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A quarter-century perspective on the growth, demography, and decline of Nichol's Turk's head cactus (*Echinocactus horizonthalonius* var. *nicholii*)

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The endangered Nichol's Turk's head cactus (*Echinocactus horizonthalonius* Lemaire var. *nicholii* L. Benson) occurs only in four small, isolated populations in the Sonoran Desert. Since 1995, we have characterized growth, flowering, recruitment, and mortality of a population in Pima County, Arizona. During that quarter century, we documented the loss of ca. 80% of individuals from study plots near Waterman Peak: only 25 plants were alive in 2022 relative to >130 alive in 1995, for an overall rate of change in abundance of -6% per year. Recruitment per capita has increased during the study period, such that the decrease in abundance reflects an increase in mortality over time. A sharp and persistent population decline began in 2008 following establishment of a watering station for bighorn sheep (*Ovis canadensis*) ca. 250 m from our study area. Since the water source was established, we have noted an increase in sheep scat and damage to plants consistent with pawing by sheep. To distinguish impacts from sheep from those due to changes in temperature and precipitation, we established two additional plots in 2016 in nearby areas where sheep are not present. In these areas, annual mortality is lower than in the areas with sheep, but is higher than that observed under cooler and wetter conditions that predominated during early years of the study. Moreover, individual plants grow less rapidly and are less likely to flower when drought is more severe. Together, our data highlight potential impacts of climate change for this rare and endangered plant.