THE BIOGEOGRAPHY OF GEOGRAPHERS: A CONTENT VISUALIZATION OF JOURNAL PUBLICATIONS

J. Anthony Stallins
Department of Geography
Room 323 Bellamy Building
Florida State University
Tallahassee, Florida 32306

Abstract: Biogeographers choose to align their scholarship within different domains, from ecological or historical biogeography, to landscape ecology, macroecology, or the analytical perspective initiated with the theory of island biogeography. Biogeography is also practiced under the umbrella of geography, as geographical biogeography. Using the ISI Web of Science journal article database, I performed content visualizations of research authored by those biogeographers with an identity or interest aligned with geography. Content affinities with ecological biogeography were strong. However, physical geography materialized as the core of biogeographical inquiry for geographers based upon the central location of physical geography within these visualizations, and upon the ranking of journals where these geographers publish. I argue that the systems legacy of physical geography provides geographical biogeographers with an identity and an invitation to connect with the field of scholars advancing the study of complex systems. [Key words: biogeography, complexity, physical geography, visualization.]

INTRODUCTION

Collectively, the identity of biogeography draws from two lines of scholarship, ecological biogeography and historical biogeography (Brown and Lomolino, 1998; MacDonald, 2003; Lomolino and Heaney, 2004; Wiens and Donoghue, 2004). The research output of ecological biogeography examines the role of abiotic and biotic controls shaping modern species distributions (Barbour et al., 1999). Questions about disturbance, controls of biodiversity, characteristics of succession, and the nature of ecological boundaries are investigated. By contrast, historical biogeographers may work at larger spatial and temporal scales to address questions about dispersal, vicariance, and the phylogenetic-geographical underpinnings of evolution (Cox and Moore, 1993; Brown and Lomolino, 1998; Crisci et al., 2003). Historical biogeography merges with geology and paleontology in its search for a better resolution of the distributional controls of flora and fauna.

Other types of biogeography nest between these two major guideposts of biogeographic research. Landscape ecology's wide-angle focus on pattern and process, inclusive of heavily human-modified environments, positions it within ecological biogeography (Turner et al., 2001; Kent, 2007). The biogeography established by MacArthur and Wilson was mathematical and theory-focused. Its legacy is the practice of island biogeography or geographical ecology (MacArthur, 1972; Whittaker, 1998; Heaney, 2007). Biogeographers working within this track examine the effects of habitat fragmentation on metapopulations within a range of

Physical Geography, 2007, **28**, 3, pp. 261-275.

environments, not just oceanic or mountain islands. Some historical biogeographers focus on cladistics and phylogenetic techniques to reconstruct how the past constrains present-day distributions (Brown and Lomolino, 1998). Others conduct environmental paleoreconstructions more reliant upon dendrochronology, palynology, limnology, and plant and animal artifacts (Burney et al., 2004; Moser, 2004; Porinchu et al., 2007). More recently, macroecologists have fused the large spatial and temporal scales of the historical biogeographers with ideas from ecology (Brown, 1995; Gaston and Blackburn, 2000) and complex adaptive systems theory (Maurer, 1999). Like geographers, macroecologists employ data visualization and exploratory analysis in order to elucidate pattern and process via quantitative models. Calls have been made to bring more geography into macroecology in the form of sophisticated cartographic and visualization techniques, as well as greater attention to spatial structure (Ruggiero and Hawkins, 2006).

None of these smaller clusters, nor ecological and historical biogeography, is topically sealed off from other types of biogeography (Blackburn and Gaston, 2002; Wiens and Donoghue, 2004). All these biogeographic identities overlap, with practitioners often claiming several (or none) of their formal titles. The biogeography of geographers is no exception. As a geographic subdiscipline, biogeography has always been broadly inclusive (Fosberg, 1976; Veblen, 1989; Meadows, 1997; Young et al., 2004). From its origins in plant geography and botany, biogeography expanded to include the human elements of the landscape (Marsh, 1864; Simmons, 1989; Gregory, 2000). Biogeography was once proposed to be a fully separate component of geography, part of a trinity consisting of physical geography, biogeography, and cultural geography (Kuchler, 1953).

Geographic biogeographers are clearly pluralistic, but they are also pragmatic (Rhoads, 1999; Cowell and Parker, 2004). Pragmatic used here does not imply that their research is oriented only toward devising practical answers to practical problems (although part of it is). Instead, pragmatic refers to its philosophical usage, whereby practitioners acquire validity and identity through active practice (Menand, 2002). The contingencies of research and prior experience determine identity. With fewer constraints of a canon, geographical biogeographers (as with geography as a whole) select methods and advance conceptual frames that work within the scales of their particular study sites, the idiosyncracies of their training, and their experiences as researchers. This gives rise to a propensity to fuse techniques and ideas to yield unique modes of inquiry. Geographic biogeographers employ methods that bring human elements into biogeography (Herlihy, 2003; Knapp, 2004; Maxwell, 2004). Quantitative techniques have expanded within remote sensing (Meentemeyer et al., 2001; Walsh et al., 2003; Young, 2003; Sohn and Qi, 2005) and genomics (Parker and Jorgensen, 2003; Rigg, 2003; Markwith and Scanlon, 2007). Dendrochronological methods have morphed into dendrogeomorphology, dendrochemistry, dendroecology, and dendroarchaeology (Rayback, 1998; Grissino-Mayer et al., 2004; Speer and Holmes, 2004). The recent interest among geographers in Jared Diamond's *Guns, Germs, and Steel* (Cowell, 2003) is one facet of a longstanding overlap of the cultural with the biogeographic among geographers (Vale, 1987; Zimmerer, 1994).

But how is the biogeography of geographers more than a list-based summary of its techniques and places of inquiry? How might geographers who practice biogeography describe the organization of their field of study? How does their work fit in the larger world of biogeography? Although there are excellent historical summaries of the field of biogeography as undertaken by geographers (Cowell and Parker, 2004), the goal of this paper is to characterize their scholarship based on a material identity: a sample of their aggregate publication output. Using peer-reviewed papers authored by the Biogeography Specialty Group (BSG) of the Association of American Geographers, I performed data visualization to characterize publication structure and content. My goal is to find a common center and distill a parsimonious, yet heterogeneous, picture of how geographic biogeographers cluster into groups of shared topical interests and methodologies. By doing so, I provide geography at large with a snapshot of the work of geographical biogeographers. For scholars outside of geography, I communicate the balance of what geographical biogeographers do.

METHODS

As employed in this study, the cartographic visualization of knowledge domains (Skupin, 2004) seeks to extract the "lumpiness" of the biogeography of geographers, how it organizes around particular methods and topics of inquiry. Cartographic visualization used in this manner enhances the exploratory, or abductive aspects of pattern analysis. It facilitates a process of learning through the creation and observation of abstract images (Hallisey, 2005).

Queries were performed within the bibliographic database ISI Web of Science (Thomson Scientific, 2006) to compile journal articles authored by nonstudent BSG members listed in the 2004–2005 membership roster. Web of Science searches were limited initially to single-term queries using the author last name and then refined to multiple-term queries using additional terms (first and middle initials, home institution). When no articles were found in Web of Science for an author, Google searches were employed to confirm the name used by the author for publication and the current (and past) home institution(s). Three databases were queried within Web of Science: the Science Citation Index Expanded (1955–present), the Social Sciences Citation Index (1956–present), and the Arts & Humanities Citation Index (1975–present).

ISI Web of Science entries were saved for first-author research articles only. Consequently, BSG members with a large number of non–first author publications are underrepresented in the database. This had the desired effect of downweighting the influence of outliers, while highlighting more recent scholarly papers and the work of less well-published biogeographers. Because the content analysis software required an abstract for each bibliographic entry, only publications with a full abstract in Web of Science could be used. This limited the dataset to articles published after 1990. From an initial list of 266 nonstudent members, I assembled a sample database of 593 research articles, comprising 144 authors. Fifty-four percent of all BSG members did not have any first-author publications in Web of Science.

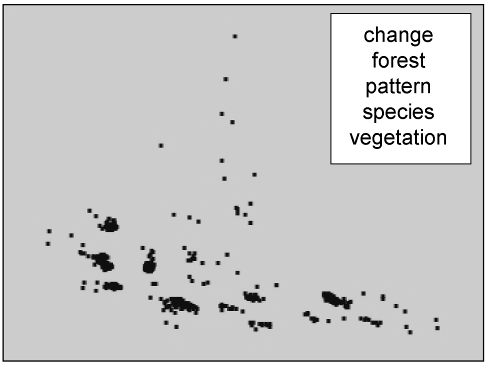

Fig. 1. AAG Biogeography Specialty Group publishing space based on ISI Web of Science bibliographic entries. Points represent first-author publications for nonstudent BSG members. For the 593 publications, the most frequent primary words derived by the RefViz algorithm were change (231 articles), forest (226), pattern (206), species (192), and vegetation (187). Two outliers had an undue influence on the visualization and were deleted.

To visualize content relationships within these publications, I employed RefViz text analysis and bibliographic visualization software (Thomson ISI ResearchSoft, 2006). RefViz was used to mathematically define the words and phrases that capture the key concepts of each individual paper. Rather than relying upon author-defined key words, RefViz assesses the frequency and distribution of terms within the title and abstract, as well as their associations with other terms. These words and phrases are then assigned a status as primary, secondary, or tertiary. Primary words are mathematically determined to be best for distinguishing and sorting references into groups. Secondary words are more evenly distributed across the reference set than primary keywords. They are less influential in creating groups but important for understanding relatedness among the primary keywords. Tertiary words are not used to distinguish references.

Primary and secondary word lists are then used to assign content similarities among individual articles. These similarities are translated to distance measures for graphical visualization. Visualizations are two-dimensional scatterplots where distance is a measure of similarity. Articles close to each other in this scatterplot are more similar; more distant articles have less similarity. The x-axis captures the maximum amount of variability within the reference set, with a lesser amount of variability along the y-axis. Only two axes are generated in RefViz, and no quantitative measures of similarity other than graphical distances are produced by the program's proprietary algorithm. Within a scatterplot, clusters of similar papers can be delineated visually and by reviewing the cluster's primary word list. Datasets are available from the author upon request.

RESULTS

Visualization of all 593 BSG-member publications indicated that geographical biogeographers share a common focus on changes in forest vegetation patterns

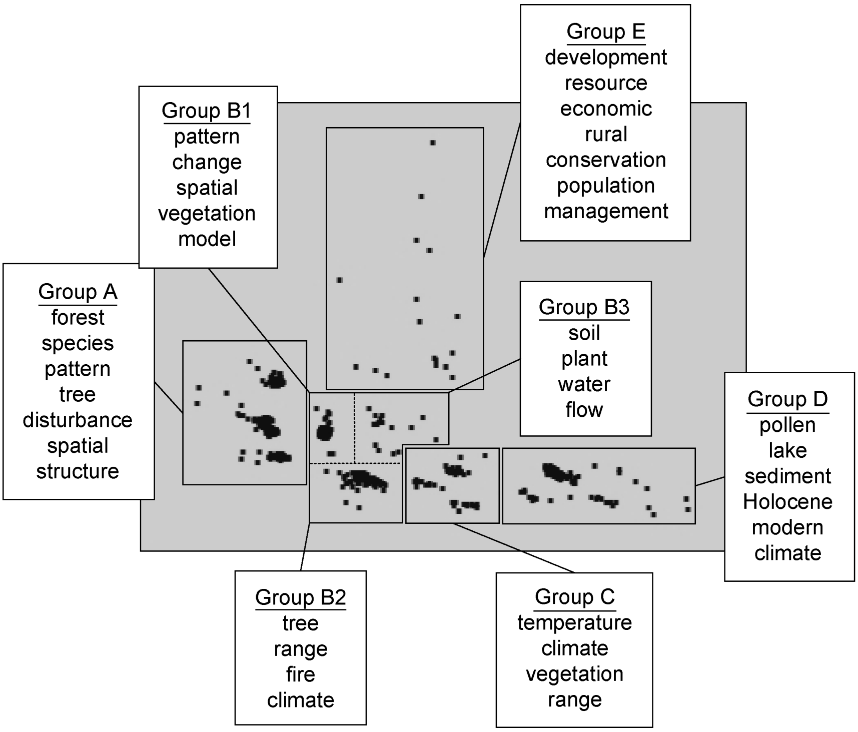

Fig. 2. Delineation of BSG publishing space into subcategories based on visual clustering of publications and local primary word lists.

from a species perspective (Fig. 1). This is based on the primary word list generated from all of the publications. Most of the articles are aligned along the first axis, with fewer articles separating out along the second axis. This indicates that the bulk of research practiced by geographical biogeographers aligns along one major axis of variability.

Individual journal articles were visually divided into five groups based on the clustering of publications along these axes and their respective word lists (Fig. 2). Roughly half of the publications (238; 40.1%) fell into Cluster A, on the left-hand side of the x-axis of our scatterplot. These biogeographers share a focus on forest patterns, with an added emphasis on disturbance ecology. Moving to the right, Cluster B (199 articles; 33.6%) biogeographers publish on topics that have more linkages to physical geography. Subcluster B1 (94 articles; 15.9%) retains a focus on plant biogeography, while subclusters B2 and B3 (105 articles combined; 17.7%) shift toward topics related to geomorphic biogeography (soil, plant, water, flow) and climatology (tree, range, fire, climate). Cluster C (58 articles; 9.8%) represents publications with strong ties to climatology. These biogeographers publish on topics related to global climate change and climatic controls of macroscale vegetation distribution. Reconstruction biogeography and paleolimnology emerge as common themes of Cluster D (81 articles; 13.7%) on the far right of the x-axis. Cluster E (17

Table 1. Journal Outlets (Not All Journals Are Shown for Each Cluster)

Journal	Article count
All publications	
Physical Geography	49
Journal of Biogeography	33
Annals of the Association of American Geographers	22
Professional Geographer	20
Canadian Journal of Forest Research	18
Quaternary Research	17
Journal of Vegetation Science	14
Geomorphology	12
Photogrammetric Engineering and Remote Sensing	12
Journal of Geography	11
Cluster A, ecological biogeographers	
Physical Geography	22
Journal of Biogeography	16
Canadian Journal of Forest Research	11
Annals of the Association of American Geographers	10
Journal of Vegetation Science	9
Cluster B, physical-geography biogeographers (geomorphology)	
Physical Geography	12
Journal of Biogeography	12
Annals of the Association of American Geographers	9
Geomorphology	7
Photogrammetric Engineering and Remote Sensing	7
Cluster C, physical-geography biogeographers (climatology)	
Physical Geography	11
International Journal of Remote Sensing	2
Annals of the Association of American Geographers	2
Climatic Change	2
Holocene	2
Cluster D, reconstruction biogeographers, paleolimnology	
Quaternary Research	13
Journal of Paleolimnology	7
Palaeogeography, Palaeoclimatology, Palaeoecology	4
Arctic Antarctic and Alpine Research	4
Physical Geography	4
Cluster E, human-oriented biogeographers	
Economic Botany	7
Human Ecology	5
Annals of the Association of American Geographers	4
Mountain Research and Development	3
Conservation Biology	2

articles; 2.9%) along the y-axis is composed of articles with ties to human geography through interests in development and conservation. For all publications, the most frequent journal outlet was *Physical Geography* (Table 1). The *Journal of Biogeography* and the *Annals of the Association of American Geographers* ranked as the next two most important journals for the biogeographical work of geographers.

Additional queries of the dataset were performed using search terms designating biogeographical methods (Fig. 3). GIScience and dendrochronology did not dominate the work of geographical biogeographers. However, their distribution in the scatterplot communicated differences in how these methods are deployed. Dendrochronological methods extended across the length of the first axis (51 of 593 articles), indicating their broad acceptance among geographers. However most of these articles were found in tight clusters, with the largest concentration within Subcluster B2, biogeographers whose emphasis is on climatology. GIScience (94 of 593 articles) articles were less clumped and more evenly dispersed throughout the dataset. They were concentrated within Cluster A, ecological biogeographers, and subcluster B1, physical geographers affiliated with plant biogeography. Human geography–affiliated biogeographers (47 out of 593 articles) had a comparably wide distribution among the sampled articles.

To gauge whether my sample was representative of geographical biogeographers, I performed an additional search within ISI Web of Science for articles more broadly affiliated with geographical biogeography. Boolean search criteria were used to extract articles with at least one author affiliated with a geography department and occurrences of at least two of the five primary terms generated in the analyses for Figure 1 (change, forest, pattern, species, vegetation). This generated a comparison dataset of 2783 papers. Visualization of content structure in RefViz indicated that the sample articles derived from AAG Biogeography Specialty Group membership were well-distributed throughout this larger, more loosely defined dataset (Fig. 4). Thus the sample data can be considered representative of the range of research undertaken by geographical biogeographers. Although the primary words from the smaller BSG sample dataset were used to extract the larger comparison from ISI Web of Science, they would have no a priori weighting in the RefViz algorithm other than presence.

DISCUSSION

The visualization of sampled ISI Web of Science publications indicated that geographical biogeography is a microcosm of the larger domains within biogeography. The x-axis, along which most of the sampled articles aligned, spans the range of biogeography, from ecological biogeography to an environmental reconstruction–focused historical biogeography. A smaller source of variability developed from those biogeographers who have authored research articles with stronger ties to human and cultural geography. These interdisciplinary articles trended along the y-axis and merged in the center of the scatterplot with publications that had a foundation in physical geography.

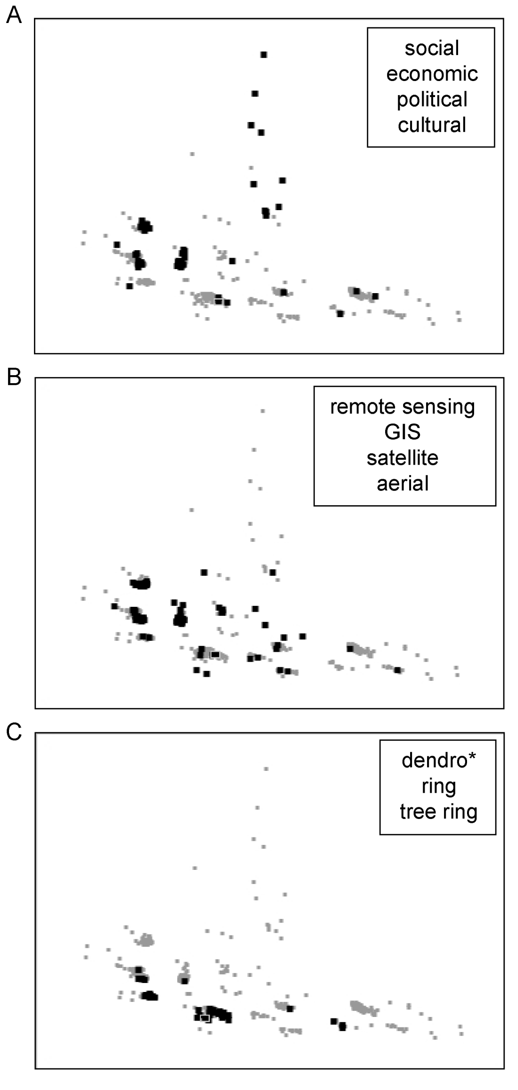

Fig. 3. Key word search of BSG publishing space. Search terms are listed in the box in each scatterplot. Symbols represent individual publications. Publications containing a key word are shown as the darker shaded symbols. One thematic key word search was performed, human-environment themes (A), and two methodological themes, GIScience (B) and dendrochronology (C).

The generality of the Boolean search terms used to construct the comparison dataset provided the breadth necessary to validate these findings. Yet this generality also conferred a degree of noise in this larger dataset, making it unsuitable for extracting more detail about publication trends. However, two characteristics warrant mention. The comparison dataset had a greater frequency of remote sensing and GISci studies, either as an artifact of the general search terms or as a reflection

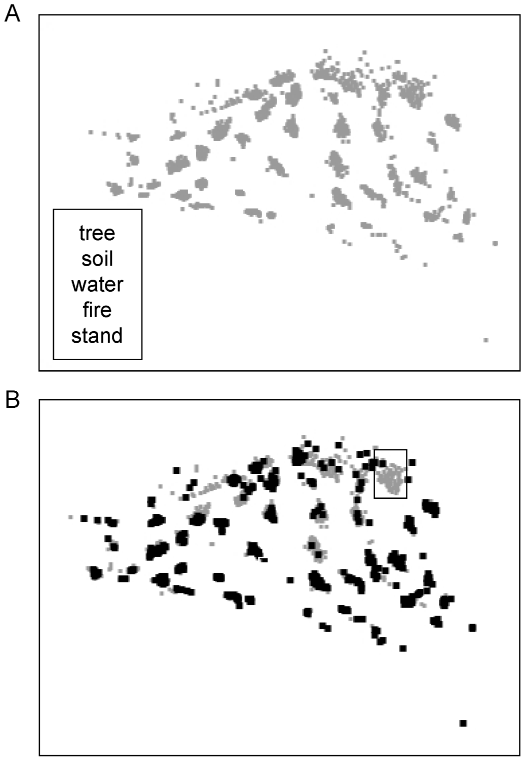

Fig. 4. ISI Web of Science articles (A) having at least one author affiliated with a geography program (address = GEOG*) and two of any of the following words (change, forest, pattern, species, and vegetation). Total number of articles = 2783. The search combination of "change and pattern" was not used due to its overwhelming generality. Two outliers had an undue influence on the visualization and were deleted. Overlay of sample dataset of articles from Biogeography Specialty Group (B). Total number of articles = 593. Darker symbols are the location of these sample articles within the larger, more loosely defined category of geographical biogeographers. Inset indicates area of nonoverlap for large-scale ecosystem studies (primary words = carbon, CO_2, flux, soil, and water).

of the popularity of these techniques. Secondly, a cluster of papers area in the larger dataset contained very few articles from the BSG sample data. These articles were associated with climate change impacts on large-scale ecosystem processes.

Almost half (40%) of BSG publications were in ecological biogeography. Forest disturbance ecology was the predominant research focus. This is due to the historical overlap between ecologists and geographers (Cowell and Parker, 2004). The earliest roots of biogeography—Darwin, Wallace, Humbolt—are also claimed by ecologists (Lomolino et al., 2004). Ecological biogeography emerged later, in reaction to ecology's preoccupation with a historically oriented, taxonomic plant geography (Hagen, 1986). The ongoing tension between biogeographers and ecologists has not been without its criticisms, as ecologists have exerted a disproportionately stronger theoretical influence (Stoddart, 1986; Meadows, 1997). However, for many biogeographers in geography, the legacy of ecology is not paramount. The remaining 60% of sampled articles fused biogeography with paleolimnology, climatology, geomorphology, and the human–environment interaction. These topics are squarely within the realm of physical geography (Gregory, 2000; Craghan, 2004). Although one may debate whether biogeography is part of or separate from physical geography (Kuchler, 1953; Watts, 1978), the salient point is that physical geography, specifically its integrative nature, is a unique identifier and organizing center for geographical biogeography.

The elements of physical geography within geographical biogeography are an opportunity to deepen recognition and foster dialogues with scholars outside of geography. Physical geography is alive among ecologists, although few there acknowledge it by name. Recent calls in ecology and macroecology highlight the propensity for feedbacks among abiotic and biotic landscape components to recursively shape pattern and process. Such self-organizing, cybernetic feedbacks have long been recognized by physical geographers (Chorley and Kennedy, 1971; Strahler, 1980; Craghan, 2004; Rhoads, 2004). The work of these geographers is part of a broad trajectory of thought now coming to fruition outside of physical geography in complex adaptive systems theory (Levin, 1998; Maurer, 1999), niche construction (Odling-Smee et al., 2003), and resiliency theory (Walker and Salt, 2006). Resiliency theory invokes human systems, and thus these schools of thought are not strictly biological and ecological. All are well within the realm of phenomena investigated by geographical biogeographers. Indeed, geographers may be better suited to explore these ideas than the ecologists, anthropologists, and economists who embrace them. Insofar as geographical biogeography remains in a mode of identity overly attached to methodology or unreflective description of pattern and process, its commentary on these topics is tardy, but not yet disadvantaged.

I propose that the full geographic dynamism of the abiotic–biotic coupling may be the distinguishing mark of geographic biogeographers. This coupling is more nuanced than the recognition of the environment as a template to explain organismal distribution, one of the foundational principles of biogeography. It also encompasses interactivity and the recursive nature between organisms, the environment, and the contingencies of place (Knox, 1972; Malanson, 1999; Fonstad, 2006; Phillips, 2007). In this manner, geographic biogeography implores us to pose questions about the ontology of species distributions (Bendix, 1997; Stallins, 2005; O'Brien, 2006; Zeng and Malanson, 2006) and their self-constituting potentials, whereby ecological entities constrain or multiply the trajectories of change (Johnson et al., 2005; Rhoads, 2006). This complex systems perspective has diffused into human-environmental geography (Parker et al., 2003; Crawford, 2005) and human geography (Massey, 1999; Thrift, 1999; Clark, 2005; Urry, 2005). The dearth of systems approaches among geographical biogeographers may hearken back to a rejection of ecosystem ecology that prioritized fluxes in nutrients and biomass as a means to understand biotic patterns, and an acceptance of a demographic conception of biogeography that favored abiotic explanations of species patterns (Malanson, in press).

In conclusion, I have presented evidence and argument to illustrate and persuade that geographical biogeographers are a robust microcosm of biogeography at large. There are no "true" geographical biogeographers; there is evenness in their diversity. Yet identity for them is not just a scaled-down reflection of all biogeographic scholarship. Geographical biogeography is distinctive for its ties to a systems-oriented physical geography, its longstanding affiliation with human-oriented scholarship, and its pragmatic, open-ended inventiveness. Such an identity would meld well with the broad field of scholars advancing the study of complex systems, where the whole is greater than the sum of its parts.

Acknowledgments: Kathryn Ziewitz provided editing assistance. There are many fine journal articles written by geographers that I could have cited in this paper if not for the requirement of brevity.

REFERENCES

Barbour, M. G., Burk, J. H., Pitts, W. D., Gilliam, F. S., and Schwartz, M. W. (1999) *Terrestrial Plant Ecology*. Menlo Park, CA: Benjamin/Cummings.

Bendix, J. (1997) Flood disturbance and the distribution of riparian species diversity. *Geographical Review*, Vol. 87, No. 4, 468–483.

Blackburn, T. M. and Gaston, K. J. (2002) Macroecology is distinct from biogeography. *Nature*, Vol. 418, 723.

Brown, J. H. (1995) *Macroecology*. Chicago, IL: University of Chicago Press.

Brown, J. H. and Lomolino, M. V. (1998) *Biogeography*. Sunderland, MA: Sinauer Associates.

Burney, D. A., Burney, L. P., Godfrey, L. R., Jungers, W. L., Goodman, S. M., Wright, H. T., and Jull, A. J. T. (2004) A chronology for late prehistoric Madagascar. *Journal of Human Evolution*, Vol. 47, 25–63.

Chorley, R. J. and Kennedy, B. A. (1971) *Physical Geography: A System Approach*. Englewood Cliffs, NJ: Prentice-Hall.

Clark, N. (2005) Ex-orbitant globality. *Theory, Culture, and Society*, Vol. 22, 165–185.

Cowell, C. M. (2003) Geographic isolation: Origins of the guns, germs, and steel model. *Antipode*, Vol. 35, 807–812.

Cowell, C. M. and Parker, A. J. (2004) Biogeography in the Annals. *Annals of the Association of American Geographers*, Vol. 94, 256–268.

Cox, C. B. and Moore, P. D. (1993) *Biogeography: An Ecological and Evolutionary Approach*. Oxford, UK, and Boston, MA: Blackwell Scientific Publications.

Craghan, M. (2004) The study of human action in the physical environment. *Physical Geography*, Vol. 25, 251–268.

Crawford, T. W. (2005) Spatial fluctuations as signatures of self-organization: A complex systems approach to landscape dynamics in Rondonia, Brazil. *Environmental and Planning B—Planning and Design*, Vol. 32, 857–875.

Crisci, J. V., Katinas, L., and Posadas, P. (2003) *Historical Biogeography: An Introduction*. Cambridge, MA: Harvard University Press.

Fonstad, M. A. (2006) Cellular automata as analysis and synthesis engines at the geomorphology–ecology interface. *Geomorphology*, Vol. 77, 217–234.

Fosberg, F. R. (1976) Geography, ecology, and biogeography. *Annals of the Association of American Geographers*, Vol. 66, 117–128.

Gaston, K. J. and Blackburn, T. M. (2000) *Pattern and Process in Macroecology*. Oxford, UK, and Malden, MA: Blackwell Science.

Gregory, K. J. (2000) *The Changing Nature of Physical Geography*. New York, NY: Arnold; Co-published in the USA by Oxford University Press.

Grissino-Mayer, H. D., Sheppard, P. R., and Cleaveland, M. K. (2004) A dendroarchaeological re-examination of the Messiah violin and other instruments attributed to Antonio Stradivari. *Journal of Archaeological Science*, Vol. 3, 167–174.

Hagen, J. B. (1986) Ecologists and taxonomists—Divergent traditions in 20th-century plant geography. *Journal of the History of Biology*, Vol. 19, 197–214.

Hallisey, E. J. (2005) Cartographic visualization: An assessment and epistemological review. *Professional Geographer*, Vol. 57, 350–364.

Heaney, L. R. (2007) Is a new paradigm emerging for oceanic island biogeography? *Journal of Biogeography*, Vol. 34, 753–757.

Herlihy, P. H. (2003) Participatory research mapping of indigenous lands in Darien, Panama. *Human Organization*, Vol. 62, 315–331.

Johnson, D. L., Domier, J. E. J., and Johnson, D. N. (2005) Reflections on the nature of soil and its biomantle. *Annals of the Association of American Geographers*, Vol. 95, 11–31.

Kent, M. (2007) Biogeography and landscape ecology. *Progress in Physical Geography*, Vol. 31, 345–355.

Knapp, P. A. (2004) Window of opportunity—The climatic conditions of the Lewis and Clark expedition of 1804–1806. *Bulletin of the American Meteorological Society*, Vol. 85, 1289–1303.

Knox, J. C. (1972) Valley alluviation in southwestern Wisconsin. *Annals of the Association of American Geographers*, Vol. 62, 401–410.

Kuchler, A. W. (1953) The trinity of geography. *Professional Geographer*, Vol. 5, 3–4.

Levin, S. A. (1998) Ecosystems and the biosphere as complex adaptive systems. *Ecosystems*, Vol. 1, 431–436.

Lomolino, M. V. and Heaney, L. R. (2004) *Frontiers of Biogeography: New Directions in the Geography of Nature*. Sunderland, MA: Sinauer Associates.

Lomolino, M. V., Sax, D., and Brown, J. (2004) *Foundations of Biogeography: Classic Papers with Commentaries*. Chicago, IL: University of Chicago Press.

MacArthur, R. H. (1972) *Geographical Ecology: Patterns in the Distribution of Species*. New York, NY: Harper & Row.

MacDonald, G. M. (2003) *Biogeography: Space, Time and Life*. New York, NY: Wiley.

Malanson, G. P. (1999) Considering complexity. *Annals of the Association of American Geographers*, Vol. 89, 746–753.

Malanson, G. P. (In press) Ecosystem. In J. A. Agnew and D. N. Livingstone, eds., *Handbook of Geographical Knowledge*. Thousand Oaks, CA: Sage Publications.

Markwith, S. H. and Scanlon, M. J. (2007) Multiscale analysis of *Hymenocallis coronaria* (Amaryllidaceae) genetic diversity, genetic structure, and gene movement under the influence of unidirectional stream flow. *American Journal of Botany*, Vol. 94, 151–160.

Marsh, G. P. (1864) In D. Lowenthal, ed. (1965), *Man and Nature: Or, Physical Geography as Modified by Human Action*. Cambridge, MA: Belknap Press of Harvard University Press.

Massey, D. (1999) Space-time, "science" and the relationship between physical geography and human geography. *Transactions of the Institute of British Geographers*, Vol. 24, 261–276.

Maurer, B. A. (1999) *Untangling Ecological Complexity: The Macroscopic Perspective*. Chicago, IL: University of Chicago Press.

Maxwell, A. L. (2004) Fire regimes in north-eastern Cambodian monsoonal forests, with a 9300-year sediment charcoal record. *Journal of Biogeography*, Vol. 31, 225–239.

Meadows, M. E. (1997) Biogeography: Adaptive radiation of a discipline? *Progress in Physical Geography*, Vol. 21, 583–592.

Meentemeyer, R. K., Moody, A., and Franklin, J. (2001) Landscape-scale patterns of shrub-species abundance in California chaparral—The role of topographically mediated resource gradients. *Plant Ecology*, Vol. 156, 19–41.

Menand, L. (2002) *The Metaphysical Club*. New York, NY: Farrar Straus and Giroux.

Moser, K. A. (2004) Paleolimnology and the frontiers of biogeography. *Physical Geography*, Vol. 25, 453–480.

O'Brien, E. M. (2006) Biological relativity to water-energy dynamics. *Journal of Biogeography*, Vol. 33, 1868–1888.

Odling-Smee, F. J., Laland, K. N., and Feldman, M. W. (2003) *Niche Construction: The Neglected Process in Evolution*. Monographs in Population Biology 37. Princeton, NJ: Princeton University Press.

Parker, D. C., Manson, S. M., Janssen, M. A., Hoffmann, M. J., and Deadman, P. (2003) Multi-agent systems for the simulation of land-use and land-cover change: A review. *Annals of the Association of American Geographers*, Vol. 93, 314–337.

Parker, K. C. and Jorgensen, S. M. (2003) Examples of the use of molecular markers in biogeographic research. *Physical Geography*, Vol 24, 378–398.

Phillips, J. D. (2007) Development of texture contrast soils by a combination of bioturbation and translocation. *Catena*, Vol. 70, 92–104.

Porinchu, D. F., Potito, A. P., MacDonald, G. M., and Bloom, A. M. (2007) Subfossil chironomids as indicators of recent climate change in Sierra Nevada, California, lakes. *Arctic Antarctic and Alpine Research*, Vol. 39, 286–296.

Rayback, S. A. (1998) A dendrogeomorphological analysis of snow avalanches in the Colorado Front Range, USA. *Physical Geography*, Vol. 19, 502–515.

Rhoads, B. L. (1999) Beyond pragmatism: The value of philosophical discourse for physical geography. *Annals of the Association of American Geographers*, Vol. 89, 760–771.

Rhoads, B. L. (2004) Whither physical geography? *Annals of the Association of American Geographers*, Vol. 94, 748–755.

Rhoads, B. L. (2006) The dynamic basis of geomorphology reenvisioned. *Annals of the Association of American Geographers*, Vol. 96, 14–30.

Rigg, L. S. (2003) Genetic applications in biogeography. *Physical Geography*, Vol. 24, 355–357.

Ruggiero, A. and Hawkins, B. A. (2006) Mapping macroecology. *Global Ecology and Biogeography*, Vol. 15, 433–437.

Simmons, I. G. (1989) *Changing the Face of the Earth: Culture, Environment, History*. Oxford, UK, and New York, NY: Blackwell.

Skupin, A. (2004) The world of geography: Visualizing a knowledge domain with cartographic means. *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 101, 5274–5278.

Sohn, Y. and Qi, J. G. (2005) Mapping detailed biotic communities in the upper San Pedro Valley of Southeastern Arizona using landsat 7 ETM+ data and supervised spectral angle classifier. *Photogrammetric Engineering And Remote Sensing*, Vol. 71, 709–718.

Speer, J. H. and Holmes, R. L. (2004) Effects of pandora moth outbreaks on ponderosa pine wood volume. *Tree-Ring Research*, Vol. 60, 69–76.

Stallins, J. A. (2005) Stability domains in barrier island dune systems. *Ecological Complexity*, Vol. 2, 410–430.

Stoddart, D. R. (1986) *On Geography and Its History*. New York, NY: Blackwell.

Strahler, A. N. (1980) Systems theory in physical geography. *Physical Geography*, Vol. 1, 1–27.

Thomson ISI ResearchSoft. (2006) *RefViz Software, Version 2.0*. Berkeley, CA: Thompson ISI ResearchSoft.

Thomson Scientific. (2006) *ISI Web of Science*. Retrieved June 2006 from ISI Web of Knowledge Web site at http://isiwebofknowledge.com/

Thrift, N. (1999) The place of complexity. *Theory Culture & Society*, Vol. 16, 31–69.

Turner, M. G., Gardner, R. H., and O'Neill, R. V. (2001) *Landscape Ecology in Theory and Practice: Pattern and Process*. New York, NY: Springer.

Urry, J. (2005) The complexity turn. *Theory Culture & Society*, Vol. 22, 1–14.

Vale, T. R. (1987) Vegetation change and park purposes in the high elevations of Yosemite National Park, California. *Annals of the Association of American Geographers*, Vol. 77, 1–18.

Veblen, T. T. (1989). Biogeography. In G. L. Gaile and C. J. Willmott, eds., *Geography in America at the Dawn of the 21st Century*. New York, NY: Oxford University Press, 28–46.

Walker, B. H. and Salt, D. (2006) *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Washington, DC: Island Press.

Walsh, S. J., Butler, D. R., Malanson, G. P., Crews-Meyer, K. A., Messina, J. P., and Xiao, N. C. (2003) Mapping, modeling, and visualization of the influences of geomorphic processes on the alpine treeline ecotone, Glacier National Park, MT, USA. *Geomorphology*, Vol. 53, 129–145.

Watts, D. (1978) New biogeography and its niche in physical geography. *Geography*, Vol. 63, 324–337.

Whittaker, R. J. (1998) *Island Biogeography: Ecology, Evolution, and Conservation*. Oxford, UK, and New York, NY: Oxford University Press.

Wiens, J. J. and Donoghue, M. J. (2004) Historical biogeography, ecology and species richness. *Trends In Ecology & Evolution*, Vol. 19, 639–644.

Young, K. R. (2003) Genes and biogeographers: Incorporating a genetic perspective into biogeographical research. *Physical Geography*, Vol. 24, 447–466.

Young, K. R., Blumler, M. A., Daniels, L. D., Veblen, T. T., and Ziegler, S. S. (2004) Biogeography. In C. Willmott and G. Gaile, eds., *Geography in America at the Dawn of the 21st Century*. Oxford, UK: Oxford University Press, 17–31.

Zeng, Y. and Malanson, G. P. (2006) Endogenous fractal dynamics at alpine treeline ecotones. *Geographical Analysis*, Vol. 38, 271–287.

Zimmerer, K. (1994) Human ecology and the "new ecology": The promise and prospect of integration. *Annals of the Association of American Geographers*, Vol 84, 108–125.