

Science, Ethics, and Governance Considerations for Gene Drive Research

An information-gathering workshop of the
Committee on Gene Drive Research in Non-Human Organisms:
Recommendations for Responsible Conduct

Speaker Biographies

Scientific Considerations

Nora J. Besansky received her Ph.D. from Yale University. After several years as a staff scientist in the Malaria Branch at the U.S. Centers for Disease Control and Prevention, she joined the Department of Biological Sciences of the University of Notre Dame, where she is the O'Hara Professor of Biology. Her research centers on the evolutionary, ecological, and population genomics of Anopheles mosquito vectors of human malaria. Ongoing genomic studies are contributing to the understanding of the genetic mechanisms that facilitate adaptation to heterogeneous environments, lead to diversification and speciation, and increase vectorial capacity.

Austin Burt was born and raised in Winnipeg, Canada. He holds BSc and Ph.D. from McGill University, Canada, and postdocs at Santa Cruz and Berkeley, California. He is currently based at Imperial College London since 1995 and is currently Professor of Evolutionary Genetics. Over the years he has worked on a diverse array of topics in evolutionary biology and population genetics, and has co-authored an extended review of the biology of gene drive systems (*Genes in Conflict*). Currently, the main focus of his research is on the development of gene drive systems to control the mosquitoes that transmit malaria.

Allison A. Snow is a professor in the Department of Evolution, Ecology, and Organismal Biology at Ohio State University. She studies the ecological impacts of genetically engineered crops on natural and agricultural systems. Trained as a plant ecologist at the University of Massachusetts (Ph.D., 1982), she received postdoctoral fellowships from the National Science Foundation (University of California/Davis) and the Smithsonian Institution. Dr. Snow's current research combines molecular and ecological approaches to understand how quickly crop genes move into wild populations, and the extent to which novel transgenic traits could affect the abundance of weedy and semi-weedy plants. She is the lead author of a 2005 position paper by the Ecological Society of America on environmental effects of genetically engineered organisms. A Fellow of the American Association for the Advancement of Science and the Aldo Leopold Leadership Program, she has served on the editorial boards of *Ecology*, *Ecological Monographs*, *Evolution*, *Frontiers in Ecology*, and *Environmental Biosafety Research*. She also has served as President of the Botanical Society of America and as a contributor to several reports of the National Research Council of the US National Academies. In 2010, Dr. Snow advised President Obama's Commission for the Study of Bioethical Issues on the topic of synthetic biology.

Shengdar Q. Tsai obtained his B.S. in Biochemistry and Chemistry from the University of Michigan, his M.S. in Bioinformatics and Ph.D. in Functional Genomics from North Carolina State University. He is currently an instructor at Massachusetts General Hospital and Harvard Medical School in the lab of Dr. J. Keith Joung, a pioneer of genome editing technologies. During his time in the Joung lab, Dr. Tsai has focused on developing methods for high-throughput genome editing with TALENs, and defining and

improving the genome-wide specificity of CRISPR-Cas nucleases. His long-term research goals are to develop safe and highly specific targeted genome-editing strategies for treating human genetic diseases.

Responsible Conduct and Ethics

Bruce Jennings is Director of Bioethics at the Center for Humans and Nature, a nonprofit research center based in Chicago that studies environmental ethics and policy, and he is an Adjunct Associate Professor in the Department of Health Policy and the Center for Biomedical Ethics and Society at the Vanderbilt University School of Medicine. He is also a Lecturer at the Yale University School of Public Health, where he has taught ethics for many years, and Senior Advisor at The Hastings Center, where he worked for 26 years and served from 1991 through 1999 as Executive Director. In 2011 Mr. Jennings was named Editor-in-Chief of the standard reference work in the field of bioethics: *Bioethics, 4th Edition*, 6 vols. (Macmillan Reference USA, 2014). Mr. Jennings has been active in the health policy and end of life care arenas and has published widely on ethical issues in hospital treatment decision making, palliative care, and hospice. He has served on the Board of Directors of the National Hospice and Palliative Care Organization, and the Board of Trustees of the Hospice and Palliative Care Association of New York State. With Mildred Solomon, he was the co-founder of the “Decisions Near the End of Life” program, an educational and practice change program that was conducted in over 200 hospitals in 20 states from 1990-1996. He has also been a leader in ethics research and education in the field of public health. From 2003-2009 he served as member and Chair of the Ethics Advisory Committee at the Centers for Disease Control and Prevention (CDC). For several years he has been active in the ethics section of the American Public Health Association, and in 2010 served as the chair of that group. He is chair of the Bioethics Advisory Committee of the March of Dimes. Among his recent books are *The Hastings Center Guidelines for Decisions on Life-Sustaining Treatment and Care Near the End of Life: Revised and Expanded Second Edition*, (Oxford University Press, 2013), *Hospice Ethics: Policy and Practice in Palliative Care* (Oxford University Press, 2014), *The Limits of Unlimited Selection: Regulating Preimplantation Genetic Diagnosis in the United States* (Palgrave Macmillan, 2015); and *Emergency Ethics: Public Health Preparedness and Response* (Oxford University Press, forthcoming 2016). A political scientist by training (Yale University B.A. 1971 and Princeton University M.A. 1973), Mr. Jennings has written and edited twenty seven books and has published approximately 200 articles on bioethics and public policy issues.

Jesse Kirkpatrick is the Assistant Director of the Institute for Philosophy and Public Policy at George Mason University. He specializes in political and moral philosophy, with particular expertise in the ethics of peace and war, emerging technologies, human rights, and global security. Kirkpatrick also serves as a Research Consultant for Johns Hopkins University's Applied Physics Lab, where he advises on ethics, technology, and international security. Before joining the Institute he was Assistant Professor at Radford University and Class of 1978 Research Fellow, U.S. Naval Academy, Stockdale Center for Ethical Leadership.

Andrew Light is University Professor and Director of the Institute for Philosophy and Public Policy at George Mason University. He also serves as a consultant at the U.S. Department of State, where he was Senior Adviser and India Counselor to the Special Envoy on Climate Change, and Senior Climate Adviser in the Secretary of State's Office of Policy Planning from 2013-2015. In that capacity he was Chair of the Interagency Climate Working Group on the Post-2015 Development Agenda and Director of the U.S.-India Joint Working Group for Combating Climate Change, among other duties. In his academic work he is the author of over 100 articles and book chapters, primarily on climate change, restoration ecology, and normative issues involving new and emerging technologies, and has authored, co-authored, and edited 17 books, including *Environmental Values* (2008), *Controlling Technology* (2005), *Moral and Political Reasoning in Environmental Practice* (2003), *Technology and the Good Life?* (2000), and *Environmental Pragmatism* (1996). Before joining the U.S. government he was Senior Fellow and Director of International Climate Policy at the Center for American Progress, where he was chief adviser on these issues to the center's founder and chairman, John Podesta. He has previously taught at NYU and the University of Washington in Seattle.

Francis L. Macrina, Ph.D. is the Edward Myers Professor of Dentistry and Vice President for Research and Innovation at Virginia Commonwealth University. Dr. Macrina's research program on the pathogenesis of infectious diseases at VCU was continuously supported by the National Institutes of Health (NIH) for 33 years, and included prestigious Research Career Development and MERIT Awards. He has authored over 120 scientific publications. Dr. Macrina has served two terms on NIH study sections and was both a member and the chair of the NIDCR Board of Scientific Counselors. He also served a four year term on the NIH National Advisory Dental and Craniofacial Research Council. He has served on the editorial boards of the *Journal of Bacteriology*, *Antimicrobial Agents and Chemotherapy*, and *Infection and Immunity*. He was both, co-editor-in-chief and editor-in-chief of the journal *Plasmid*. His current scholarly interests include teaching and behavioral and educational research in scientific ethics. He has served as a member of the ASM Ethics Committee and the Ethics Committee of the American Association for Dental Research. In 2014 he was appointed to a 4 year term of service on the National Science Advisory Board for Biosecurity, a federal advisory committee that addresses biosecurity and dual use research issues. He is the author of a widely-used textbook on research ethics. The fourth edition of *Scientific Integrity* (ASM Press, Washington) was published in 2014. Dr. Macrina's career at VCU has included service as a chair of two departments, Interim Director of the VCU Massey Cancer Center, and Director of the Philips Institute for Oral Health. Dr. Macrina earned his B.S. degree from Cornell University and his Ph.D. from Syracuse University. He completed postdoctoral training at the University of Alabama at Birmingham.

Perspectives on Opportunities and Limitations in Low and Middle Income Countries

Diran Makinde is the Director, NEPAD Planning and Coordinating Agency, African Biosafety Network of Expertise (ABNE) based in Ouagadougou, Burkina Faso. He is the immediate past Director of the NEPAD West African Biosciences Network in Dakar, Senegal. He earned the degrees of Doctor of Veterinary

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Medicine in 1976, Diploma in Neurophysiology 1981 and a Ph.D. in Veterinary Physiology from the University of Ibadan, in 1986. Prior to his current appointment, he was Professor of Animal Science at the University of Venda, South Africa where he also served a five-year term as Dean of the School of Agriculture, Rural Development and Forestry (1997-2001). In addition, he taught at the universities of Ibadan (Nigeria), 1977-1991 and Zimbabwe, 1989-1995. His research interest is in the field of gastrointestinal physiology of monogastrics, which included such areas as digestibility and intestinal transport. He developed and applied these methodologies in risk assessment studies in agricultural biotechnology and biosafety. He has well over 45 publications in peer-reviewed journals locally and internationally, as well as several contributions in the form of books/ chapters in books. He is a C-rated scientist as evaluated (1998) by the South Africa National Research Foundation. He serves in several technical advisory boards on the continent and outside.

Norma Padilla, Ph.D. studied Biology (BSc at the Universidad del Valle de Guatemala) and Medical Entomology at the MSc level at the University of Panama before my PhD in Tropical Medicine at the Liverpool School of Tropical Medicine and Hygiene. She began a career as a public health entomologist at the former Medical Research and Training Unit (MERTU/CDC) where she undertook entomological research relevant to public health priorities. She joined the UVG faculty in 1997 as a malaria researcher. As a malaria researcher her work focused on malaria vector biology and control with the aim of applying the knowledge directly from research toward developing and guiding more appropriate control measures in the region. Research has ranged from vector incrimination and bionomics in Guatemala and the region, insecticide resistance mechanisms and their impact on control strategies, and the evaluation of the effectiveness of insecticide treated nets in reducing malaria in Latin America. Current projects are exploring the behavior of malaria vectors in the human home and responses of mosquitoes to insecticides for the development of tools for the evaluation of the lifespan and performance of bednets. At the international level, she has been a member of the Amazon Malaria Initiative (AMI) for the last 15 years providing technical guidelines for the standardization of anti-malarial efficacy protocols and the strengthening of the entomological surveillance networks in partnership with USAID and PAHO/WHO and the Amazon country members. She has worked extensively in promoting and delivering cost-effective malaria control interventions for the Latin American setting with the aim of applying the knowledge directly from research toward developing and guiding more appropriate control measures in the region. Since 2014, Dr. Padilla joined Population Service International (PSI) to lead malaria elimination in Central America and the Hispaniola Island by 2020.

Wannapa Suwonkerd obtained her Ph.D. in Medical Entomology from Institute of Tropical Medicine, Nagasaki University, Japan, in 2003. She worked in the Malaria Control Program, MOPH, for more than 30 years, which is now integrated with other Vector Borne Diseases Control activities. She gained experience and expertise working both in Thailand, and, internationally in the field of Vector Biology and Vector Control, for example, as Third-country expert of JICA dispatched to Laos PDR in 1990; as WHO short-term professional Entomologist in Sri Lanka, Post Tsunami Relief Project in 2005; as WHO short-term consultant on dengue in Laos PDR in 2013; as coordinating Entomologist of the Malaria Committee for Cambodia-Thailand Malaria Control Collaborative Project under the initiative of HE Prime Minister Samdech Hun Sen, Cambodia, and Her Royal Highness Princess Maha Chakri Sirindhorn, Thailand, since

2008 to present. She is now currently working as an Assistance Director of Office of Disease Prevention and Control and Head of Technical Support and Senior Entomologist. She has conducted research activities on vector biology, vector ecology and vector control for more than 25 years in her career.

Scales of Governance

Zach N. Adelman is an associate professor in the Department of Entomology and Fralin Life Science Institute at Virginia Tech. Following earlier work on the generation of pathogen-resistant mosquitoes, Dr. Adelman's research has more recently focused on the development of novel gene editing/gene replacement approaches for disease vector mosquitoes as well as understanding genetic interactions between arthropod-borne viruses and their mosquito vectors. In addition to managing his research program, Dr. Adelman has served as a member of the Virginia Tech Institutional Biosafety Committee since 2007, and as its Chair since 2012, helping to provide oversight for all recombinant DNA research on campus that falls under the NIH guidelines. Dr. Adelman serves as a member of the steering committee of the Insect Genetic Technologies Research Coordination Network (an NSF-funded project), and is a lead instructor in the IGTRCN workshop on gene editing. Dr. Adelman has also recently served as editor on a new 19-chapter volume entitled "Genetic Control of Malaria and Dengue" due out in Nov 2015, and serves as an editor for the journal PLoS One; his work is funded through several grants from the National Institute for Allergies and Infectious Disease at the National Institutes of Health. Dr. Adelman received his B.A. degree in Biochemistry from Ithaca College and Ph.D. in Microbiology from Colorado State University; he joined the faculty at Virginia Tech in 2005.

Megan J. Palmer's work seeks to develop and advise on best practices and policies for responsibly advancing biotechnology. She is a Senior Research Scholar and William J. Perry Fellow in International Security at the Center for International Security and Cooperation (CISAC) at Stanford University. She is also an investigator of the multi-university NSF Synthetic Biology Engineering Research Center (Synberc) and served for four years as the Deputy Director of its Policy & Practices research focus. Dr. Palmer leads policy- and safety-related efforts with the international Genetically Engineered Machine (iGEM) competition, and founded and serves as Executive Director of the Synthetic Biology Leadership Excellence Accelerator Program (LEAP), a nonresidential fellowship program in responsible biotechnology leadership. Previously, she was a Research Scientist at the California Center for Quantitative Biosciences (QB3) at UC Berkeley. Dr. Palmer holds a Ph.D. in Biological Engineering from MIT, and was a postdoctoral scholar in the Bioengineering Department at Stanford University. She received a B.Sc.E. in Engineering Chemistry from Queen's University, Canada.

David A. Wirth is Professor of Law at Boston College Law School in Newton, Massachusetts, where he teaches primarily in the field of public international law, with a specialty in international environmental law. Professor Wirth began his career as Attorney-Adviser for Oceans and International Environmental and Scientific Affairs in the Office of the Legal Adviser of the U.S. Department of State in Washington, D.C., where he had principal responsibility for all international environmental issues. Prior to entering

academia, Professor Wirth was Senior Attorney and Co-Director of the International Program at the Washington, D.C. office of the Natural Resources Defense Council (NRDC), a nonprofit public interest law firm specializing in environmental issues. Professor Wirth is a 1981 graduate of the Yale Law School and served as law clerk to Judge William H. Timbers of U.S. Court of Appeals for the Second Circuit in New York for a year thereafter. He holds undergraduate and graduate degrees in chemistry from, respectively, Princeton and Harvard Universities. Professor Wirth is the author of more than fifty articles and reports on international environmental law and policy for legal, academic, professional, and popular audiences. He is a life member of the Council on Foreign Relations.