woody plant species richness is higher in tropical regions and lower in extra-tropical than expectations of single domain geometric constraint models. When controlling for sample size and geometric constraints, mean latitudinal extents are larger than expected close to the equator and at high northern latitudes. Latitudinal extents of woody plant species ranges do not match predictions of differential speciation models, differential extinction models, or climate variability (i.e., Rapoport's Rule). Further, the distribution of range sizes shows non-random structuring and differs from predictions made by bounded geometric constraint models. These results have important implications for understanding the origin and maintenance of biological diversity on a global scale and for assessing conservation priority.

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POPULATION CONNECTIVITY: ANALYSIS OF GENETIC STRUCTURE OF THE SOUTHERN RED-BACKED VOLE (*CLETHRIONOMYS GAPPERI*)
***Runck, A. and Cook, J.**

Populations in fragmented habitats often experience limited dispersal, resulting in reduced gene flow, increased inbreeding, and increased genetic drift, all which may affect long-term viability. The isolating nature of physiographic

barriers (i.e. rivers, glaciers, mountains, and islands) in addition to impacts from forest habitat modification of southeast Alaska mainland and the Alexander Archipelago, leads to expectations of genetic subdivision among forest-associated terrestrial populations. Sequence variation in the cytochrome b gene was examined within and among nine populations of the forest-associated southern red-backed vole (*Clethrionomys gapperi*) in southeast Alaska to assess genetic subdivision, connectivity, and differentiation among populations. Although low levels of mitochondrial diversity were observed, populations were distinctive. Low levels of diversity are most likely explained by post-Pleistocene colonization of the region, and genetic subdivision is consistent with expectations of populations in fragmented habitats.

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DECONSTRUCTING CONTINENTAL-EXTENT CORRELATIONS BETWEEN TREE SPECIES RICHNESS AND CLIMATE

***Pither, J., Swenson, N., and Enquist, B. J.**

Debate continues over the processes underlying highly significant correlations between tree species richness and climatic variables. This may be because traditional analyses fail to detect potentially informative patterns otherwise concealed within richness-climate relationships (RCRs). For example, given that broad-scale richness patterns reflect the differential overlap of species' ranges, a detailed evaluation of how geographically rare and common species, and climate-specialist and generalist species contribute to RCRs should prove informative. Using digitized range maps for over 400 species native to North America north of Mexico, we are currently evaluating how species falling into quartiles of (i) range size, (ii) minimum temperature tolerance, and (iii) minimum precipitation tolerance contribute to the observed RCRs. These analyses will provide, for the first time, a detailed view of the structure of continental-scale tree RCRs.

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GLOBAL WARMING AND THE BIOGEOGRAPHY OF BIRDS

***Jetz, W.**

Identifying the effect of climate change on the distribution and survival of biodiversity on our globe is timely and pressing. Projections of potential range shifts and future occurrence of species are limited by methodological difficulties, knowledge about species ecological needs and their potential to shift, and the number of environmental variables with reliable predictions. Here I take geographic range stationarity as first, conservative assumption and analyze how the geographic pattern of temperature change will interact with the global avian biogeography to highlight species and regions of highest impact. For all 9,738 bird species I evaluate the minimum predicted temperature change across the least affected portion of their current day range. The highest impacts will mostly not be in the well-known hotspots of diversity and endemism (and threat), but in regions with specific interactions between the pattern of climate change and size, orientation and shape of geographic ranges - temperate to boreal Asia and North America and Western South America. These results have important implications for the setting of climate- vs. land-use change focused conservation strategies and the geographic prioritization of conservation efforts under a changing climate.

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