NEON Workshop Proposal

Title: Integrating Phenological, Trait and Environmental Data For Continental Scale Analysis: A Community Approach

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Background: There is a wealth of biodiversity and environmental data that can provide the basis for addressing global scale questions of societal concern. However, our ability to discover, access and integrate these data for use in broader analyses is hampered by the lack of standardized languages and systems. New tools (e.g. ontologies, standards, integration tools, unique identifiers) are being developed that will enable the establishment of a framework for linked and open data, but these tools are nascent and require efforts in the biodiversity and environmental realm to bring to fruition, as has occurred in other domains (e.g., biomedicine). We propose to bring together ontology experts, informaticians, and data producers, working across multiple projects and knowledge domains to tackle the challenge of providing consistently described and formatted data for immediate application in ecological analysis. This working group will first model phenology, trait and environmental data products from continental-scale efforts (e.g. NEON, USGS, USDA and others) focusing on ways to assure linkability and discoverability. The group will then use a suite of existing tools to rapidly prototype semantically enabled datasets that vastly decrease the time needed to assemble heterogeneous data for use in ecological analyses on varying spatial scales. We will show those datasets can address key scientific and management questions such as: "What traits determine differential phenological responses to changing environmental conditions?"

Goals and Objectives: ***The proposed work will focus on improving the discoverability and usability of biodiversity data. Through a community vetting process, we will aggregate plant trait data and annotate phenology data using ontologies that promote data interoperability. We will use existing tools to prototype delivery of "ecological model-ready" datasets. Objectives include:***

- Mapping instance data, especially NEON and USA National Phenology Network (NPN) datasets but also other data brought by working group participants, to the ontologies described below.
- Assigning Permanent Global Unique Identifiers to data instances and groupings
- Transforming datasets to RDF format
- Demonstrating the ability to quickly deliver trait and phenology data in standardized and "model-ready" formats.
- Demonstrating the ability to integrate these data with other data sources such as biocollections data from museum collections or other citizen science efforts.
- Developing use cases to address societally relevant questions such as: "How does phenological plasticity relate to other plant traits in the face of changing and variable climates?" and "Can we predict phenological responses given knowledge of intrinsic characteristics and extrinsic environmental drivers?"
- Publication of the results of the working group in a relevant world-class journal.

Approach: The 5-day workshop will be organized by the conveners, and participants will be invited as early as possible to assure the greatest possibility for participation. The conveners will establish the workshop agenda and activities and be responsible for follow-on deliverables. John Deck will spend 5 additional days at NEON to prepare for the workshop and provide training in the use of the relevant software to be used in the workshop. The conveners will seek NEON support for on-site logistics including audio-visual support and catering. Workshop participants will be responsible for arranging their own travel and will submit reimbursement documentation to NEON Inc. The details of workshop activities and expected results are detailed above.

Benefits: What are the benefits to ecological science?

1. Changes in the phenological responses of plants and animals are known to be highly responsive to environmental drivers and thus strongly influenced by climate change (Parmesan and Yohe 2003; Root et al. 2003; Cleland et al. 2007; IPCC 2007). Phenological changes have pervasive influences throughout nearly all ecosystem functions (e.g., trophic interactions, carbon, nutrient and water cycling, energy exchange). Specifically, advancing our understanding of the drivers of phenological response can provide insight into future states of species distribution (Durant et al. 2005; Chuine 2010; Miller-Rushing et al. 2010), biogeochemistry (Richardson et al. 2010), hydrologic cycles and other ecosystem services e.g. pollination (Memmott et al. 2007; McKinney et al. 2012). Additionally, increasing scientific understanding of relationships between phenology and the structure and function of ecosystems can help inform adaptive management of natural resources (Walther 2010; Young et al. 2010; Bellard et al. 2012, Enquist et al. 2014).

2. The key challenge to application of phenological information to natural resource management and planning becomes the integration of phenology, biodiversity and environmental data to understand landscape to continental-scale processes and inform management practices. As phenology data becomes more available, and the diversity and granularity of data sources increase (e.g., through citizen science or sensor networks), these challenges become more acute (Hochachka et al. 2012; Suresh, 2012). We can only understand the complexities of ecological and environmental processes on large scales if we are able to easily integrate diverse data sources into modeling and analysis frameworks.

   Phenological data, like most data in the biodiversity arena, are currently distributed in a manner that makes integration and re-use challenging (Wolkovich et al. 2012). This is due to non-standardized terminologies and metrologies employed during data collection, and different data sources residing in different systems. The end result is tremendous inefficiency as data and knowledge producers build similar but non-interoperable end products. Emplacing infrastructure that facilitates interworkability and interoperability among environmental systems data can transform scientific understanding and predictive capacity at the continental scale. Emplacing these community accepted standards within NEON will greatly increase the value and usability of NEON data for continental scale cross-disciplinary modeling efforts.

Proposed Timeframe: January 2015
Estimated Costs: See attached estimated budget and participant list.
Suggested Participants (optional attachment): See attachment.