

Candidate's Statement – J. Andrew Whitehead

1. Research Activities

My research program seeks to understand the mechanisms through which animals integrate cues from, respond to, and are shaped by the external environment. We examine responses to stress that occur over physiological timescales (acclimation responses) and over evolutionary timescales (adaptive responses). We integrate genome expression profiling, population genetics/genomics and phylogenetics, and physiology, to study how individuals and species respond to and adapt to environmental stress. Stressors of interest include those that are natural (temperature, salinity) and of human origin (pollutants, climate change).

We have three major research themes in our lab: 1) Evolution of phenotypic plasticity, where our model system focuses on osmoregulatory flexibility within and between species of killifish; 2) Rapid evolutionary adaptation in human-altered environments, where our model system focuses on repeated adaptation to urban estuarine pollution in Atlantic killifish; 3) Oil spill ecotoxicology, where we examine the molecular underpinnings of oil injury during development in the killifish model system, including trans-generational impacts. For each of these research themes we apply a novel and innovative integrative approach; we combine mechanistic information contributed from genome sequences and genome-wide sequence variation within and between species, variation in genome-wide gene expression within and between species and in response to environmental change, and link these to physiology, behavior, toxicity, and development. We seek a greater integration of genome-enabled systems biology, which has facilitated great advances in the biomedical sciences, into the ecological, environmental, and evolutionary sciences. We are particularly motivated to integrate 21st century genomics technologies into the applied environmental sciences. It is this integration of genomics into comparative functional biology, and into applied environmental science, that distinguishes our research program. Our efforts to meaningfully integrate genomics technologies into applied environmental sciences is revealed, for example, by our participation as founding member of the Shanghai Environmental Genomics Consortium, and our leadership role in organizing the recent UC Davis conference on contaminants in the San Francisco Bay/Delta system. Our work is also highly collaborative; we have active research projects that integrate our program with others, for example at Louisiana State University, Washington University, MIT, University of British Columbia (Canada), University of Guelph (Canada), University of Birmingham (UK), Xiamen University (China), NOAA, and the US EPA.

Our contributions to basic and applied sciences, in each of our research themes, have been highly influential as revealed by our publication record, our record of invited talks and presentations, and interest from politicians and the popular press. For each of our research themes, we have published papers in the top journals (e.g., including multiple papers in *PNAS* and *Science*) and in top specialty journals (e.g., *Environmental Science & Technology*, *Evolution*, *Molecular Biology & Evolution*, *Journal of Experimental Biology*). These papers have been highly cited. A further indication of the professional impact of our research is the numerous invitations to present our work at national and international conferences, workshops, and departmental seminars – these requests are for each of our

research themes in ecotoxicology, evolution, and phenotypic plasticity. Additional highlights include Senator Bill Nelson visiting my lab to learn first-hand about our research findings and implications, after which he presented our findings on the floor of the United States Senate. We have also been invited to testify in front of Congress. Our evolution and environmental research has also been widely disseminated in the popular press, including radio (NPR, CBC), television (MSNBC, ABC with Diane Sawyer), and print/online (e.g., New York Times, Washington Post, National Geographic, Newsweek, LA Times, Al Jazeera, AAAS podcast).

Our group has had success in winning grants continuously and from diverse sources. We have been continuously funded by the NSF since my first year as Assistant Professor. We have also been funded by other major federal agencies including the NIH, NOAA, and the US EPA, in addition to other non-federal sources. This reflects the merits of our approach to integrative research that pushes the boundaries of both basic and applied science. Most recently, we have been awarded a \$1.6M 5-year grant (2017-2022) to study the causes and consequences of Pacific herring fisheries collapses and the role of the Exxon Valdez oil spill. Furthermore, we have proposals in review to discover the molecular and physiological mechanisms that underpin circa-tidal rhythmicity in marine organisms (which is likely a major mechanism that underpins physiological flexibility), and to discover how the environmental toxicity of oil changes, and how, as it weathers in the environment following an oil spill. New research themes in the Whitehead lab expand on our themes of integrative genomics and physiology in a human-altered planet. For example, we are developing red abalone as a model system for studying ocean acidification (ongoing experiments and genomics work supported by NOAA), and are characterizing genotype-by-environment interactions that underpin resilience of mangrove killifish to extreme environmental change (new partnership with the University of Guelph, Canada, and which supported training of a visiting scholar to the Whitehead lab from China).

2. Teaching Activities

I consider the education of an informed citizenry as one of my most important missions as a professional academician. My main research interests in evolution, climate change, and environmental pollution, are fields that are not well understood, or are woefully misunderstood, by the American public. Proper education in these fields is crucially important for the near-term and long-term prosperity and integrity of our society. I have taught Evolution in the past, and at UC Davis I teach Ecotoxicology (including climate change) and Aquatic Toxicology, and have designed now teach a new course Evolution in Human-Altered Environments, and a new course in Ecological Genomics. Two of these courses are taught every year, and the other two are taught every other year. Though more senior faculty currently teach large enrollment classes in my department, I have taught several guest lectures in multiple courses, and am keen to contribute to these courses in the near future.

I of course seek to instill an understanding of, and appreciation for, these particular topics in my students, but perhaps more importantly I use these classes as a vehicle to teach and instill a basic understanding of the scientific process. I want students to understand science not as a collection of facts, but as an active, creative, and rigorous process to discover how nature works. As such, I discuss scientific questions in the context of testable hypotheses, and make much use of data and data interpretation. I also make

much use of active learning tools, including student feedback “clickers” to enhance active engagement, “think-pair-share” activities, debates, group work, and case studies. I require students to do much writing, as I consider excellent written communication skills crucial for almost any career in science. I provide much constructive criticism on assignments, and allow for revisions, just as professional scientists benefit from peer evaluations and the opportunities for improving our work that ensue. The heavy writing requirements in my classes usually attracts criticism on student evaluations, but I receive just as many compliments. Importantly, I sometimes witness huge improvements in writing quality in progressive assignments, which offers self-validation of my teaching model, despite typically average or slightly above-average student evaluation scores. Though students sometimes complain that my courses are too much work, I do pay close attention to student evaluations that offer constructive criticisms. As such, my teaching styles and approaches continue to evolve, as does my efficacy and impact as an educator.

3. Advising Activities

I consider the training of graduate and undergraduate students in all aspects of the scientific endeavor as a core component of my professional mission. I act as an advisor to undergraduates for the Environmental Toxicology major. I am also an advisor in the Graduate Group in Ecology. I have participated in numerous qualifying examination committees (including 15 since arriving at UCD in 2012) and dissertation committees (9 since arriving at UCD, not including my own students). I have also served as an external examiner or committee member to students outside of UC Davis (e.g., University of Montana, University of British Columbia, Canada). I am head of a medium-sized research group, where I currently mentor 6 Ph.D. students, 3 undergraduate students, and one visiting scholar (Professor Yunwei Dong from Xiamen University, China).

4. Service Activities

Since arriving at UC Davis in 2012 I have contributed significant resources in time and effort to serving my Department, University, and broader research community, including extensive outreach to the general public. Departmental service includes serving on the Information Technology Committee, the Curriculum and Teaching Committee, and two faculty search committees (once as chair). I also served on a faculty search committee in the Department of Neurobiology, Physiology, and Behavior that resulted in two hires (both female, one minority).

At the campus level I am active in multiple graduate groups (PTX, PBGG, IGG, GGE) and centers (CPB, CMSI). For the Pharmacology and Toxicology Graduate Group I serve on the Faculty Membership Committee. For the Graduate Group in Ecology I served on the Executive Committee. I am also Chair of the Ecological Genetics and Genomics Area of Emphasis in the GGE, for which I am also advisor and I designed and teach the core course. For the Center for Population Biology I serve on the Steering Committee and am a member of the Strategic Planning Team, and also served as chair of the Student Fellowship and Support Committee. I have served on numerous qualifying examination committees and dissertation committees for students from four graduate groups (PTX, PBGG, IGG, GGE). I am an active member in the UC Davis CMSI, where I recently co-organized a UCD/CMSI hosted symposium “Contaminants in the San Francisco Bay-Delta - Novel Tools and Approaches to Evaluate Effects of Multiple Stressors” that brought together world experts

in Environmental Genomics (USA, UK, Canada) with regulators and environmental managers from Federal and CA State agencies (Delta Science Program, State Water Resources Control Board, CA Fish & Wildlife, CA Dept. of Pesticide Regulation, USGS, NOAA Fisheries) whose mission is to monitor, maintain, and restore environmental health in California ecosystems.

I have, and continue to, actively contribute service to the broader research community outside of UC Davis. I served as a member of the Board of Directors for the Northern California Chapter of the Society of Environmental Toxicology and Chemistry, and continue to serve as the webmaster for that organization. I have reviewed research grant applications from national and international agencies in the United States, France, Belgium, Canada, and the United Kingdom. I serve as manuscript reviewer for numerous academic publishers spanning diverse disciplines (e.g., environmental toxicology, evolutionary biology, comparative physiology, molecular biology, genome biology) and I currently serve on two editorial boards. I am leader of the Fundulus Genomics Consortium; In addition to initiating and coordinating many research activities within this community, I organized and led an international bioinformatics workshop (2012) that included nearly 60 participants, and that paid for the travel and participation fees of 24 students and postdoctoral researchers, as part of an inclusive community-building and training exercise. I am annually invited as a guest instructor to the Environmental Genomics Workshop at Mount Desert Island Biological Laboratory, and this contribution has extended to additional workshops in the UK. As stated above, our novel research findings have provided many opportunities to engage the local, national, and international public in important topics including environmental pollution, evolution, and climate change. Our research findings have been highlighted in the NSF's Report to Congress, in a 2013 report by the European Commission, and have been presented on the floor of the United States Senate, and in testimony to the United State Congress.