

SPRINGS AND SPRINGS-DEPENDENT SPECIES OF THE COLORADO RIVER BASIN, SOUTHWESTERN USA

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Abstract: The hydrogeology of the Colorado River basin (CRB) has been intensively studied because it is the primary water source for more than 40 million people in southwestern North America and is famously over-allocated. More than half of the Colorado River, and a critically important percent of its baseflow, is provided by springs; however, springs contribution to flow and ecosystem and biodiversity values, have received little attention in the basin. We studied the distribution of springs and springs-dependent species in the CRB using existing literature and 5,873 recent and historic surveys on 2,910 springs to review the extent of information on springs distribution, ecosystem roles, and goods and services. We find 20,485 springs have been reported in the CRB, and many more likely exist but are unreported. Springs are highly patchily distributed, with highest concentrations in montane and cliff-dominated escarpment settings, and relatively few on valley floors. Certain spring types are closely tied to geophysical province, with hanging garden springs located disproportionately within the Colorado Plateaus, and rheocrenes appearing predominately in the Basin and Range region. Springs exist widely across elevation, from 0 m to more than 4000 m. CRB springs flows range up to 3,029 L/sec, and in Arizona springs contribute $>0.6 \text{ km}^3$ of water, flow that is primarily used to support wildlife and livestock, rural use, and some urban use. We detected several hundred springs-dependent species throughout the basin, primarily invertebrates, fish, amphibians, reptiles, several mammals, and one bird species (southwestern American Dipper, *Cinclus mexicanus*). One site, Montezuma Well, has the highest reported concentration of unique species of any point in North America to our knowledge. Thus, although springs remain biologically and culturally significant and highly threatened, they are poorly mapped, underappreciated, and generally poorly managed. We recommend more thorough inventory, assessment and, where practicable, rehabilitation.