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Implications for flora management and restoration

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HIERARCHIES OF CAUSE: UNDERSTANDING RARITY IN AN ENDEMIC SHRUB WITH A HIGHLY RESTRICTED DISTRIBUTION

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Verticordia staminosa ssp *staminosa* is an extremely rare plant species occurring as an isolated population of approximately 1200 plants on a granite outcrop in the semi-arid agricultural region of Western Australia. We aimed to determine a hierarchy of causes for explaining the shrub's extremely restricted distribution. We measured seed production for three consecutive years and demography for five consecutive years. We used transition matrix models to describe the shrub's population dynamics and stochastic simulations to explicitly compare the effects of low rainfall and disturbance on population viability. *Verticordia staminosa* ssp. *staminosa* produces large numbers of seeds each year and has flower to fruit ratios greater than reported for related rare and common congeners. Seedling recruitment occurs in most years with pulses in the wettest years. The finite population growth rates rate ranged from 0.997 to 1.184. Elasticity analyses showed that population growth rate was more sensitive to stasis of established plants than to seedling recruitment. Stochastic growth rates declined under low rainfall regimes with increased incidence of disturbances that killed established plants. Rarity in *V. staminosa* is best explained by evolutionary history and the interaction of climate change and disturbances such as fire that kill plants. Climatic fluctuations since the late Pliocene have led to stochastic extinction episodes of populations on other granite outcrops resulting in the currently restricted distribution. We discuss the implications of our findings for management of the species.