The role of upland wetlands in modulating snowmelt runoff in the semi-arid Andes

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The wetlands, or bofedales, of semi-arid northern central Chile (29º-32ºS) provide a critical store of water that modulate spring snowmelt runoff. Water released from bofedales helps sustain flows throughout the dry portions of the year, providing fresh water to downstream residents and a robust tourist, agricultural, and mining economy. In the Río Claro watershed (30ºS, 1515 km2, 800m to 5500 m a.s.l.) a series fourteen bofedales have formed at natural choke points in the valley bottoms of the headwater reaches. The highly erosive dynamic of this watershed provides ample sediment, and some of these bofedales are up to 30 m deep. Annual precipitation in the region is limited to 4-6 events annually that fall primarily as snow at elevations above 3500 m. The subsurface storage of the headwaters is limited by the steep terrain of the headwater catchments that are devoid of soils and primarily underlain by granite bedrock. Downstream, irrigated area has increased by 200% between 1985 and 2005, driven by the cultivation of table grapes for export.

For over 70 years local water managers have flooded the bodfedales during spring runoff to augment late season flow when irrigation demand peaks. While this low-tech strategy has worked in the past, a recent 8-year drought has raised concerns over long-term water security. We apply geophysical and geographic measurements, water quality, and stable isotopic tracers to calculate the volume of water storage and residence times in the bofedales of Río Claro. This information will be used to evaluate the reliability of the bofedale system as compared to a proposed reservoir in the headwaters of the Río Claro. Additionally, estimating the storage and residence times of the will help reduce uncertainty for modeling efforts currently underway in Río Claro.