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Department of Biological Sciences

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Dear Dr. Poisot,

Thank you for taking the time to consider my application. Various colleagues who use networks to investigate ecological processes introduced me to your work. When I began my career as an ecologist, my roots were firmly planted in the “dirty boots” camp where I investigated species distributions in agroecosytems. However, when I was introduced to modeling and simulation duriny my master’s degree, I developed a deep appreciation of and interest in theory. I saw how starting from a theoretical framework allowed researchers to build off each other’s work and advance the field. By the time I had finished, I was fully convinced of the need to use computational ecology techniques in order to unify important fine scale interactions with ecological processes occurring at landscape scales. During my PhD, I would like to apply machine learning to graph representations of empirical ecological interactions in order to derive ecological theory relating fine scale behavioral interactions and landscape scale patterns in species distributions.

My career in ecology began in 2007 working as a field technician conducting habitat restoration in prairies in Southeastern Wisconsin. In 2008, I joined Claudio Gratton’s lab at the University of Wisconsin Madison, where over five years I was able to grow from a laboratory techinician to a fieldwork team lead and co-lab manager. In the lab, I was conducting research in agroecosystems and helping to analyze nutrient flow around lake Myvtan in Iceland. While working on those projects, I was responsible for executing the entire data collection pipeline from field sampling to data entry on five projects. As a team lead, I was responsbile for creating training materials for athropods, flowering plants, lab equipment, lab safety, data entry and basic GIS techniques that were critical to the lab. I also trained undergraduate technicians on field and lab techniques as well as several graduate students on using ArcGIS. In my role as technical support, I directly contributed data to six research papers and five dissertations. Several of those papers were included in meta-data analyses regarding ecosystem services and landscape composition.

As a master’s student at the University of Colorado-Boulder, Dr. Deane Bowers gave me the opportunity to contribute to a multi-institution research initiative and develop an additional research project during my degree. The overarching theme of our USDA-NIFA funded project was the investigation of biofuel policy’s impacts on native bee communities in the grasslands of Eastern Colorado. On this project, I used my experience in pollinator diversity studies to help design and execute collection methods for grassland bees. Because this area was extremely under represented in museum collections, we needed to conduct extensive literature review to understand what level of species diversity to expect. This lead me to build a tool that scrapes the Biodiversity Heritage Library and the Discovery Life websites in order to build natural history tables for each of our expected bee species. Using these natural history tables, we were able to develop lists of floral associations, bee body size, and sociality, all potentially important traits for explaining community composition. For my thesis, I examined the relationship between landscape elements and species community composition at various spatial scales using multivariate generalized linear models. I found three components of the landscape (topography, row crops, roadside edge) explained differences in communinity composition at distinct spatial scales. The impact of roadside edges was particularly interesting because they occur at fine spatial scales that concentrate floral resources in narrow bands leading to a high number of species interactions. To investigate these interactions further, I established a common garden experiment where I artifically increased the concentration of a cryptic predator in a patch of planted Helianthus petiolarus, an abundant roadside plant, and monitored foraging behavior in solitary bees. I found that the predators had no detectable effect on foraging behavior, a direct contrast to previous studies of cryptic predators conducted in eusocial bees.

After completing my masters, I began working on a project with the University of Colorado Musuem of Natural History Bee’s Needs participatory science project where I developed a data dashboard for volunteers and designed analyses to investigate trends in cavity nesting insect diversity. One of the goals of this short project was to develop a statistical model that would assist in identification of the cavity nesting organisms based on nest characteristics and nest box location. Unfortunately, the data were not sufficient to develop an identification model. However, I was successful in deploying an Rshiny application that allowed users to access their data and explore it as they saw fit.

In my next position, I spent six months as an intern in the Smithsonian Institute’s National Museum of Natural History working in the National Insect Collection imaging primary type specimens of parasitic wasps and developing an online hymenoptera anatomy learning tool. During this time, I gained a deep appreciation for the amount of manual labor it takes to make collections accessible digitally. To help ease the burden of data entry, I wrote a python application that automated much of the tedious file management and data re-entry involved in processing specimens As a result of this work, we were able to make high quality annotated images of rapidly deterioting holotype and lectotype specimens and disseminate them via a publicly accessible web portal.

I then joined the consulting firm Accenture Federal Services where I worked as a Biosurveillance Scientist at the National Biosurveillance Integration Center (NBIC), part of the Office of Health Affairs in the Department of Homeland Security. NBIC’s mission is to use open source information to monitor the globe for emerging infectious diseases, invasive species, or other biological threats to animals, plants, and people, and share the information with interagency partners. Each biosurveillance scientist monitors a continent and produces three reports per day plus as-needed in depth products. This reporting cycle meant that I had to hone my analytical and research skills to be as efficient as possible. As the sole ecologist employed by NBIC, it fell to me to push my co-workers to think about systems as dynamic entities and dissuade them from an anthropocentric view of biology. Because of my previous experience working with digital collections, historical literature, and geospatial data, I was able to greatly expand the types of information used to contextualize events of concern. This became important during the Zika outbreak in Latin America. I was able to provide finer scale habitat suitability maps for disease vectors to local public health officials so they could make informed decisions about transmission risk. Additionally, I wrote several reports dispelling frequently repeated falsehoods about health issues among migrant populations including an in depth document on cholera that received praise from colleagues at the US Centers for Disease Control and Prevention.

In addition to my work at NBIC, over the past year I worked with Dr. Bill Fagan, Dr. Jeff Demers, and Dr. Sharon Bewick on the development of a web-based mosquito control resource optimization application. This application ingests raw mosquito abundance data, estimates key population parameters, and determines the optimal time to apply control methods. Working with Bill, Jeff, and Sharon brought back the joy that comes with academic freedom.

As a member of the Poisot lab, I would like to explore the relationship between species interaction networks, spatial scale, and species diversity to better understand how and where species coexist using graph representations of ecological networks. Being able to reliably infer species interactions based on functional traits and spatio-temporal relationships would be a huge step forward because it would demonstrate a level of predictive power rarely seen in community ecology.

The ability to generate interaction networks at scale would allow more ambitious projects to take shape. To infer networks at scale using artificial intelligence, huge amounts of formalized interaction data would be needed. In order to generate these large and clean datasets from existing data, it would be necessary to produce a natural language-processing model that can reliably extract high quality interaction data from digitized collections and literature, as well as increase access to schemas and ontologies that inherently capture formalized interactions. As someone who has worked in well resourced and under funded museum collections, I know adoption of an interaction data standard would be a monumental achievement requiring buy-in from hundreds of institutions. Making that process beneficial to collections will be crucial for widespread adoption. Once we can reliably generate interaction networks, we can formally describe patterns in network structures related to diversity and spatial scale. As your article *Data-based, synthesis driven: Setting the agenda for computational ecology* points out, researchers would then be able to reconstruct paleo ecological networks, accurately identify areas where functional species are under sampled, and begin to explain hyper diverse systems like the Amazon rainforest before they are destroyed by human activity.

Working on any component of this mammoth project would be thrilling. Given my experience researching species distributions and interactions, this fellowship would be a natural extension of my scholarship and allow for further professional growth.

Sincerly,

Collin Schwantes

Understanding the consequences of those inferred interactions on species coexistence, and being able reliably scale them

future research plans, - explore the relationship between species interaction networks and spatial scale in ecology. - establish online repository of interaction data and tools to increase accessibility to network analysis - build NLP tool to extract interaction data from historical literature - understand how inter-species interactions impact community composition - understand community resiliency and its relationship to network structure - Leverage open data from GBIF etc - Use AI to explore relationships between interaction and spatial scale in communities - demonstrate the need for additional natural history/biodiversity project using maths

Deane’s guidance on study design, excellent mentorship model, obvious care for her students

Kendi Davies community ecology class

outlining past research achievements, - university of wisconsin madison research tech - developed strong foundations in field research, agroecology, understand how data are collected, curated, and stored  
- university of Colorado - Behavioral ecology, pollinator predator interactions - community ecology - species distribution models - spatial modeling - smithsonian - deeper appreciation for specimen curation - saw the need for better use of - NBIC - how academic research is translated into govt policy, importance of clear concise sci commm., value of data vizualization, recognize the value of openscience to resource constrained govt institutions like public health and wildlife mgmt agencies