



Lee Raleigh Shugart

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Lee R. Shugart passed away on September 20, 2021, much to the great sorrow of his family, friends, and colleagues. Lee was the Editor-in-Chief and sole surviving founder of this journal—following the death in 2001 of his friend, colleague, and Ecotoxicology co-founder David Peakall. The success of Ecotoxicology is due in great part to Lee's dedication to the quality and recognition of this journal, and he would take great pride every time the impact factor increased. It is because of his diligent efforts that Ecotoxicology is what it is today, and Lee worked tirelessly to promote the journal and serve as Editor-in-Chief until his death.

Lee was born on December 23, 1931, in Corbin, Kentucky, USA. There, he attended St. Camillus Academy, and graduated as the valedictorian of his class. He then attended East Tennessee State University in Johnson City, Tennessee, where he earned a B.S. in Chemistry in 1951. After graduation, he enlisted in the U.S. Navy and served in the Korean Conflict. His Naval service lasted for six years, and he achieved the rank of Lieutenant as a Line Officer. After leaving the Navy, he enrolled in graduate school, and graduated with an M.S. in Biochemistry in 1962 and a PhD in Microbiology in 1965, both from the University of Tennessee Knoxville. His master's thesis was entitled “A Study of Ashing and Colorimetric Procedures in the Determination of Protein-Bound Iodine”, and his PhD dissertation was “A Study of the Proteinase from *Streptococcus faecalis* var. *liquefaciens*”.

Shortly after graduation, he started developing his career as a world-renowned scientist. From 1965 to 1967, he was a post-doctoral fellow at Oak Ridge National Laboratory in Oak Ridge, Tennessee, USA (ORNL). He became a staff scientist there in 1967, which continued until his retirement in 1996. He started in the Biology Division before moving to the Environmental Sciences Division (ESD) in the mid-1980s. There, he reached the rank of Senior Research Staff Member and Group Leader. Additionally, he was on an Off-Site Assignment for the Pentagon from 1995 – 1996.

Lee's research centered on biomonitoring efforts that contributed to the remediation and restoration of contaminated sites in Oak Ridge, the United States, and around the world. He played a major role in developing the concept of biomarkers of environmental contamination and their use in biomonitoring and risk assessment. Lee was a leading authority in DNA damage and a major contributor to the development of the fields of genetic ecotoxicology and evolutionary toxicology. His main focus was developing assays for investigating DNA strand breakage, DNA adducts, contaminant protein modifications, and other biomarkers in fish, invertebrates, rodent models, and humans. Prior to the 1980s, his work largely focused on biochemistry of tRNA and nucleotides/nucleosides in bacterial and

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eukaryotic research models. He was also one of the first to demonstrate epigenetic effects of contaminants in native fish species, having published a paper showing that benzo[a]pyrene caused global hypomethylation in bluegill sunfish (*Lepomis macrochirus*; Shugart 1990). Sadly, he retired before he could develop this line of research further, otherwise he probably would have also been a driving force in ecotoxicological epigenetics.

Lee was a highly productive scientist and a prolific writer. He was sole, lead, or co-author of at least 125 peer-reviewed publications including book chapters, encyclopedia entries, conference proceedings, and manuscripts in internationally-renowned journals. Plus, he was the co-editor of 3 peer-reviewed books on biomarkers or toxicology. He also authored or co-authored numerous editorials, one book review, and 4 obituaries in *Ecotoxicology*. In addition, he authored or co-authored many ORNL technical reports of his research, most of which were published in the scientific literature as well. His publications focused not only on ecotoxicology and DNA damage, but also protein biosynthesis, mechanisms of enzyme action, and nucleic acid biochemistry.

He was equally productive in a number of professional activities other than publication. First, besides his role in *Ecotoxicology*, he was on the editorial board of the journal "Biomarkers", an Associate Editor for the 2nd edition of the "Encyclopedia of Toxicology", and - from 2009 to 2018 - the series editor of the book series "Emerging Topics in *Ecotoxicology: Principles, Approaches and Perspectives*". Second, he served as advisor to governmental and non-governmental organizations, including as a Consultant to the Science Advisory Board of the U.S. Environmental Protection Agency and as a Scientific Assistant to the Deputy Assistant to the Secretary of Defense for Nuclear, Chemical and Biological Matters/Counter Proliferation. Importantly, Lee also advised and collaborated with Greenpeace in monitoring contaminants and DNA adducts in beluga whales (*Delphinapterus leucas*) in the St. Lawrence River (located on the US/Canadian border). Third, he was the chairman, organizer or co-organizer for several international workshops and symposia. These included "The International Symposium for Nondestructive Biomarkers in Vertebrates" (Sienna, Italy, 1992); the "NATO Advanced Research Workshop on Biomarker Research and Application in the Assessment of Environmental Health" at the Netherlands Institute of Sea Research (Texel, The Netherlands, 1991); the "14th Symposium on Aquatic Toxicology and Risk Assessment", sponsored by the American Society for Testing and Materials (San Francisco, California, 1990); and the "Symposium on Biological Markers of Environmental Contaminants" (Los Angeles, California, 1988). Fourth, he was active in several professional societies, including the American Chemical Society, Sigma

Xi, the American Society of Biochemistry & Molecular Biology, and the Society of Environmental Toxicology & Chemistry (SETAC, for which he was a member since 1987). In fact, from 1987 to 1996, the ORNL ESD was very visible at SETAC North America conferences, and Lee was a major contributor to this. He was listed as co-author on multiple poster or oral presentations during these years. Finally, Lee's professional activities led him to visit many parts of the world. He had research collaborators in Italy, The Netherlands, Russia, and Portugal. He also traveled to these countries—as well as Spain, India, and China—to impart his knowledge, experience, and expertise in the form of invited seminars and educational courses.

Lee was heavily involved in academic and educational activities as well. He served as an adjunct Associate Professor for the University of Tennessee Knoxville Departments of Plant Sciences and Ecology and Evolutionary Biology, the Graduate School for Biomedical Sciences, the College of Veterinary Medicine, and the Center for Environmental Biotechnology. In this capacity, Lee was a valued advisor and research mentor for many undergraduate, master's, and PhD students. He was also affiliated with Oak Ridge Associated Universities in the capacity of a supervisor for post-doctoral fellows.

Lee's professional endeavors did not end with his retirement from Oak Ridge National Laboratory. Besides retaining a leading role in *Ecotoxicology*, he remained active in his consulting firm, LR Shugart and Associates, which he founded in 1995. The activities of his consulting firm included providing advice, guidance, and expertise for the Canadian Wildlife Service; the United Nations Environmental Program; the City of Porto, Portugal; Exxon Mobil (largely in association with the Valdez oil spill); and USGS (Greater Everglades Restoration Project). Another focus of this firm was providing educational and manuscript-editing services for students and researchers around the world. Finally, LR Shugart and Associates was a vehicle for establishing *REACH Risk*, a contractual service for contributing to risk assessments associated with European Union Registration and Assessment of Chemicals (REACH). In addition to his consulting business, Lee participated in a number of scientific workshops, such as in Goa, India (Marine Pollution and Ecotoxicology, 2004), Lisbon, Portugal (CICTA 2008), Beijing, China (China-U.S. Joint Workshop on Bioenergy Consequences for Global Environmental Change, 2008), Nanjing, China (EHPC 20, 2008) and Huaipei, China (International Ecopolis Forum, 2009). Furthermore, he was instrumental in helping to organize the International Workshop on Ecotoxicity in Guangzhou, China in 2010, in collaboration with UT Knoxville, Purdue University, South China Sea Institute of Oceanology, and the Chinese Academy of Science.

On his professional achievements, Gary Saylor—professor emeritus of University of Tennessee Knoxville (UT) and long-time colleague of Lee—writes: “I joined the University of Tennessee Knoxville in 1975 and Lee was already a well-respected Staff Scientist at ORNL and an Adjunct faculty member in the Graduate Program in Ecology (GPE) at the University. The GPE was an early successful model of interdisciplinary education working across institutional boundaries i.e., UT/ORNL/TVA [Tennessee Valley Authority]/USDA [US Department of Agriculture]. Lee was a terrific mentor in cross disciplinary student training and PI collaboration. In the 1980s, led by the GPE, the University initiated a new focus in Environmental Toxicology and Lee had a significant advisory role in curriculum planning and faculty recruitment. His interdisciplinary strengths led to Adjunct Professor status participation across several departments in the College of Arts and Sciences, the College of Veterinary Medicine and the College of Agriculture. From 2010 to 2018, Lee was an active participant in the UT-led China/US Joint Research Center for Ecosystem and Environmental Change (JRCEEC). At invitation of the Chinese Academy of Science, Lee joined UTK faculty and ORNL staff in JRCEEC organized field site and lecture tours across China. He additionally provided invaluable technical editing service to many foreign researchers and greatly improved their opportunity to publish in leading international journals. In this and other capacities, Lee was a valued advisor and research mentor for undergraduate, master’s, and PhD students. As a member of the UT/ORNL Science Alliance, Lee helped in reducing institutional barriers and promoting collaborations in joint initiatives such as the Radiation Biology Program, the Genome Sciences Program, and the Center for Environmental Biotechnology”.

Besides his professional relationships, Lee’s interpersonal relationships were also well-appreciated. He had perennial energy, an infectious laugh, a zest for life, a great sense of humor, and a charming personality. He was kind, generous, warm, hospitable, patient, and easy-going (most of the time). He was well-liked or well-loved by friends and colleagues, not only in the U.S., but in many countries around the world. He loved to garden, and was particularly proud of the tomatoes he raised in his greenhouse. He even constructed an ingenious contraption for mechanically pollinating them because of the lack of insect pollinators in the greenhouse (CT; pers. obs.). In fact, in the 1970s, he owned several greenhouses where he would hydroponically raise tomatoes to sell at the Oak Ridge farmer’s market. He very much enjoyed fine dining, as well as visiting and traveling with, and cooking for, friends and family. In addition, he was an avid golfer and stamp and coin collector. He also enjoyed spending time outdoors—whether it was in his beautiful yard and gardens at his home in Knoxville,

Tennessee, at his lovely cabin in the hills of Townsend, Tennessee, in the Smoky Mountains (Tennessee), or on his many travels. And he always had a good story to tell.

Most important in his life, however, was his family. He is survived by Shirley Shugart (his wife of 37 years), his three daughters (with former wife Mary Susan Ryburn, now deceased), five grandchildren, and four great-grandchildren. He will be very much missed by all.

Below are some personal statements from friends and colleagues, followed by a list of his publications.

Personal Statements

Chris Theodorakis writes:

“My first experiences with Lee were as a PhD advisor and my first post-doc mentor, but to me he was more than that. The German word for PhD advisor is ‘Doktorvater’, which literally translated means “doctor father”, and that pretty much sums it up. He was a colleague and dear friend for over 30 years. Every time I saw him (which was far too infrequently), he had a smile on his face, a funny story, a good laugh, and presents for my children. I am fortunate to have known him. He was always kind and patient with me—a mentor beyond measure. He gave me a chance when many would not, and for that I am eternally grateful. And he introduced me to John Bickham (my second post-doc mentor), which was instrumental in starting my career. I literally would not be where I am today without him. I will always have precious memories of spending time with him and Shirley at his home, joining them on their travels, and sharing dinners with them and John at SETAC meetings. In fact, the last time I saw him was when I had dinner with him, Shirley, John, and Lindy Paul at the 2018 SETAC meeting in Sacramento, CA. These meetings will not be the same without him. I am very regretful that I was not able to visit with him more recently (because of staying in Germany for family reasons, and the pandemic). He will live on in his family, his accomplishments, the people that he trained, and the many lives he touched. As they say at Greek funerals: ‘everlasting be his memory’. He will be sorely missed. Rest in peace, old friend”.

John Bickham writes:

“A good part of my career was devoted to studying the genetic effects of environmental contaminants in natural populations of fish and wildlife, and no one helped me more in this endeavor than Lee Shugart. Lee was my close friend and mentor for 33 years, from the time of our chance meeting in Chapel Hill, NC in 1988 until his death in 2021. He graciously included me in so many of the meetings and symposia that he organized during those years, which had a profound impact on my career. I co-authored 5 papers with Lee, but that doesn’t begin to tell the story of his deep impact on my thinking with regards to the importance of genetic effects and especially the need to develop sensitive

biomarkers to measure them. As it always is with teachers and mentors, you owe them a debt that can never be repaid. I'll miss Lee not only for his unsurpassed knowledge of the field, but also the warmth of his friendship. My wife Pat and I travelled with Lee and Shirley to so many places and had so many wonderful experiences. These included The Netherlands, Italy, Spain, Portugal, China, and many places here in the U.S. These trips always provided the opportunity to exchange scientific information, meet new people in the field, and to catch up and renew our personal friendships. I greatly appreciate Lee's contributions to my career, for his help for the careers of my grad students Karen McBee and Cole Matson, and for sending Chris Theodorakis to my lab as a postdoctoral researcher. Two things that I cherish the most and of which I am most proud, are co-authoring a paper with Lee and my daughter Amy, and that Cole has followed Lee as the editor of *Ecotoxicology*".

Gabriele Rutz writes:

"Lee Shugart was my husband's 'Doktorvater', and when I met him 20 years ago it felt like they were not just colleagues but family. A family I was immediately accepted into. Lee was one of the warmest, sincerest, most modest people I have ever met and he will be greatly missed. He shared his knowledge, his home and his heart with us and will forever be one of the most influential mentors and role model who will stay with us always".

Marie-Agnes Coutellec writes:

"I met Lee in Seville (SETAC Europe meeting 2010), as he came to Carlos Barata and myself, after a symposium on evolutionary toxicology (to which you were both invited participants) to invite us to co-edit a special issue on the topic, and thereby provided a new impulse to a research field quite understudied since a few seminal papers in the early nineties. To me, this marked the beginning of an ongoing relationship with Lee, through my activity as associate editor for the journal *Ecotoxicology*. Since then, he has always shown confidence and been supportive to me, and from his caring attitude I could feel a sensitive personality, who will always inspire me greatest respect and gratitude.

My deepest compassion to his family".

Marcela Ines Schneider writes:

"I am so sorry to hear this sad news regarding Dr Shugart. I had a great appreciation for him without knowing him personally. I can remember when he invited me to belong to the *Ecotoxicology* Editorial Board in 2008 considering that being a South American scientist and woman could be a great contribution to the journal. Also, he highlighted the relevance for the Journal to include researchers from worldwide for the *Ecotoxicology* EB. His passion for science and the journal's role in spreading knowledge was admirable. I raise a prayer in his memory, praying that his soul is at peace. My deepest condolences to his family".

Joana Luísa Pereira writes:

"Dr. Shugart invited me to join the Editorial board of *Ecotoxicology* as an Associate Editor back in 2011, possibly following my contribution as a reviewer—he never disclosed the motivation for assigning such a young researcher to such a position. But he trusted in my capacity to assume the position competently and since then I was gifted with his close presence and incredible support in dissolving any insecurities while developing and delivering the requested editorial work for the Journal. Lee guided and mentored me through a stimulating learning and maturation process in this context. While discussing about different editorial issues, he was also incredible generous in sharing his experienced perspectives on any other interesting parallel issues. Although (unfortunately) I never had the chance to meet Lee in person, he has been and will continue to be a remarkable influence and a reference to me as a scientist and as an editor toward high-levelled quality standards, deep respect for all actors involved, honesty and passion in science and scientific publication. I will miss his written words but Lee's messages and consequent lessons learnt will be a living legacy forever".

Compliance with ethical standards

Conflict of interest The authors declare no competing interests.

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Professional Publications

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