



Response to Senator Paul's "Summer 2019 Waste Report"

The National Science Foundation (NSF) has been the backbone of America's science and engineering research enterprise for over 70 years. In fact, NSF is the only federal agency that supports all fields of fundamental science and engineering research and education. NSF supports cutting-edge research projects — many of which serve as bellwethers for solutions to the myriad complex issues facing society. NSF programs also traditionally integrate research and education, fast tracking innovation excellence via hands-on learning to train our next generation of researchers and innovators.

Each year, NSF competitively awards thousands of grants that collectively advance our nation's scientific capabilities and engage the talents of hundreds of thousands of researchers, postdoctoral fellows, technicians, teachers and students in every field of science and engineering.

NSF is the primary source of federal funding for non-medical basic research, providing approximately 12,000 new awards annually. Through its merit review process, NSF ensures that proposals submitted are reviewed in a fair, competitive and in-depth manner. Competition for funding is intense, with only about one out of five proposals ultimately being approved.

Each proposal submitted to NSF is reviewed by science and engineering experts well-versed in their particular discipline or field of expertise. All proposals submitted to NSF are reviewed according to two merit review criteria: *Intellectual Merit* and *Broader Impacts*. NSF's merit review process is widely considered to be the "gold standard" of scientific review. Perhaps the best evidence of NSF's success is the repeated replication of its merit review model for discovery, education and innovation around the globe.

The results of this process — funding the best and brightest ideas through competitive merit review — have been profound. NSF-supported research has underpinned multitudinous discoveries leading to new inventions — the Internet, web browsers, Doppler radar, Magnetic Resonance Imaging, DNA fingerprinting, and bar codes — to name a few. These diverse examples underscore NSF's significant contributions to our nation's prosperity, health and wellbeing. NSF-funded discoveries have expanded our understanding of the world in which we live, led to life-saving medical advances, enhanced our national security, improved our everyday lives and yielded insights into the creation of the universe.

NSF's task of identifying and funding work at the frontiers of science and engineering requires keeping close track of research around the United States and the world; maintaining constant contact with the research community to advance the horizons of inquiry; and choosing the most promising people to conduct the research.

The following grants cited in the "Summer 2019 Waste Report" illustrate examples of promising NSF-funded research awarded support through the merit review process.

Sensory Bases and Evolution of Interspecific Eavesdropping

NSF Award 1433990

Summer 2019 Waste Report: “Studied frog mating calls in Panama”

Purdue University

Understanding communication is an important challenge in biology. Another area of interest to both basic and applied research is how parasites find their hosts. One largely unexplored strategy is host communication itself – essentially can parasites locate their hosts by “eavesdropping” on host communication? Ultimately, this research project pursued this avenue of inquiry and generated new insights into the fundamental biology of animal parasites and – importantly – the potential to develop novel ways of fighting vector-borne diseases that impact humans.

The main goal of this research was to study the evolution of sensory systems and eavesdropping behavior in biting flies, such as midges and mosquitos, and the modification of their host-seeking behavior in response to host calls (túngara frogs, in this case). Bites from midges and mosquitos can transmit a variety of deadly diseases to frogs and also to humans such as malaria, Dengue fever, Zika, and West Nile virus. Understanding how parasites detect their hosts aides both in the management of disease-transmitting insects and the protection of humans from such devastating illnesses. For example, this research is being used to develop an acoustic trap for capturing the mosquito *Aedes aegypti* (often referred to as the “yellow fever mosquito”) – a species that can also spread dengue fever, chikungunya, Zika fever, and other mosquito-borne diseases. Additional impacts of this research include a greater understanding of insect sensory physiology, ecology, and evolution and how light and sound impacts the distribution of biting flies, which is important to future management strategies for human health. In addition, findings from the study could lead to improved understanding of smaller and more powerful sound sensors, such as hearing aids.

While the primary work for the award has been completed, the investment continues to have impact. The investigator mentored over 30 students during the course of this 4-year project, making substantial contributions to training the next generation of scientists. Over a dozen journal articles were published on topics directly addressed in the work, and tangential projects such as frog calling behavior in urban and rural populations. It is also noteworthy that parasite-infected túngara frogs change their calling behavior, a finding that could occur in endangered frog species, making these results important for conservation and recovery efforts in amphibians, which are in decline world-wide.

Graduate Research Fellowship Program (GRFP)

NSF Award: 1650441

Summer 2019 Waste Report: “Paid for Google Scholar searches in Hawaii”

Cornell University

The NSF award referenced was made through the NSF Graduate Research Fellowship Program (GRFP). Since 1952, NSF has funded over 60,000 graduate Research Fellows. Many of these Fellows have gone on to become leaders in their chosen fields and have made groundbreaking and important discoveries in STEM research. Over 450 GRFs have become members of the National Academy of Sciences, Engineering and Mathematics; and 40 Fellows have been honored as Nobel Laureates.

NSF funds its GRFs by bundling funding into a single award to an academic institution for disbursement to its fellows. NSF GRFs are provided three years of financial support over a five-year period comprising \$34,000 stipend and \$12,000 Cost of Education allowance for total funding per Fellow of \$138,000. Fellows are selected annually from ~14,000 individual applications based on their demonstrated potential to make outstanding contributions to science and engineering. Fellows submit a brief statement of proposed research so reviewers may assess applicants’ educational and research training, creativity, and promise. The Fellowship supports the individual student, not any specific research project in which they may participate during the course of their fellowship.