Peril in the Ponds: Deformed Frogs, Politics, and a Biologist's Quest

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information technicians, and administrators work together to deliver some of the world's most impressive citizen science programs. The investment in and sustained commitment to these programs is impressive but not directly relevant to many smaller groups.

Many scientists will be challenged by the new and rapidly evolving paradigm of citizen science. The ongoing needs of massive field teams, huge data sets, and distance education curricula require trade-offs—none more fundamental than the likely sacrifice of traditional scholarly productivity in exchange for the ability to achieve broad conservation goals. I suspect that some agencies and nonprofit organizations will view the benefits of conservation as outweighing the costs of lowered scholarship, but will academic institutions maintain scholarship at a cost to both a broader understanding of environmental problems and the effective implementation of conservation policy?

Citizen Science succeeds in showcasing a path of knowledge that is unfamiliar to—and, at first glance, unwanted by—many professional scientists. Its well-written, wide-ranging, and accessible chapters make a compelling argument that engaging the public in scientific research is important in order to increase our environmental knowledge and build a citizenry that values and uses what science produces. This book inspires the professional to see the scientist in everyone and to broaden our research programs, which will stoke the fire of scientific curiosity that burns within each of us.

Surrounding an informative text are the motivational foreword by Richard Louv and afterword by John W. Fitzpatrick suggesting that the movement to involve ordinary citizens in the craft of science is nothing new. We are reminded that Thomas Jefferson, an amateur scientist himself, tutored Meriwether Lewis before sending him westward to catalog the flora and fauna of our country. By extending his reach, Jefferson increased our scientific knowledge immensely. Today's citizen science projects are infinitely more complex, but the rewards are equally great. Any scientist anxious to improve their scope of inference by following Jefferson's lead will find much to learn from the pages of *Citizen Science*.

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LEARNING FROM DEFORMED FROGS

Peril in the Ponds: Deformed Frogs, Politics, and a Biologist's Quest. Judy Helgen. University of Massachusetts Press, 2012. 272 pp. $24.95 (ISBN 9781558499461 paper).

Most people have heard of deformed frogs, but few know the backstory. Their discovery in Minnesota wetlands in 1995 was covered by local news media and then catapulted onto the front pages of newspapers around the world—a harbinger of a new kind of environmental health crisis. Deformed frogs became an issue of national concern in a matter of weeks after they were found. The ensuing public demand for answers challenged the somewhat stately pace of science, a subject covered in detail by William Souder (2000), whose book appeared in the midst of the response, describing what was then a seemingly impenetrable mystery.

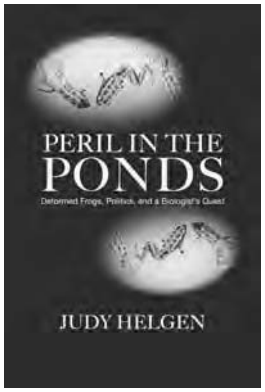
More than a decade later, it is high time to check back in on the frogs.

Peril in the Ponds: Deformed Frogs, Politics, and a Biologist's Quest does just that, and Judy Helgen could not be better positioned to tell the story. As a biologist with the Minnesota Pollution Control Agency (MPCA), Helgen was the point person at the onset of the investigations and remained engaged throughout subsequent efforts to explain the cause of the crisis. Her account of the initial responses to these unprecedented occurrences and the subsequent actions of scientists, bureaucrats, politicians, and members of the public has a *you-are-there* feel to it. Unfortunately, the author's chronological recounting of events—meeting by meeting and phone call by phone call—can become tedious. Although her writing style highlights the complicated nature of the situations that she faced, the major themes that Helgen wishes to communicate would survive a less detail-oriented treatment.

Most readers want to know, first and foremost, what led to the outbreaks. Unfortunately, they will be disappointed on this front. Seventeen years after the initial discovery, we still do not know what caused the deformities in Minnesota. This book is no victory lap. As an ecologist who has long worked on amphibians, I already knew the broad outlines of the story. I had assumed that Helgen would use the deformed frog crisis as a platform for understanding how we can mount more effective responses to environmental crises, but we do not learn much on that score, either. Helgen focuses on individual incidents that are emblematic of larger forces at work in society, but the individual trees never give way to a view of the forest.

Instead, *Peril in the Ponds* is about three things: making the case for amphibian deformities as an ongoing cause for societal concern, describing the beauty and worth of frogs and their wetland homes, and providing a window into Helgen's personal life as she deals with the slings and arrows that inevitably arrive as she works to do science while under a spotlight. In the writing of these overlapping themes, Helgen also offers readers a view of how one scientist reconciles her beliefs and her responsibilities as a seeker of scientific understanding. This topic deserves more attention, since much of what is currently being written about scientists and their motivations is often critical but not necessarily informed by scientists' own perspectives (e.g., Sussman 2010).

It is clear that Helgen held tenaciously to the goal of keeping the project funded and moving forward, and her commitment to her work was critical to bringing so much attention to the issue. Less clear is the portrayal of the MPCA (now her former employer) as an unwilling partner in her work. At every turn in the book, funds are threatened, her position is in jeopardy, or the project is destined to be taken from her control and ruined. She repeatedly implies that the people behind these actions may have dark motives. But this is not investigative reporting, and readers are left only with the author's vague sense of conspiracy with little to support it. Whatever the facts, few readers will conclude that the system worked well in this case.



So, what is the bottom line? Perhaps the largest lesson lies with what is still not evident: However sophisticated our approaches, developing an understanding of the causes of certain types of environmental threats will take a great deal of time and effort. Commonly, when an environmental problem emerges, we can readily discern the cause and figure out what we would need to do to remedy the issue. Acid rain offers one clear example. The symptom led us to the cause and to the range of possible solutions (Likens and Bormann 1974). It is with increasing frequency, however, that we are encountering environmental issues that we simply do not understand. Initially, we may not even know how to study them or when we have reached false conclusions about their causes (Sessions 1996, Lannoo 2008). Deformed frogs are a great case in point—one that deserves our attention, regardless of how much we may care about the fate of frogs themselves.

In reflecting on Helgen's story, I kept asking myself what kind of response would have been mounted were the deformities afflicting humans instead of frogs. As Helgen notes in the book, whatever was causing the maladies to frogs could potentially represent a threat to the health of other species, including humans. (At one point, Minnesota families living near ponds with deformed frogs were being supplied with bottled drinking water against just such a possibility.) Undoubtedly, millions of dollars and hundreds of researchers would have been involved—and yet, it might have taken years to work out what was happening. It is not so surprising, then, that the very few who have worked on the issue have not produced a definitive understanding of deformed frogs. Helgen deserves great credit for her accomplishments under the circumstances and for bringing the issue back under our scrutiny.

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SIMULATION OF EARTH-BASED THEORY WITH LIFELESS RESULTS

First Life: Discovering the Connections between Stars, Cells, and How Life Began. David Deamer. University of California Press, 2012. 286 pp., illus. $24.95 (ISBN 9780520274457 paper).

First Life: Discovering the Connections between Stars, Cells, and How Life Began is an eloquent exposition of what can be described as the "conventional wisdom" on Earth-based theories of the origin of life. Author David Deamer, professor of biomolecular engineering and research professor of chemistry and biochemistry at the University of California, Santa Cruz, is a preeminent leader in the field and tells his personal story of discovery in a unique and absorbing way. The text is sprinkled throughout with interesting anecdotes of how leading figures in the field of biochemistry influenced the author and his scientific career, thus driving home the fact that science is an intensely human pursuit. The topics covered in the book's 15 chapters span a wide range, from meteorites and biochemical pathways to evolution and the prospects for synthetic life, but Deamer keeps well within the bounds of consensus and convention throughout the book. Cultural constraints dating back to pre-Copernican times have tended to restrict origin-of-life investigations to within an Earth-centered framework; *First Life* is no exception.

The functioning of a living system depends on thousands of chemical reactions taking place within a membrane-bound cellular structure. Such reactions, grouped into metabolic pathways, have the ability to harness chemical energy from the surrounding medium in a series of very small steps: transporting small molecules into cells, building biopolymers of various sorts, and ultimately making copies of themselves while possessing a capacity to evolve. Batteries of enzymes,