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Ecohydrology-Why Hydrologists Should Care

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ground water

Editorial/

Ecohydrology—Why Hydrologists Should Care

by Randall J. Hunt[1] and Douglas A. Wilcox[2]

Historically, "interdisciplinary research" has often been interdisciplinary in objective, and perhaps in budget, but not necessarily in understanding. Rather, the work is dominated by an ecologist trying to incorporate a hydrologic element, or vice versa. However, the insight needed and fields of study are often larger than either researcher can hope to understand fully. As a result, a curious phenomenon occurs, which we call the "black box" syndrome. For hydrologists working in bioactive systems (e.g., wetlands and hyporheic zones), what cannot be explained is attributed to the "biota" or to invisible, uncharacterized "microbial communities." For ecologists, unexplained results are lumped into a black box that includes "unmeasured hydrologic flows" or uncertainty in the system's "hydrology."

This behavior is understandable because we all recognize the importance of other disciplines. Hydrologists know that heterogeneous reactions and microbial communities can be powerful catalysts for chemical transformations in aquatic systems. Plant transpiration can be the dominant hydrologic sink in many wetlands, but the rate can vary drastically among species. Ecologists recognize that hydrology is the most important forcing function in the establishment and persistence of wetlands. Thus, these powerful but poorly understood drivers are responsible for unexpected outcomes in one's interdisciplinary research.

These convenient black boxes do not advance our understanding, however. Rather, there is a need for true interdisciplinary "ecohydrology," defined here as tightly coupled research in which both disciplines are equally involved in the formulation of the research objective, design of the work plan, and ongoing interpretation. Of course, there is the danger that the combined approach will replace the two black boxes with one comprehensive, interdisciplinary black box. However, collaboration ensures that the best possible science is performed and that future work shrinks the black box by revealing the connections and processes underlying aquatic systems.

There are other reasons that hydrologists should care about ecohydrology. For one, the questions that society asks often are not simply focused on hydrology but are more encompassing; for example, "what is the effect of pumping on this spring/lake/trout stream/wetland?" The hydrologist can collect hydrogeological data, construct a model, and develop a defensible estimate of water-level declines and flux reduction. However, that is not what was asked. The public cares about the effect on things it can relate to—plants, birds, fish, or other animals of interest. So, the hydrologist is not expected to stop at reporting the water-level and flux declines (although we often do). We are expected to relate the declines to the bugs/plants/animals. Unfortunately, this is the abyss. There are few studies linking the abiotic effects hydrologists know well to the ecological community the public holds dear. Without understanding the ecohydrology, we will never truly answer these important societal questions.

There is also a pragmatic reason that can be illustrated by relating the conversation one of the authors had when leaving for a National Academy of Sciences panel. A neighbor directs a medical research group at the University of Wisconsin-Madison. He was keenly interested in the panel until he heard that the topic was "ground water fluxes at interfaces." To him, this had no intuitive meaning or societal importance. "Why," he asked, "would the government fund a panel to work on that topic?" When told the human dimension (drinking water sources and migration of contaminants) and the environmental importance (rare and endangered species preservation, contaminant transformations), he agreed that this understanding was important. The biological connection (human or "fin and feathers") that decides societal importance is a basic fact of life. Rather than trying to educate the populace on the inherent wonder and importance of ground water in and of itself, ecohydrology makes the connection in ways readily apparent to a nonscientist. This, in turn, should give hydrologic work a direct societal relevance that historically has been hard to convey.

To make ecohydrology more than a buzzword, hydrologists must become partners in interdisciplinary work. This will involve explaining hydrologic principles and concepts, but also includes listening to and learning about ecological principles and concepts. It will mean learning a new world where datasets are more often described using qualitative terms and statistics rather than equations and strict deterministic models. The benefits would be many, however. While learning more about the other disciplines, scientists might generate ideas that otherwise would have remained buried in their gray matter. If hydrologists and ecologists interacted on a daily basis, individual scientists could leverage their capabilities and become true ecohydrologists through assimilation of knowledge. The investment in time and energy might stretch our abilities, but we would be furthering science, truly answering the questions asked of us, and gaining societal recognition of the importance of our work.

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