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Rethinking species selection for restoration of arid shrublands

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Abstract

Restoration is playing an increasingly important role in ecology as natural habitats become scarcer and chances to restore ecosystems damaged by human activities are more common. However, restoration of degraded Mediterranean arid ecosystems is hampered by drought and poor soils, which cause many establishment failures. To compare how species belonging to different successional stages establish in a very stressful site, we carried out a field experiment with 14 tree and shrub species differing in functional traits. After three growing seasons, mid-successional shrubs such as the leafless *Ephedra fragilis* and the C₄ *Salsola oppositifolia*, or green-stemmed legumes like *Coronilla juncea*, *Genista umbellata*, and *Retama sphaerocarpa*, showed survival rates up to 93%, while late-successional species like *Tetraclinis articulata*, *Pinus halepensis*, *Olea europaea*, and *Pistacia lentiscus*, frequently used and recommended in regular restoration projects, hardly reached 55%. We found that survival was highest for legumes, followed by leafless species, and C₄ shrubs, traits that are believed to maximize resource uptake in cleared and infertile areas while reducing water losses. Thus, selection of mid-successional species having such traits should be considered for successful restoration. These species would increase the success of restoration programs, but also would increase soil fertility, reduce soil erosion processes, and eventually facilitate establishment of other species, therefore accelerating secondary succession. We suggest a new approach for the restoration for arid shrublands in which species are carefully selected based on traits that best suit the environmental conditions.

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Zusammenfassung

Die Renaturierung spielt eine zunehmend wichtige Rolle in der Ökologie, da natürliche Habitate seltener und die Möglichkeiten häufiger werden, von Menschen zerstörte Ökosysteme zu renaturieren. Die Renaturierung von zerstörten mediterranen, trockenen Ökosystemen wird durch Trockenheit und arme Böden behindert, die zu vielen Fehlschlägen bei der Ansiedlung führen. Um zu vergleichen, wie sich Arten, die zu verschiedenen Sukzessionsstadien gehören, an besonders extremen Orten ansiedeln, führten wir ein Freilandexperiment mit 14 Baum- und Straucharten durch, die sich in funktionalen Merkmalen unterschieden. Nach drei Wachstumsperioden zeigten Büsche der mittleren Sukzession, wie die blattlose *Ephedra fragilis* und die C₄-Pflanze *Salsola oppositifolia*, oder die stängelgrünen Leguminosen wie *Coronilla juncea*, *Genista umbellata* und *Retama sphaerocarpa*, Überlebensraten bis zu 93%, während Arten der späten Sukzession, wie *Tetraclinis articulata*, *Pinus halepensis*, *Olea europaea* und *Pistacia lentiscus*, die in regulären Renaturierungsprojekten häufig genutzt und empfohlen werden, kaum 55% erreichten. Wir fanden heraus,

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