CNH-L (or S?): Modeling infection risk of an emerging tropical disease: Social and environmental drivers of American trypanosomiasis (Chagas Disease) in Central America.

**1. Project Summary**

**Overview:** Environmental conditions often influence individual human behaviors that predispose communities to emerging infectious diseases (EIDs). Around half of human diseases that originate in animals (zoonoses) are linked to environmental change, and are increasingly sensitive to changing land uses. Despite known disease ecology, the mechanisms by which environmental and social variables lead to infection risk remain poorly understood for many EIDs including Chagas. This proposal addresses the dynamic complex social, ecological, and environmental processes underlying disease risk due to deforestation and land-use change. Lastly, we will test the effects of different land-use change policies and individual behavioral incentive programs on Chagas disease risk. We will conduct empirical censuses to quantify host species and vector population size, and host species biodiversity. We will also conduct human behavior field studies, and quantify anthropogenic land-use change at selected sites in Central America to create and validate a spatial Chagas disease model: **1)** We will investigate the natural **'pathogen potential'** **(Aim 1)** of study landscapes by establishing whether the animal host and vector community ecology are predictive of reported and field confirmed outbreak data; **2)** We will investigate the human **'contact potential'** **(Aim 2)** of landscapes through an intensive human behavior study to map human-vector contact risk, and examine if the human-vector contact rate and socio-economic factors that are associated with land-use change predict Chagas outbreaks; **3)** We will use geographically weighted regression and structural equation models **(Aim 3)** that combine anthropogenic land-use change, disease host population diversity and distribution, disease vector range and distribution, seasonal climate, and individual behavior data to produce a Chagas risk hotspots map and generate predictions for use in land management and informing land-use decisions. **4)** To validate, verify, and test our model of disease risk **(Aim 4)** we will compare our model’s disease predictions against withheld cases of Chagas outside our study area. **5)** Finally, we will use this model to measure changes in disease risk under different policy scenarios **(Aim 5)**.

**Intellectual Merit:** Despite a large body of theoretical and empirical studies on emerging infectious tropical diseases, very little is understood about the interdependent mechanisms that promote disease emergence, how individual human behavior is affected by environmental conditions, and how human behavior changes environmental conditions to increase disease emergence. There is high potential for climate change to trigger land-use change. Climate change has direct effects to bioregions (e.g., natural disturbances, wildlife populations, temperature, and precipitation) and these effects strongly influence human behavior and decision-making (e.g., deforestation, agricultural production, land-use change, and land-use policy). Thus, quantifying the potential for climate-change to increase disease risk requires a CNH approach. The proposed research will quantify the mechanisms underlying and potential for Chagas disease risk in Central America. We will accomplish this through a broad-spectrum approach to social science data collection and analysis designed to facilitate a novel coupling for a spatially explicit disease risk model. Our modeling approach will add new data and capacity to existing modeling frameworks and deepen understanding of disease emergence risk factors for prevention and mitigation strategies. Finally, our approach will incorporate new technologies and software to measure behaviors in study communities. This project will generate new knowledge to fill fundamental gaps in disease risk, and help elucidate the full dimension of the impacts of global environmental change on a dynamic coupled natural-human system. Overall, the integrated, multidisciplinary nature of the project maximizes opportunities to advance understanding of coupled human and natural systems.

**Broader Impacts:** This study has implications for disease ecology, behavioral science, conservation, and public health. It will contribute to the professional development of postdoctoral scholars, graduate students, and field assistants in the U.S. and Central America. PI Huff currently directs a DTRA grant (GRITS) that will be leveraged to develop web-based programs to share and disseminate infectious disease data and forecasts to a broad audience. PI Daszak directs a current NSF RCN grant (EcoHealthNET) that will be leveraged to train U.S. and international graduate students in multi-disciplinary projects related to this proposal. Results from the proposed work will be published in high-impact journals, and presented at conferences and to the public as part of EcoHealth Alliance's (EHA) non-profit outreach programs to 90 international conservation and health partners of EHA, and to Congress and the White House via the regular briefings we hold. Our data will also be made publically available for the ongoing effort to reduce the risk and global burden of infectious diseases, protect ecosystems, and influence climate change adaptation policies.