MRI: Development of an Urban-Forest Gradients Research Laboratory: Blurring the Edge - Lateral Impacts of Urbanization on Remnant Forests

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Durham NC together with nearby Chapel Hill and Raleigh are examples of rapidly growing, moderate-sized metropolitan areas which will be home to most of humanity by 2030 (UNDP 2003). This proliferation of the urban environment has impacts that propagate well beyond city and suburban boundaries. While recent research often focuses on comparing and contrasting urban and nonurban ecosystems and long-distance transport of pollutants, there is much less study on more immediate gradients between these two systems, i.e., on the extent to which pollutants (e.g., heat, nitrogen, ozone, CO_2, trace metals, and emerging contaminants) are locally transmitted from urban to rural areas. *The overall hypothesis is that urban-edge stressors of heat and nitrogen are affecting and transforming remnant forest ecosystems in urbanizing landscapes much more extensively than is currently understood.*

Intellectual Merit: This MRI proposal aims to deploy a coordinated system of advanced instrumentation to quantify, map, and model the extent to which atmospheric and hydrologic vectors of heat and N pollutants penetrate forest boundaries and how these pollution vectors affect biophysical responses in forest ecosystems. Research platforms are not only designed to provide rigorous, high resolution empirical data on transfers of urban heat and nitrogen species across urban-forest interfaces, they will be platforms for much of the next generation of research, education, and training on the Duke Forest. This proposal is motivated by recent Duke Forest research that points directly to the importance of urban-forest interfaces, research with important implications for public policy and education.

Several of the instruments to be situated in these platforms are being hailed as transformative. This includes the distributed temperature sensing system using fiber optics, automated GC-ECD for N_2O and integrated analytical instrumentation to quantify NOx, NO_y, and NH_3. The MRI proposal is guided by three questions which lead directly to future research proposals: (1) How far do urban heat and mobile source N pollution penetrate beyond the urban-forest "edge"? (2) What biophysical factors influence the spatial and temporal extent of urban-heat and N through "edges"? (3) How are organisms, communities, and ecosystem processes responding to localized heat and high N supply in terrestrial and aquatic edge habitats?

Broader Impact: This NSF MRI proposal builds on Duke Forest's historic prominence as a research center and its location in a rapidly urbanizing landscape. The MRI proposal is planned to initiate the development of an interdisciplinary research program addressing the connections between urban and forest ecology at the landscape scale. Datasets generated will prove relevant to Duke University's new sustainability initiative and will be of great interest to the municipal governments of the Research Triangle. Researchers will work with staff of the NC Life and Science Museum and the NC Kenan Science Teachers program in developing museum installations and classroom educational materials to teach K-12 students throughout the state of NC about the impacts of urbanization on natural ecosystems – and the capacity of natural ecosystems to buffer these pollutant stresses.