

Global Disease Biology, The New Approach

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Abstract

One of the many reasons UC Davis students find themselves in a state of confusion is choosing to pursue a major that corresponds to their passions. A new rising major that has been the center of attention recently is Global Disease Biology (GDB) that uses an interdisciplinary One Health-based approach to study infectious diseases. It is vital that current or potential GDB students are aware of the goals, resources, opportunities, and modes of communication of this discourse community to successfully graduate. By exploring all the GDB related online resources, reading a primary scientific article and a book based on One Health concept, and interviewing a professor and a graduating senior, I have gained a multi-perspective knowledge on how to purposefully navigate through the GDB major. The awareness, resources, and knowledge about the GDB community will help students choose appropriate courses, get involved in research and other activities, network with professors and other professionals, and build their professional and personal profile.

Keywords: Global Disease Biology, One Health

Introduction

A discourse community is formed by a group of people who share the same interests, values, and goals. As explained by Schmidt and Vande Kopple (1993) in “Communities of Discourse: The Rhetoric of Disciplines,” there are countless of discourse communities because each one “differ[s] in [...] fundamental beliefs about reality,” and as a result, “make[s] progress toward addressing [...] concerns in different ways [...] and work[s] to achieve different ultimate purposes” (p. 1-3). The discourse community that this study focuses on is Global Disease Biology.

Being declared as a major less than a couple of years ago, the GDB major has already about 243 enrolled students and counting (retrieved from OASIS Advising Record). Aiming for students to be able to learn about infectious diseases using One Health model, the creator of the

major, Professor David Rizzo, initiated this major with the collaboration of the UC Davis' Plant Pathology Department, Veterinary School, and Medical School. Through the GDB's program and courses, students will develop transdisciplinary critical thinking and research skills to connect concepts across evolving time, space, and culture.

In order to develop a transdisciplinary mindset, the GDB major has a work-in-progress and a flexible program. The course options range from major specific classes to a broad range of restricted electives. Additionally, the students are required to design and submit a senior research project. With a strong foundation in global health, graduate students continue to pursue a post-graduate degree or other professions.

As an aspiring doctor and researcher, I have been searching for a program that provides a multiperspective view of society and science. Intrigued by the One Health model and the importance of scientific research, I have researched about the community's values, goals, resources, and national and international level programs to provide a holistic perspective about the major for new and potential GDB students. As this study is about further understanding the major through primary and secondary research, I developed research skills, scholarly article writing skills, and presentation skills, all of which are a part of the GDB's learning outcomes.

Methods

For this project, primary and secondary sources include two interviews, extensive background research, and readings. The first interview was with Donald Nguyen, a graduating senior of the GDB major, who is ready to commence the next chapter of his journey at Mt. Sinai and Hofstra-Northwell's MD/Ph.D. program. Nguyen shared a student perspective on not only the GDB's unique values as a community but also on the process of growing from a student with general interests to a student with focused goals. The second interview was with Professor Rizzo,

Plant Pathology Department Chair and founder of the GDB major. His countless published papers include the discovery of the cause of sudden oak death as forest pathology and mycology specialist (Bailey, 2017). Recently, he also received “the 2017 UC Davis Prize for Undergraduate Teaching Scholarly Achievement (Bailey, 2017). In regards to readings, I read articles from UWP 1 on concepts of a discourse community and genre analysis, one of Professor Rizzo’s publications, and a book by Barbara Natterson-Horowitz. All the findings in this study are drawn from the background research, interviews, readings, and personal experience as I am a GDB student.

One Health Model

The revelation of One Health model was explained by Barbara Natterson-Horowitz in her book *Zoobiquity*’s first chapter ‘Redefining the Boundaries of Medicine.’ As an experienced cardiologist and a Professor at the University of California, Los Angeles, Horowitz never thought that human and animal diseases were interlinked until her visit to an emperor tamarin, a species of monkey, with heart failure. After learning that almost all animals suffer from same diseases that humans do such as Leukemia, cancer, diabetes, and even ones that are sexually transmitted, Horowitz understood that veterinarians have encountered these diseases in animals long before the diseases were even discovered in humans (Horowitz, 2012). This discovery led her to ask one of the most important questions, “Shouldn’t human and veterinary doctors be partnering, along with wildlife biologists, in the field, the lab, and the clinic?” (Horowitz, 2012, p. 13). Soon, the integrated study of animals, plants, and humans became the One Health Model.

Understanding the importance, Professor Rizzo initiated the GDB major to introduce the One Health model to UC Davis. According to Professor Rizzo, students interested in public health or medicine or research should be able, “to see the big picture. Disease is not just a human

or an animal thing or a plant thing,” (D. Rizzo, personal communication, May 9, 2017) rather a concept that is interdependent on all of them. An education that involves such collaboration and transferrable knowledge among multiple fields results in young scholars who will improve medicine and health globally.

Courses and Resources

The GDB department created a program that offers a wide range of courses and resources. Introductory courses such as Introduction to Global Disease Biology course (GDB 90) help students transition into the discourse community by teaching its goals and values. In addition to teaching students about the scientific method, ethics and the One Health model, the professor provides networking opportunities with guest speakers that include doctors, medical students, researchers, Ph.D. students, professors, and public health professionals (D. Rizzo, personal communication, May 9, 2017). As students continue onto upper division courses, they can explore their interests to build a personal profile through the flexibility in choosing restricted electives. As one of the students of the first graduating GDB class, Nguyen shared, “I kind of do wish I took classes that widened my perspective [...] what interests me [...] that makes it more interdisciplinary. As the whole point of the major is to look at things from a transdisciplinary perspective” (D. Nguyen, personal communication, May 4, 2017).

The advising team helps students plan their courses, find internships, and explore career options through multiple resources. The major advisor, Brandy A. Fleming, emails various research and internship opportunities including forwards from other departments, student clubs, and professors (see Figure 1). The department also uses its Facebook page to feature graduating seniors’ experience and also share current news about global health topics (see Figure 1). Lastly, students not only have access to the major advisor and peer advisors, but also a personal advisor.

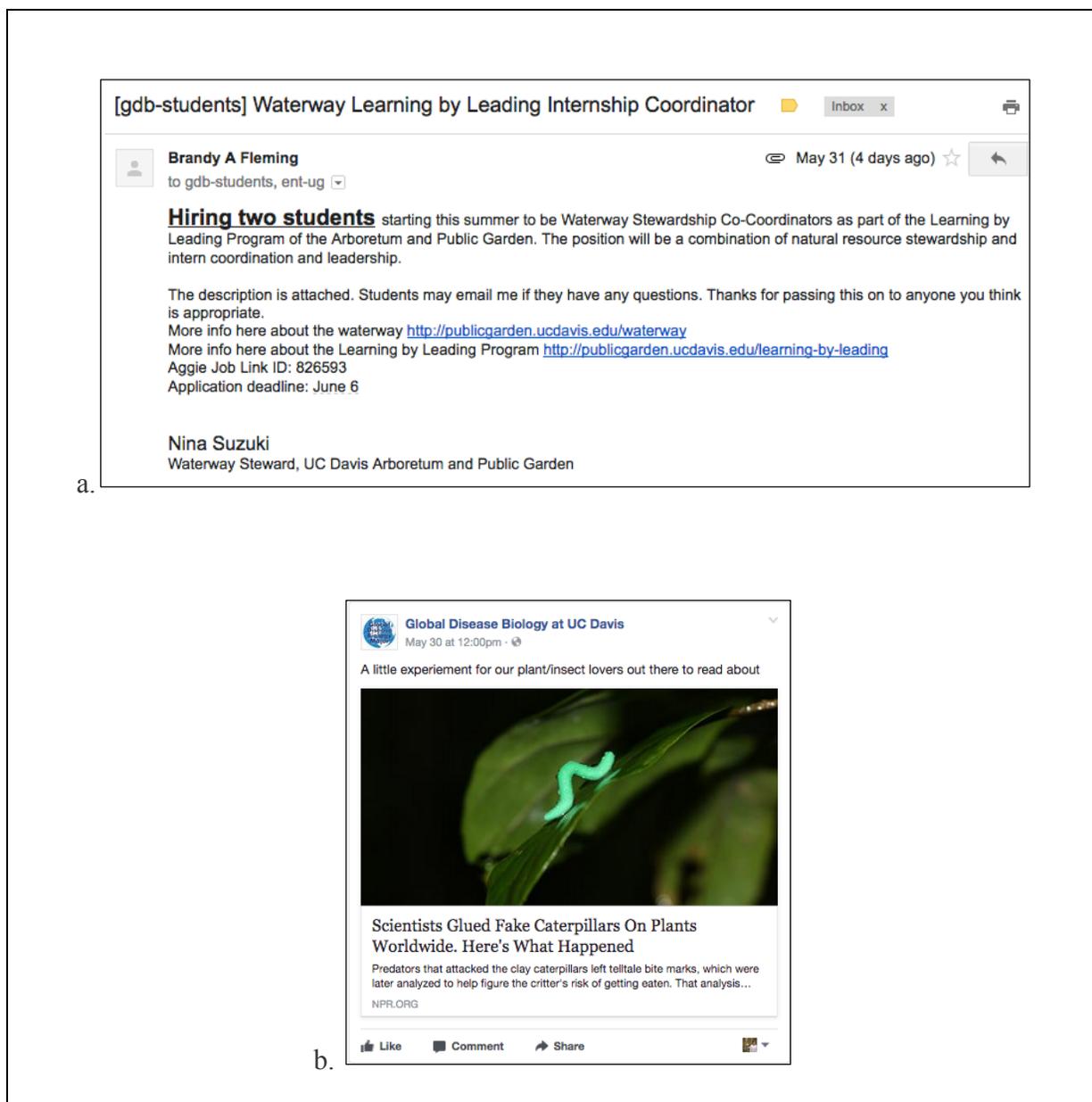


Figure 1: a. The image above shows an example of many emails GDB students receive about various research and internship opportunities. (B. Fleming, personal communication, May 31, 2017). b. An example of a shared news article on the GDB's Facebook page.

Importance of Research

The One Health model is studied and explored through research, as a result of which scientific research articles become one of the primary manners of communication among its members that includes students, researchers, and professors. Students are taught to not only to

understand but also to compose research material including sections of primary manuscripts, literature reviews, editorials, grants, and proposals (D. Rizzo, personal communication, May 9, 2017). Training to read and analyze scientific articles start as early as in GDB 90 course and continues into upper division GDB courses and also UWP 104F and 104E (D. Nguyen, personal communication, May 4, 2017). With this training students are required submit a 2 quarter GDB related research project in written format and also present to peers and professors. This project is usually done during the final year for 1- 2 quarters, but students can also use one of their research projects that they have done in the lab they are involved in throughout their undergraduate career (D. Rizzo, personal communication, May 9, 2017). Even a GDB seminar course is offered to guide students through this process. As a result of this research project, GDB students will explore their personal passions by demonstrating their knowledge and research skills.

Genre Analysis

Primary Scientific Research Article

In this genre, researchers such as Professor Rizzo have an opportunity to present new findings to support or reject the hypothesis based upon observations or previous studies. As this is a scientific genre, ideas or hypotheses or questions can only be supported with evidence that is obtained using procedures that can be repeated by any other researcher to obtain similar results. These scientific articles have a formal tone with jargon, references, and visuals. Other genres include literature reviews, proposals, and grants that are practiced in upper division courses (D. Rizzo, personal communication, May 9, 2017). Through required courses and research project, this discourse community teaches its students the scientific writing required to demonstrate transdisciplinary knowledge about infectious diseases.

As a researcher, Professor Rizzo has published many scientific manuscripts, one of which is “The key host for an invasive forest pathogen also facilitates the pathogen’s survival of wildfire in California forests.” This scientific article is for other researchers, professors, and students with college-level expertise in the fields of ecology and biodiversity because key terms such as sporulation, opportunistic pathogens or inoculation would be difficult to comprehend, otherwise. Being published through the Department of Plant Pathology, this study about the interaction among a plant pathogen, host, and natural disturbances that are occurrences such as floods, fires or earthquakes. This study will not only provide information, but also raise new research questions because “there have been few studies on the interactions between forest pathogens and fire” (Beh, Metz, Frangioso, & Rizzo, 2012, p. 1145). This study also provides more insight on plant pathogen’s survival, pathogen and host interactions, and forest ecosystem, all of which are major topics of research in the Plant Pathology Department.

The key host for an invasive forest pathogen also facilitates the pathogen's survival of wildfire in California forests

Maia M. Beh, Margaret R. Metz, Kerri M. Frangioso and David M. Rizzo

Summary

The first wildfires in sudden oak death-impacted forests occurred in 2008 in the Big Sur region of California, creating the rare opportunity to study the interaction between an invasive forest pathogen and a historically recurring disturbance. To determine whether and how the sudden oak death pathogen, *Phytophthora ramorum*, survived the wildfires, we completed intensive vegetation-based surveys in forest plots that were known to be infested before the wildfires. We then used 24 plot-based variables as predictors of *P. ramorum* recovery following the wildfires.

The likelihood of recovering *P. ramorum* from burned plots was lower than in unburned plots both 1 and 2 yr following the fires. Post-fire recovery of *P. ramorum* in burned plots was positively correlated with the number of pre-fire symptomatic California bay laurel (*Umbellularia californica*), the key sporulating host for this pathogen, and negatively correlated with post-fire bay laurel mortality levels.

Ridgely burn patterns that left green, *P. ramorum*-infected bay laurel amidst the charred landscape may have allowed these trees to serve as inoculum reservoirs that could lead to the infection of newly sprouting vegetation, further highlighting the importance of bay laurel in the sudden oak death-epidemic.

Introduction

Disturbance is a key component of many forest ecosystems (Pickett & White, 1985). However, in addition to natural disturbances (e.g. wildfires), many forests are now being transformed by accelerated climate change, biological invasions and habitat change (Turner, 2010). As these novel disturbances proliferate, more long-term effects and qualitative changes to forest ecosystems are expected (Lorenz et al., 2006; Turner, 2010). Novel disturbances may interact with historically recurring disturbances in unknown ways with the potential to alter landscape structure and function (Parks & Westman, 2011). In spite of these consequences, changing and interacting disturbance regimes have received little attention relative to other drivers of ecosystem change (Turner, 2010).

Interactions between invasive forest pests and wildfires are currently of great relevance in the USA. From 1990 to 2006, there was a nearly three-fold increase in the devastation rate of established high-impact forest pathogens and insects (those species of regulatory significance or that have caused notable damage to forest trees) compared with the previous 130 yr (Chakraborty et al., 2010). In addition, the frequency of large wildfires in the western USA has increased significantly since the mid-1980s, together with warming temperatures and lengthened fire seasons (Veitch et al., 2006). Although there is a growing body of literature on interactions between forest insects and wildfires (e.g. McCallough et al., 1998; Taylor et al., 2006; Jenkin et al., 2006), there have been few studies on the interactions between forest pathogens and

Table 1 The estimated odds ratios and P values for the predictor variables in the multiple logistic regression models used to determine the influence of plot variables on *Phytophthora ramorum* presence within 63 forest plots in the Big Sur region, Monterey County, CA, USA, 1 and 2 yr following wildfires (2009 and 2010, respectively)

Predictor variable ^a	2009		2010	
	Odds ratio	P value	Odds ratio	P value
Burn status: unburned vs burned	29.117	0.000**	3.740	0.129*
Forest type: RW ^b vs ML ^c	6.618	0.134	11.882	0.036*
Pre-fire plot variables				
Total basal area, bay	2.006	0.627	6.670	0.054*
Total basal area, tan oak	3.156	0.128	1.164	0.817
No. of symptomatic bays	1.237	0.008**	1.039	0.200
No. of symptomatic tan oaks	1.056	0.267	1.016	0.708
Post-fire plot variables				
Prop. dead basal area ^d , bay	0.053	0.133	0.019	0.006**
Prop. dead basal area ^d , tan oak	0.276	0.436	0.972	0.981
ALC value		0.943		0.920

P values: 1. P < 0.1. * P < 0.05. ** P < 0.01. *** P < 0.001.
^aAll plots were known to be infested with *P. ramorum* before the fire.
^bRW, redwood; ML, mixed-evergreen.
^cProportion of basal area that died between 2006 and 2009.
^dProportion of basal area that died between 2006 and 2009.

Potential reservoirs of the pathogen

As the vast majority of samples were collected from bay laurel and tan oak, these were the host species from which we recovered *P. ramorum* most frequently, although we also occasionally recovered the pathogen from *Quercus* spp. in burned plots.

Figure 2 Fitted probabilities for the post-fire presence of *Phytophthora ramorum* in 63 plots in the Big Sur region, Monterey County, CA, USA, known to be infested with *P. ramorum* before the fire. (a) pathogen recovery in 2009 in response to the number of symptomatic bay laurel trees before the wildfire; (b) pathogen recovery in 2010 in response to the proportion of post-fire bay laurel mortality levels. The predicted fits are from the models presented in Table 1. Variables on the x axis were varied across the 2.5–97.5 percentile range of values observed in our plot network, whereas other model predictors were each held at their respective median value. Red and blue lines indicate reduced and mixed-evergreen forest types, respectively, with unburned and burned plots indicated with solid and dashed lines, respectively.

Figure 2: The images above are from a primary scientific article.

The purpose of this research was to “examine the direct and indirect impacts of wildfire on the persistence of *P. romorum* in Big Sur” by studying the biotic and abiotic factors that influenced the eradication, persistence, and re-invasion of the pathogen (Beh et al., 2012, p. 1146). Professor Rizzo and team conducted on-site surveys on burned and unburned plots in forests of Big Sur during 2009 and 2010 in addition to using related data from other studies. Other than categorizing data based on plot type, year, tree type, and leaf type, other survey methods included measuring stems diameters, confirming pathogen’s presence, and recording abiotic observations of the plots. Data and observations collected were presented in the form of topography, graphs, tables, and other statistical analysis images (see Figure 2). Since this was an on-site study over a long period of time, visuals such as graphs and topographies provide trends and geographical identity, respectively. Other visuals such as tables and scaling images allow the researchers to clearly organize numerical data.

Beyond Undergraduate Career

With a strong foundation about One Health model and research experience, students can either choose to pursue further education or a profession. Further education can include Ph.D., MD or Masters in Public Health. Others who would like to gain work experience can either work in research labs or in the field. Fieldwork opportunities include working for organizations such as Doctors Without Borders, Centers for Disease Control and Prevention, UNICEF, or UC Davis One Health’s PREDICT project that aims to detect pathogens of infectious diseases worldwide (D. Rizzo, personal communication, May 9, 2017). Other career options include jobs in healthcare, public health, agricultural industry, pharmaceutical and biotechnology research industry, economics, teaching, and much more (GDB, 2017).

Conclusion

As a result of this study, an in-depth knowledge about the GDB major discourse community's values, goals, and resources was acquired. With a broad range of courses, research opportunities, and internships, students will gain knowledge about infectious diseases and acquire critical thinking skills by analyzing scientific articles and case studies on global health issues. Also, by learning about the One Health model and developing research skills, students will have the ability and potential to excel in various fields of global and public health. For example, Professor Rizzo and team applied interdisciplinary knowledge about ecology and animals study the interaction between sudden oak death pathogen and wildfires that occurred in the Big Sur region of California. Being involved in similar research projects can help students meet the major's goal, which is studying about global diseases in plants, animals, and humans using acquired disease knowledge and applying scientific research methods.

Bare knowledge can mislead students into thinking that this major is for students interested in agricultural sciences as this major is part of the College of Environmental Sciences. However, the flexibility and transdisciplinary focus of this major allows students to pursue in a wide range of career paths successfully. The GDB department and the advisory board have created a friendly and approachable environment for students to contribute to the growth of the community. Overall, any student with strong academic aspirations who are intrigued by the One Health perspective of science and society should consider Global Disease Biology as their major.

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