THE INVISIBLE PULSES AND PATHWAYS FOR ECOSYSTEM HEALTH – INCONSTANT GROUNDWATER FLOW, EPHEMERAL RESEARCH FUNDING, AND FLUCTUATING PUBLIC PERCEPTIONS

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Springs, seeps, wetlands are often remote and hidden – from physical view and from funding sources. Recent dye tracer tests in the Grand Canyon, Arizona, U.S.A. have shown what scientists have learned in other parts of the world - that groundwater can flow in totally unexpected directions to springs with unanticipated average residence times in the subsurface. In this invisible world of the Grand Canyon, new caves are being discovered with many miles of passage. Likewise pathways and pulses of research funding are often tortuous and periodic. When springs are actually located and measured, often chemical and biological assays are limited. Sticking with the example of the Grand Canyon, analysis of heavy metals is rarely carried out in the sampling of springs, but when those parameters are actually analyzed, their aqueous concentrations are very often above drinking water standards. Arsenic in Grand Canyon spring water is a prime example; from over 4100 historical sampling events throughout the Canyon, arsenic was not even included in analyses 87.0% of the time. When it was measured it was detected 88.4% of the time, and when detected it was above drinking water standards (Maximum Contaminant Level or MCL of 0.01 mg/L) 53.8 % of the time (Kreamer, 2017). Clearly there is a lot going on in subsurface water quality that scientists, because of limited data and resources, are missing.

Many springs, particularly in arid and semi arid lands, are vulnerable to slight changes in water table or piezometric surface elevation which can result from groundwater exploitation and climatic variability. Perennial springs in wetter lands are often no less vulnerable to diminishment or change in quality. The historical record of springs, and documentation of their chemical, biological and physical attributes is, in many locales, sparse or non-existent, (although recent standard methodologies for spring description and inventory have been developed and are revolutionizing spring characterization). In spite of successes, while aquifers overflow to land surface from invisible pathways, financial resources underflow to ecohydrological research. Much of the erratic nature of environmental investigation and support comes from the inconstancy of political direction, evidenced in changing administrative environmental priorities.