Best Management Practices
Salvaging topsoil

The upper 5-10 cm (2-4 inches) of soil contains much of the soil organic matter, nutrients, and microorganisms of Mojave Desert soils. The upper 5 cm (2 inches) of soil also contains the entire or nearly entire viable soil seed bank. Salvaging topsoil, using effective practices, is among the most ecologically beneficial ways to enhance recovery of desert ecosystems after disturbance.

Best-management practices for salvaging topsoil in the Mojave Desert include:

- **Avoid salvaging soil from areas of extreme non-native plant infestation or containing non-native plants that may become invasive.** Certain non-native plants, like Mediterranean grasses (*Schismus* spp.), are nearly ubiquitous in the Mojave Desert, likely precluding salvaging completely weed-free soil. It is wise, however, to avoid salvaging soil containing non-native plant monocultures or non-native species uncommon in an area. This can avoid spreading new non-native species to recipient sites where topsoil is re-applied.

- **Time soil salvage optimally in summer (June through September).** This timing captures seeds of winter-growing annual plants dispersed the previous spring, but is before germination of winter annuals in late fall/winter (October through April). During dry years, soil salvage also can probably occur through fall (October through December) if no germination has occurred.

- **Carefully salvage the upper 5-10 cm (2-4 inches) of soil.** Avoid "diluting" this surface layer with deeper subsoil (Fig. 1). Diluting topsoil is undesirable because certain subsoils contain properties unfavorable to plant growth and the soil seed bank is negatively affected. For example, if the upper 2 cm of soil contain all of the viable seed and seedlings can only emerge from within a depth of 2 cm, then salvaging the upper 20 cm of soil immediately reduces viable seed bank density by 90% when the topsoil is reapplied.

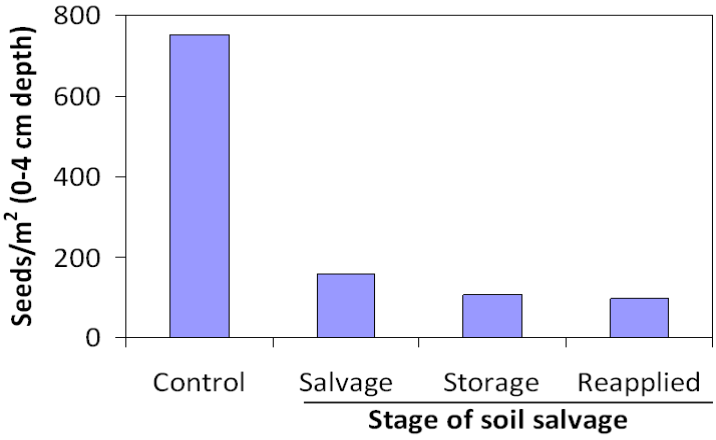

Figure 1. Loss of germinable seed during three stages of topsoil salvage, relative to the 0-4 cm soil layer of undisturbed desert, in the eastern Mojave Desert. Most (79%) of the seed loss occurred during the salvage operation itself, likely because subsoil (to a depth of 30 cm) was mixed with topsoil. The topsoil was stored for 4 months. Data from Scoles-Sciulla and Defalco (2009).

- **Store salvaged topsoil as briefly as possible before reapplication.** Ideally topsoil should not be stored at all and immediately applied to a recipient site. Practical constraints typically result in some storage being required, and this unavoidably creates some loss of biotic resources. If soils must be stored, storage time ideally would not exceed 6-12 months (Figure 2).

- **Protect stockpiled soil and consider treatments to extend longevity.** If soil must be stored for long time periods, it should not be assumed much live material remains. Stored soil should be protected from wind erosion or other damage, such as through using tackifier or covering. For long storage durations, consider immediately implementing treatments to potentially extend longevity of biotic components. Some possible treatments may include transplanting some vegetation (such as native cactus pads) on top of the piles to potentially enhance longevity of soil microorganisms. These types of treatments have not been tested extensively and should be considered experimental.

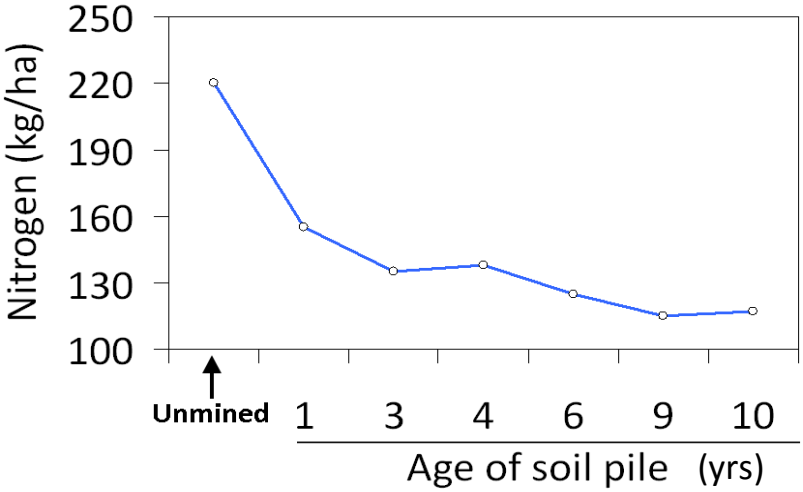

Fig. 2. Loss of nitrogen in stockpiled topsoil stored for 1 to 10 years, relative to undisturbed soil. Data from Ghose (2001) in coal mining areas of arid land in India.

- **Keep the height of soil stockpiles as short as possible.** The deeper the pile, the more likely it is that biotic components will be lost. Ideally, piles are no more than 45-60 cm (18-24 inches) tall. If storage space limitations require deeper piles, consider periodically turning the soil or some of the treatments above to try and extend longevity of biotic components.

- **If the salvaged topsoil is not returning to the same site, match environmental characteristics of the donor and recipient sites as closely as possible.** This can be particularly important to avoid having species germinating from the salvaged topsoil that are not adapted to root into the subsoil beneath.

- **Monitor effectiveness of treatments applied to topsoil and the influences that topsoil salvage has on restoration and recovery.** Numerous variables –from soil type to handling procedures and rainfall any given year topsoil is reapplied – can influence effectiveness of topsoil salvage. Building a knowledge base for how and when the most benefits from topsoil salvage can be expected would assist restoration planning.

Plant recovery on an area receiving salvaged topsoil (right side of gray line) after disturbance from re-alignment of Northshore Road, Lake Mead National Recreation Area, eastern Mojave Desert. Photo by S.R. Abella, 4 years after disturbance.

Example References and Further Reading

Abella, S.R., L.P. Chiquoine, A.C. Newton, and C.H. Vanier. 2015. Restoring a desert ecosystem using soil salvage, revegetation, and irrigation. Journal of Arid Environments 115:44-52.

Ghose, M.K. 2001. Management of topsoil for geo-environmental reclamation of coal mining areas. Environmental Geology 40:1405-1410.

Scoles-Sciulla, S.J., and L.A. DeFalco. 2009. Seed reserves during surface soil reclamation in eastern Mojave Desert. Arid Land Research and Management 23:1-13.