Trends in
Ecology & Evolution

CellPress

In Memoriam

Professor Barry Sinervo (1960–2021)

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Professor Barry Sinervo, an influential evolutionary biologist, died 15 March 2021 at the age of 60 after a long battle with cancer (Figure 1). Over the course of his career, Barry made seminal contributions to life history theory, behavioral ecology, and most recently, predicting species responses to climate change. Most of his major contributions were derived from his 30+ year study of the side-blotched lizard (*Uta stansburiana*) at a site near Los Banos, California, USA, which was known as 'Lizard Land'.

Barry was born in Port Arthur in Ontario, Canada. As a child his passion for reptiles was well known to his family. He earned a dual BSc degree in biology and mathematics at Dalhousie University, Nova Scotia. He then moved to the University of Washington, Seattle, to work on his doctorate in zoology in the laboratory of Ray Huey. After completing his PhD, he was awarded a prestigious Miller Postdoctoral Fellowship at UC Berkeley, where he started his research on the life history traits of side-blotched lizards. He was an assistant professor of biology at Indiana University from 1993 to 1997 and joined the faculty in the Department of Ecology and Evolutionary Biology at UC Santa Cruz in 1997, where he spent the rest of his career.

Barry's research contributions spanned a diverse swath of subjects in evolutionary biology. He published papers on population and evolutionary genetics, life history theory, ecological physiology, behavioral ecology, and speciation. During his PhD, Barry focused on the evolution of the clutch size: egg size trade-off. He (together with Larry R. McEdward) had previously figured out a way to manipulate blastomere size in developing sea urchin embryos to test the role of egg size in development and life history attributes [1]. He then applied this approach (termed allometric engineering), much to the skepticism of his PhD advisor, Ray Huey (pers. comm.), himself a seasoned lizard biologist, to understanding egg clutch size trade-offs in side-blotched lizards while testing early theory proposed by the ornithologist David Lack. The experiments involved removing a small quantity of yolk from newly laid side-blotched lizard eggs to create smaller hatchlings. He created larger hatchlings by ablating the developing follicles from one of the lizard's ovaries. The reduction in the number of follicles resulted in females investing more energy (yolk) to the remaining eggs. Thus, he ended up with clutches of fewer eggs, but of a larger size. To understand the fitness consequences of offspring size, he then released 1668 control, miniaturized, and gigantized hatchlings over two seasons. To say that Barry always thought big is an understatement!

At the first World Congress of Herpetology in Canterbury in 1989, Barry gave a talk about his work on allometric engineering. At the end of his talk, the moderator, Henry Wilbur, said something to the effect of 'you have just heard the most important paper of this congress' (Ray Huey pers. comm.). And certainly, the editors at *Science* agreed. Barry, together with Ray Huey and other collaborators, went on to publish three of his PhD chapters there [2–4]. One of these was accompanied by an eye-catching cover image of size-manipulated side-blotched lizards arranged in a circle from miniature to giant sized [2]. These papers described the proximate constraints on clutch size, the functional consequences, and patterns of selection operating on offspring size.

His next major discovery involved merging game theory and mating patterns to describe the dynamical mating system of the side-blotched lizard. Barry noticed that male side-blotched lizards exhibited a polymorphism for throat color and the mating pattern of males correlated with throat color. The mating strategy of males (monogamy, polygyny, or sneak) resulted from differences in ability to defend a territory or evade a dominant male. Barry used game theory to show that each morph had a fitness advantage when rare, such that over time each morph would have an equivalent long-term fitness payoff. This paper was published in *Nature* because it was the first demonstration of the 'rock-paper-scissors' (RPS) game in a natural system [5]. The description of the RPS game stimulated more research involving both microevolutionary and macroevolutionary concepts. One line of research showed that females also had a throat color polymorphism, such that the sexes were engaged in two games, which had consequences for mate choice and reproduction in females. Barry also used hormone manipulations to induce changes in physiology, behavior, or both. Both males and females were used to identify the role of androgens, estrogen, and gonadotropins in influencing phenotypic traits associated with mating and reproduction. The continuing study of side-blotched lizards also resulted in the discovery of cooperative behavior among blue males, which enhanced their ability to repel the socially dominant orange males. This was one of the first demonstrations of the greenbeard effect in nature and refined the RPS game to one of aggression, cooperation, and deception [6].

Barry's interest in climate change emerged indirectly in the quest for determining the generality of the RPS game. Research initially involving color morphs and RPS dynamics in a species of spiny lizards (*Sceloporus*) in Mexico and common lizards (*Zootoca*) in France led to the discovery of the extirpation of local populations. Extensive surveys of known, historical locations of *Sceloporus* in Mexico by collaborators from the National Autonomous University of Mexico (UNAM) and by Barry in

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Figure 1. Professor Barry Sinervo (1960–2021).

Europe resulted in a consistent pattern of extirpation, but without a reasonable explanation. A clever experiment developed by Barry and Fausto Mendez de la Cruz of UNAM compared the thermal landscape of sites where lizards persisted compared with those where populations had disappeared. Barry worked out that the sites where species vanished were also warmer than persistent sites. He then compared the pattern with other species from different continents using data from a large team of collaborators. The analyses revealed a global pattern of loss of lizard diversity attributable to altered thermal niches, as described in a high-profile paper published in *Science* [7].

Predicting the responses of species to a rapidly warming earth became a major focus of Barry's research. He assembled a global network of investigators to gather key environmental and ecophysiological data to predict extinction risk due to rising temperatures. As part of this project Barry and close collaborators conducted workshops nationally and internationally on the methods necessary for quantifying extinction risk. These workshops trained over 300 graduate students, postdocs, and principal investigators on the techniques for measuring key physiological and environmental variables and the quantitative methods for analyzing the data.

Concern about the growing extinction risk threatening species persistence due to rising temperatures became a major aspect of Barry's research and community engagement. He often gave public lectures alerting the public to the perils of climate change and to encourage people to become advocates for reducing greenhouse gases. In 2014 Barry became involved in establishing a multi-institution initiative for using the University of California Natural Reserves Systems to study the impacts of climate change on biological diversity. Barry was the director of The Institute for the Study of the Ecological and Evolutionary Climate Impacts until the time of his death.

Not only was Barry an accomplished mathematician and theoretician, but he was also a formidable field biologist. Visitors to Lizard Land would witness Barry as he surveyed the habitat for lizards. He knew the site in a way that others could not. He was all about thinking out of the box. His credo was 'you need to think like a lizard', which would apply to any other organism. He would spend February through April capturing lizards as part of his long-term project and any side projects that were planned for the year. It was not unusual for Barry to return to the laboratory at UCSC with over 100 lizards to be included in a breeding experiment.

One facet of Barry's personality was his desire to have fun whether out in the field or performing arduous and repetitive tasks in the laboratory. He always had a bright attitude and made sure that everyone on a project felt they were a part of something big. He enjoyed interacting with graduate students and colleagues regardless of discipline and relished suggesting new ideas or novel approaches for addressing long-standing research paradigms. He was also an excellent chef and the dinner parties he held at his home were legendary.

Despite battling a rare cancer for the past 6 years, Barry remained active in teaching and research. His laboratory was frequently visited by national and international undergraduates and graduate students, postdocs, and collaborators. It was not unusual to hear conversations in three or four different languages at any one time. And while anyone that has worked with Barry will attest to his quickness of mind, they are also quick to convey how supportive and generous he was. He had time for everyone.

Barry also never lost his enthusiasm for seeking out new ways of viewing variation in nature and conveying that to students. To his great satisfaction, shortly before he died, Barry completed his *magnum opus*: a 20 chapter interactive e-book entitled '*Behavioral Genetics to Evolution*', with 465 videos, 627 figures, and study questions for every chapter (https://tophat.com/marketplace/science-&-math/biology/full-course/behavioral-genetics-to-evolution-barry-sinervo-professor-of-ecology-and-evolution-university-of-california-santa-cruz/4400/). The book spans subjects from classic behavioral ecology to hypotheses about the evolution of human mating systems. He favored an e-book over a traditional book because of its interactive nature. And, as a bonus, the book is narrated by his wife Jeanie Vogelzang. This book will serve as an enduring legacy to his life-long work as a scientist and educator. He will be much missed by the many students, colleagues, and friends he has touched over the years.

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