Understanding range shifts: using current and historical data to model the invasive redlegged earth mite, Halotydeus destructor

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The niche of an invasive species is often conserved during invasion, although there are numerous examples of species distributions expanding via range-shifts beyond expected climatic boundaries of their invasive range. Halotydeus destructor is an important agricultural pest in Australia and has been the focus of extensive surveys that suggest this species has expanded its invasive range inland to hotter and drier environments. We compiled comprehensive distribution datasets for H. destructor, representing the native range in South Africa, its invasive range in Australia in the 1960s (40 years post-introduction), and its current range in Australia. Using MAXENT, we built correlative models and reciprocally projected them between South Africa and Australia, and investigated post-invasion range expansion with historical and current models. We used model exploration tools to examine the climate similarity between native and invasive ranges, and subsequently examined climatic variables that limit distributions. The invasive niche of H. destructor transgresses the native niche and the species has expanded in Australia beyond what is predicted from the native South African distribution. Our models support the notion that H. destructor has undergone a more recent range shift into hotter and drier inland areas since establishing a stable distribution in the 1960s. Our models demonstrate that invasion is an ongoing dynamic process, and that once a species has reached an established range it may still expand at a later stage. The models generate hypotheses about adaptive shifts in H. destructor, and may aid future climate change predictions.