

Supplementary Materials for

**Something for nothing: a synthesis of active versus passive restoration in drylands**

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**This PDF file includes:**

Materials and Methods

Figs. S1 to S2

Table S1

Materials and Methods

Literature search and eligible criteria

PRISMA guidelines were used to structure this synthesis and meta-analysis (Preferred Reporting Items for Systematic reviews and Meta-Analyses; Fig. S2) (*31*). We systematically searched Scopus and The Web of Science using the following term combinations: [restoration\* desert\* vegetation\*] OR [restoration\* grassland\* desert\*] OR [restoration desert\* plant\*] OR [restoration "agricultural lands"] OR ["restoration techniques" desert\*] OR ["passive restoration" desert\* plant\*] OR ["active restoration" desert\* plant\*] OR [revegetation abandoned desert\*] OR [restoration "agricult\*land\*" desert\* plant\*] OR [restoration dryland\* vegetation] OR [restoration semiarid\* plant\*] OR [restoration arid\* plant\*]. The searches were done in September 2018 and returned 1504 published articles. We collected data from studies that met the following inclusion criteria: (1) research articles including results, review articles were not included; (2) agriculture as the main disturbance reported (crop and grazing lands); (3) studies with experimental (restoration practice) and control groups specifically compared; (3) reported statistical analysis and significance of treatments. After the application of the above inclusion criteria, a total of 40 studies were included in the meta-analysis (Fig. S2).

Data extraction

The specific restoration practice described in each study was recorded and subsequently classified as active or passive restoration. Passive restoration refers to the natural regeneration of degraded ecosystems with minimal to no human interventions such as the cessation of disturbance by installing fences to terminate grazing locally (*9*, *22*). Active restoration strategies were always direct human interventions on ecosystems to assist and accelerate their restoration (*21*). Different practices that addressed a similar restoration goal were further classified into four main categories: soil, vegetation, water supplementation and grazing exclusion. Soil and vegetation practices included both active and passive types of restoration, water supplementation was classified as an active restoration practice, and grazing exclusion as passive (Table 1A). Moreover, for each study we extracted data of the outcomes reported for each restoration practice in primary studies (*25*). We grouped the different outcomes into four general categories including soil, vegetation, animals, and habitat (Table 1B).

We collected data of all the response variables reported in each article. For each response variable we extracted the mean and standard deviation for the restoration practice implemented, either active or passive, and control conditions. When these data were provided in figures within a publication, we used WebPlotDigitizer (*32*) to extract values. In addition, we collected data of the mean annual temperature and annual precipitation from the study sites of each article to calculate the aridity index (*26*), and recorded the reported duration of study in months. When climatic data were not provided in studies, we used the latitude and longitude listed to look up the means from WordClim (www.worldclim.org). The aridity index and duration of studies were used as covariates in statistical models.

Statistical analysis

To determine the effect of the restoration practice, either active or passive, over the control group, we calculated the log response ratio (lrr) (*24*). This effect size quantifies the log-proportional change between the means of the two groups compared (*33*). A negative value of the log response ratio implies the effect of the control group was higher than that of the treatment while a positive value indicates that a treatment leads to an increase in some responses evaluated. Statistical significance of active and passive restoration strategies was tested with t-tests with mu = 0. All analyses done in R version 3.5.5 (*34*), and both the packages meta (*35*) and metafor (*36*) were used for meta-analytical analyses. All support code is published (Lortie, C.J. and M.F. Miguel. 2019. A set of R code to test dryland restoration efficacy using meta-analysis. Zenodo. DOI: 10.5281/zenodo.2653943).

**Fig. S1.** Disturbances reported in drylands globally and the restoration strategy implemented, active or passive. The *y*- axis represents the frequency of studies that reported each disturbance. Red represents the frequency of studies that applied active restoration practices while blue represents the frequency of those studies using passive recovery practices.

Imagen que contiene captura de pantalla

Descripción generada automáticamente

**Fig. S2** PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) report of a meta-analysis comparing active versus passive restoration strategies, and individual restoration practices in dryland ecosystems globally.

Records identified through

database searching

= 1504)

(

n

Records after duplicates removed

= 1039)

n

(

Records screened

= 1039)

n

(

Additional records identified

through other sources

(

5)

n =

Records excluded

= 861)

n

(

Full-text articles assessed

for eligibility

(

n

= 178)

Studies included in qualitative synthesis

(

n

= 77)

Full-text articles excluded,

with reasons

(

n

= 101)

Studies included in

quantitative synthesis

(

meta-analysis

)

(

n

= 40)

**Table S1.** List of restoration practices and outcomes included in a meta-analysis comparing active versus passive restoration strategies, and individual techniques for restoration in drylands globally. Sample size indicates the number of observations and data entries obtained for each restoration technique from the studies included in the meta-analysis (n = 40).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Restoration strategies** | **Practices** | **Outcomes** | **Techniques** | **Sample size** |
| Active | soil | habitat | carbon addition, top soil removal, seeding | 45 |
| habitat | carbon amendment | 27 |
| soil | fertilization, biostimulants, seeding | 48 |
| vegetation | mycorrhizal inoculation | 128 |
| vegetation | habitat | burning, mowing | 24 |
| vegetation | mechanical disturbance, seeding | 4 |
| habitat | mowing | 3 |
| habitat | planting | 369 |
| vegetation | planting | 26 |
| soil | planting | 84 |
| animals | planting | 24 |
| vegetation | seeding | 44 |
| soil | seeding | 117 |
| vegetation | seeding and ripping | 12 |
| habitat | seeding, cutting, grazing treatments | 2 |
| habitat | seeding, gypsum and organic mulch | 9 |
| vegetation | seeding, irrigation | 7 |
| habitat | seeding, mowing and herbicide, mulching | 18 |
| vegetation | seeding, mulching, weeding | 6 |
| habitat | seeding, planting | 15 |
| vegetation | seeding, safe sites for seeds, fencing | 8 |
| vegetation | seeding, soil tilling, fertilization | 7 |
| water supplementation | vegetation | seeding, irrigation | 63 |
| habitat | water supply | 12 |
| Passive | grazing exclusion | vegetation | fencing | 21 |
| vegetation | grazing exclusion | 8 |
| soil | soil | mycorrhizal recovery | 6 |
| soil | natural recovery | 198 |
| vegetation | habitat | facilitation | 59 |
| habitat | natural recovery | 30 |
| vegetation | natural recovery | 4 |
| habitat | fencing | 15 |
| vegetation | grazing exclusion | 17 |