Introduction - sdms for restoration

Abstract

1) THE PROBLEM
2) WHAT WE DID
3) BASIC RESULTS
4) INSIGHTFUL RESULTS
5) **Synthesis and applications**

Introduction *(at most 1 1/4 pages)*

A primary challenge to restoring Earths terrestrial ecosystems is the lack of available plant germplasm (@national2023assessment, @merritt2011restoration). Given the scale of our restoration needs, in most scenarios, the only sustainable source of seed is from grow-outs of wild harvested seed in agricultural settings (@pedrini2020collection, @broadhurst2015seeding, @national2023assessment). Enormous efforts are now underway to increase the number of species, the number of populations within these species, and the genetic diversity of these populations, available for restoration @national2023assessment. However, difficulties exist in both the wild harvest and increase of seed which are limiting our ability to develop adequate amounts of germplasm.

While most species desired in restorations have historically had relatively large geographic ranges, numbers of populations, and number of individuals per populations, the development of native germplasm remains behind targets (@national2023assessment). We posit that in part this is due to the difficulty of finding populations with the appropriate number of individuals, which are experiencing climatic conditions conducive to producing enough viable seed to being agricultural increase, a complications borne of widespread habitat degradation and unnatural wildfires *(cite on degradation and wildfires).* Tools which are capable of predicting a species geographic range, the presence and size of populations across the range and in seed collection target units (such as empirical or provisional seed transfer zones or ecoregions), such as Species Distribution Models offer promise to increase the rate at which native germplasm can be developed.

However, while SDM's generate hypothesis of whether areas have environmental conditions similar to the observed environmental niche of the species they do not consider the probabilities of colonization, nor the populations census sizes. A possible tool to associate a probability of occurrence of a species in a suitable habitat patch, is connectivity analysis. Utilizing the predicted unsuitability of habitat, with extreme barriers to dispersal, to create cost-resistance surfaces between patches with known populations and predicted populations allows for simulating the probability of occurrence. While previous correlations between habitat suitability and population size have often been low, we posit that patch level parameters offer a more useful prediction of population size (@weber2017there, @waldock2022quantitative) Patch metrics will more appropriately reflect parameters of a potential population, e.g. geographic extent, which we posit is a more informative proxy of population size than environmental niche correlation.
Utilizing this approach will allow field crews to associate probabilities with previously unground truthed patches.

Here we showcase the utility of SDM's to predict suitable habitat for common species in natural settings and use those data to test two specific hypotheses. Firstly that SDM's can identify more populations than exist in the occurrence based records they were derived from. And secondly patch metrics derived from

SDM's correlate with observed population census size. In order to determine whether SDM's are useful in detecting new populations, over $_{10}$ field crews were given 50 putative populations to survey for the presence and absence of the modelled species. To determine if patch metrics can be used to predict population census sizes, these crews noted whether the populations was large enough to support