

Sponsoring Scientist Biographical Sketch

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Department of Botany and Plant Pathology
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I. Professional preparation

Harvard University	BA History and Science, <i>Magna Cum Laude</i>	2002
Harvard University	MS Forest Ecology	2006
Stanford University	PhD Biology	2012

II. Appointments

Assistant Professor, Department of Botany and Plant Pathology	2016-
NSF SEES Postdoctoral Fellow, Duke University & University of Idaho	2013-2016
DOE Global Change Education Program Graduate Fellow	2009-2012
Teresa Heinz Scholar for Environmental Research	2009-2012
Rotary Ambassadorial Fellow, Universidad Austral de Chile	2002-2003

III. PUBLICATIONS – most closely related to proposed project

1. **Busby PE**, Soman C, Wagner MR, Friesen ML, Kremer J, Bennett A, Morsy M, Eisen J, Leach J, Dangl JL. 2017. Research priorities for harnessing plant microbiomes in sustainable agriculture. *PLoS Biol* 15(3): e2001793.
2. **Busby PE**, Peay KG, Newcombe G. 2016. Common foliar fungi of *Populus trichocarpa* modify *Melampsora* rust disease severity. *New Phytologist* 209:1681-1692.
3. **Busby PE**, Ridout M, Newcombe G. 2016. Fungal endophytes: Modifiers of plant disease. *Plant Molecular Biology* 90:645-655.
4. **Busby, PE**, Newcombe, G, Dirzo, R, Whitham, TG. 2014. Differentiating genetic and environmental drivers of plant-pathogen community interactions. *Journal of Ecology* 102: 1300-1309.
5. Newcombe, G, Muchero, W, **Busby, PE**. 2018. Exapted resistance to an eriophyid mite in a hybrid pedigree of *Populus*. *PLoS One*. Accepted with revision.

PUBLICATIONS – 5 additional

1. Brown SP, Leopold DR, Busby PE. 2018. Protocols for investigating the leaf mycobiome using high-throughput DNA sequencing. In: Ma W., Wolpert T. (eds) *Plant Pathogenic Fungi and Oomycetes. Methods in Molecular Biology*, vol 1848. Humana Press, New York, NY
2. Newcombe G, Harding A, Ridout M and Busby PE. 2018. A hypothetical bottleneck in the plant microbiome. *Front. Microbiol.* 9:1645. doi: 10.3389/fmicb.2018.01645
3. Lamit, LJ, **Busby, PE**, Lau, MK, Gehring, CA, Schweitzer, J, Whitham, TG. 2015. Tree genotype mediates covariance among functionally and taxonomically divergent communities. *Journal of Ecology*, 103: 840-850.

4. **Busby, PE**, Newcombe, G, Dirzo, R, Whitham, TG. 2013. Genetic basis of pathogen community structure for foundation tree species in a common garden and in the wild. *Journal of Ecology* 101: 867-877.
5. **Busby, PE**, Zimmerman, N, Weston, D and Newcombe, G. 2013. Leaf endophytes and host genotype in *Populus* alter severity of damage from the necrotrophic leaf pathogen, *Drepanopeziza populi*. *Ecosphere* 4:125.

IV. Recent Synergistic Activities

1. Agricultural microbiome research coordination

I am a co-PI on **NSF IOS 1714276, RCN: AgMicrobiomes: An interdisciplinary research network to advance microbiome science in agriculture (2017-2022)**. This project will create a global network of scientists, research sites, and model systems focused on agricultural plants and soil microbes. The overarching goal is to advance the understanding of agricultural microbiomes and their relationship to plant productivity and sustainability. We will do this through a series of workshops over the five-year project.

I was the PI on **NSF DEB 1519383 Meeting Proposal: Microbiomes for sustainable agriculture (2015-2016)**. I organized a meeting of academic and industry experts in microbiomes in March 2016 (Asilomar CA). The goal of the meeting was to identify research priorities for accelerating the integration of microbiome research into agricultural practices. The meeting resulted in a high-profile publication: Busby et al. 2017. Research priorities for harnessing plant microbiomes in sustainable agriculture. *PLoS Biol* 15(3): e2001793.

2. Fungal trait database development

I am part of an NSF working group (**NSF DEB 12734: Workshop: MacroMycoFunc**) aimed at forming an integrated understanding of function across fungi. Our international group has generated a functional trait database for fungi (<https://github.com/traitecoevo/fungaltraits>); a publication describing the database is in review at *Ecology Letters*.

3. Teaching

Instructor:

Biology 301 Human Impacts on Ecosystems, Oregon State University	2017-
Biology 371: Ecological Methods, Oregon State University	2017-

Teaching Assistant:

Biology 43 Evolution, Ecology and Plant Biology, Stanford University	2009
Biology 143 Evolution, Stanford University	2007
Biology 175 Tropical Ecology and Conservation, Stanford University	2007
Teaching assistant mentor, Biology Department, Stanford University	2009

4. Reviewer

NSF SEES Fellows Review Panel FY 2014; Ad hoc reviewer for Population and Community Ecology Panel

Journals: *Ecological Monographs*, *Ecology Letters*, *Journal of Ecology*, *New Phytologist*, *Molecular Ecology*, *PLOS One*, *Journal of Visualized Experiments*, *Forest Ecology and Management*, *Conservation Biology*, *Ecosphere*, *Oikos*, *Biotropica*, *Diversity and Distributions*, *Plant and Soil*, *ISME J*, *Nature Plants*, *Bioinformatics*, *Forests*, *American Journal of Botany*, *Plant Disease*, *Ecology*, *Fungal Ecology*, *Molecular Ecology*, *Mycologia*, *FEMS Microbial Ecology*

Research and Training Plan

1. A brief description of the research projects in the host research group(s), including a statement of current and pending research support, both private and public, for each sponsor. If any sponsor has submitted similar research for funding, the degree of overlap must be addressed.

Busby is an Assistant Professor in the Botany and Plant Pathology Department at Oregon State University (OSU). Research in her lab focuses on plant-fungal interactions, ecology and evolution of the leaf microbiome, and plant disease. Current research seeks to determine the factors structuring communities of non-pathogenic fungi that live in plants, endophytes, and to test how endophytes influence plant disease severity. This involves working in a variety of wild and crop plant pathosystems, including *Populus trichocarpa*. Research on *P. trichocarpa* is an ongoing focus in the lab and has involved productive collaborations with the Biosciences Division at Oak Ridge National Laboratory (ORNL) for several years. The Busby lab is supported by the NSF (1714276 and pending), DOE (219086), Agricultural Research Foundation (8689A), and Joint Genomes Institute (1665). There is no overlap between the objectives of these projects and those proposed by Thomas.

2. A description of how the research and training plan for the applicant would fit into and complement ongoing research of the sponsor(s) as well as an indication of the personnel with whom the Fellow would work.

The Busby lab has a strong focus on the *Populus trichocarpa*/*Melampsora* plant/pathogen system. Douglas-fir (*Pseudotsuga menziesii*) is the host organism proposed for study here, and is also the alternate (aecial) host for *Melampsora* × *columbiana*, a pathogen on which the Busby lab has focused much of its research. Busby's research especially focuses on placing the question of pathogen virulence in the broader context of the hosts microbial community, thus testing the real-world consequences of the ecology of the plant microbiome. The project herein proposed explicitly attempts to address a bioinformatic gap in methods currently available for monitoring response in the microbiome to disease (analysis of gene expression using RNAseq from the microbiome). This project also proposes to monitor changes in microbiome gene expression and microbiome community membership of trees in response to even-aged harvesting methods ("clearcutting"), a system of management used also for commercial *Populus* hybrids.

3. An explanation of how the sponsor(s) will determine what mentoring the applicant needs in research, teaching, and career development skills and how these would be translated into a specific plan that fosters the development of the applicant's future independent research career.

Primary sponsor Busby and Thomas will create a mentorship plan that addresses Thomas's needs in research, teaching, and career development skills. This plan will be based on an evaluation of Thomas's strengths and weaknesses in disciplinary knowledge, teaching, mentorship, communication, and grant writing. Throughout the fellowship period Busby and Thomas will meet on a regular basis to discuss progress toward mutually agreed upon goals for research, publication, presentations, proposals, and teaching that reflect specific needs.

In weekly meetings Busby and Thomas will discuss experiments, results, interpretations, current literature, manuscript preparation and obstacles. Busby will provide guidance to Thomas as he mentors undergraduate and graduate student projects in the lab that are directly related to the proposed project. These projects will allow Thomas to extend the reach and impact of his research while also gaining valuable experience in mentoring students. Finally, as Thomas prepares to transition to an academic position, Busby will provide guidance and perspective based on her recent experience navigating the academic job market.

4. A description of the role the sponsor(s) will play in the proposed research and training and the other resources that will be available to the Fellow to complete his or her training plan during the fellowship.

The Busby lab has a tradition of culture and culture-free sampling of fungle endophytes and pathogens. Their recent work with effects of environmental gradients^{1,2} on endophyte and pathogen communities complements the goals of the experiments proposed here. They have up-to-date experience with preparation of plant tissues for high-

throughput DNA sequencing³. Busby will provide additional training in the essential tools and techniques required for working with leaf microbes as well as intellectual guidance and support.

In the areas of expertise that may be outside of Busby's comfort to advise directly, she will aide Thomas in finding appropriate advice and resources. Oregon State University has highly qualified faculty that teach classes or have knowledge in the stated interests and needs of Thomas (for example, algorithm design with Cython or C++). An Illumina sequencing facility is on-site at OSU to facilitate library preparation and turnover of sequence data. OSU also has high-performance computing clusters available to meet the stated needs of the project, which involve regular manipulation of RNAseq and DNA-amplicon libraries.

5. A description of the limitations, if any, that will be placed on the Fellow regarding the research following the fellowship.

No limitations will be placed on Daniel's research following the fellowship. To the contrary, Daniel can take cultivars, culture collections, microbial community datasets, and collaborative partnerships forged during his postdoc to a future faculty position.