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Evaluating impacts of fire management strategies on native and invasive plants using an individual-based model

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The capacity for species to coexist and potentially exclude one another can broadly be attributed to drivers that influence fitness differences (such as competitive ability) and niche differences (such as environmental change). These drivers, and thus the determinants of coexistence they influence, can interact and fluctuate both spatially and temporally. Understanding the spatiotemporal variation in niche and fitness differences in systems prone to fluctuating drivers, such as fire, can help to inform the management of invasive species. In the Cape floristic region of South Africa, invasive Pinus pinaster seedlings are strong competitors in the post-burn environment of the fire-driven Fynbos vegetation. In this, system native Protea spp. are especially vulnerable to unseasonal burns, but seasonal prescribed (Summer) burns are thought to present a high safety risk. Together, these issues have limited the appeal of prescribed burn management as an alternative to costly manual eradication of P. pinaster. Using a spatially-explicit field-of-neighbourhood individual-based model, we represent the drivers of spatiotemporal variation in niche differences (driven by fire regimes) and fitness differences (driven by competitive ability). In doing so, we evaluate optimal fire management strategies to a) control invasive P. pinaster in the Cape floristic region of South Africa, while b) minimizing deleterious effects of management on native Protea spp. The scarcity of appropriate data for model calibration has been problematic for models in invasion biology, but we use recent advances in Approximate Bayesian Computing techniques to overcome this limitation. We present early conclusions on the viability of prescribed burn management to control P. pinaster in South Africa.