"Native" vs. "Exotic"—The Dilemma of Ecological Mine Waste Revegetation

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The Law:

The legal mandate to specifically use "native" species for revegetation of mine wastes and other disturbances is well established in law and regulation. The Federal Surface Mining and Reclamation Act of 1977 - P.L. 95-87 specifically states: "... establish permanent vegetative cover of the same variety native to the area", (30 USC 1201 - 91 STAT. 445-532, Title V., Sec. 515, para (19)). Further regulations have reinforced this legal mandate and make any deviation from using other than native species excessively restrictive. Some regulations even impede the inter-transfer of a species within the United States from one ecosystem to another.

The Problem:

The dilemma created by the restrictions of using only plants that are native to an area, is both complex and perplexing. It can restrict the ecological diversity of species required to re-establish a viable ecosystem on severely disturbed sites. In extremely harsh environments, one way to revegetate is to recreate a habitat that will sustain vegetative growth and supply sufficient species variation to allow nature to evolve a viable and self-perpetuating natural ecosystem. In some places, there are insufficient native species adapted to the specific site conditions to allow for effective evolution to occur. Some natives can be established in sufficient quantities to stabilize the area and satisfy legal requirements, but in the long run they may not be able to perpetuate themselves. The restriction of natives only seriously impedes innovation and development of improved reclamation techniques. Few reclamation programs can afford to "experiment" and risk lengthy extension of bonding requirements. Hence new gene pools of superior species can not be introduced. Also the productivity of the site may not be improved upon by introducing more valuable species. Some technological drawbacks of native species may include labor intensive practices for seed gathering from sparse populations, which makes it extremely difficult to obtain sufficient seed quantities to revegetate large areas. Also there may be inherent characteristics that impede germination and seedling development, or physical characteristics which make sowing of the seed difficult.

A Solution:

Some native plants are excellent candidates for revegetation projects and should be utilized wherever and whenever possible. One dominant factor that must be considered in any species selection is the species adaptability to the specific site conditions. These site factors include soil characteristics and topography in addition to climatic conditions. These specific site conditions will often dictate what plant species will potentially survive. Mining disturbances and wastes are definitely not natural but are man made; often site conditions are quite different from the undisturbed natural sites. In practicality, the exact origin of a species used for revegetation should have little bearing upon its selection if the site conditions specifically favor its survival.

Mix of exotic grasses with native mesquite in foreground and eucalyptus in back.

The desirable goal of all revegetation programs should be to consider all potentially suitable species. With sound ecological understanding of the species selected, and careful monitoring of field trials, a happy marriage of native and exotic species can create a sustaining and productive ecosystem.

An Approach:

Various studies have been underway in evaluating species for disturbed land revegetation in southern Arizona for more than 15 years. The result has produced a blend of both native and exotic plant species to create a viable and productive naturalistic ecosystem. The primary criteria used in species selection were (1) adaptability to the specific site conditions to insure a self-sustaining vegetative cover for stabilization,

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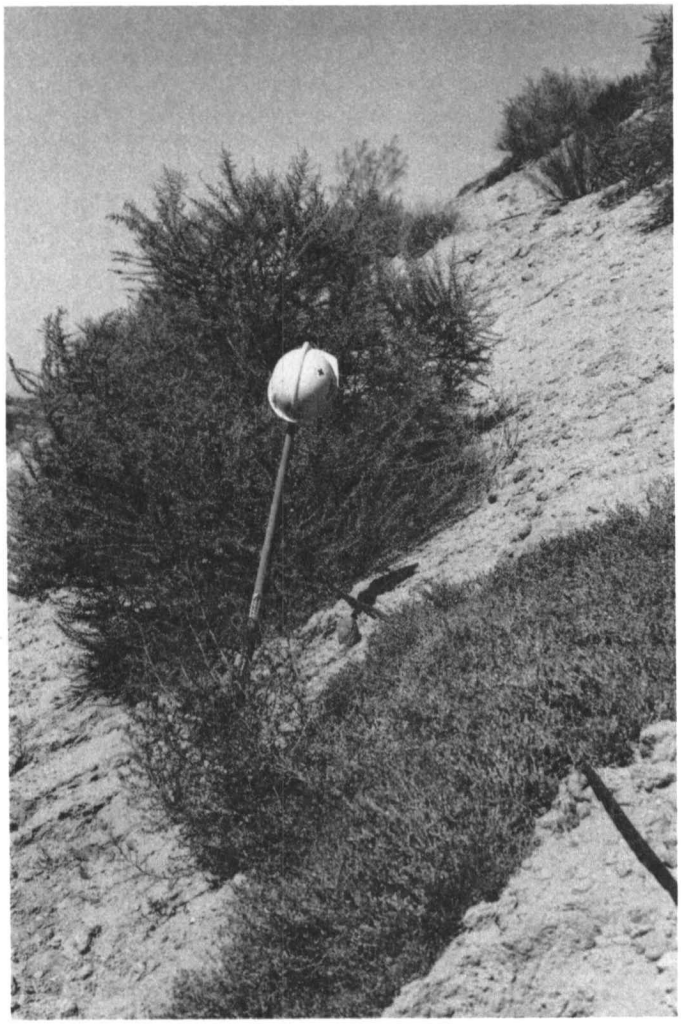
and (2) soil stabilizing characteristics such a: rooting structure, life span, growth form, etc., Secondary criteria for species selection were economic and natural resource values for future uses of the stabilized sites. Also considered were plants with commercial potentials. Some other factors considered in species selection were aesthetic appearance and compatibility to blend in with the adjacent natural areas and public acceptance as well as meeting all legal requirements.

It was found that a prerequisite to any success was the development of a sound understanding of the ecological and physiological characteristics of the plant species. By monitoring the growth habits, regeneration and competitive characteristics of various species, the problem of invasion and disruption of native ecosystems can be avoided.



Four-wing saltbush and Australian saltbush together on drip irrigation.

Following is a partial listing of some native and exotic plant species that have been successful at various revegetation sites in southern Arizona. While some of the natives may not be endemic to a specific site they are still listed as native since they do occur in the Arizona-Sonoran desert ecosystem. *Desert saltbush,* a prolific seeder, is easily established, usually without any supplemental watering. *Four-wing saltbush* and *Quailbush* are two other prolific seeders which can be established easily. *Desert broom* is a plant easily established that will spread rapidly. *Mexican paloverde* grows very fast and adds bright color to an area. Another flowering plant used successfully is *Brittlebush.* Other successful natives include *Fluffgrass, Desert holly, Blue paloverde, Mesquite, Lycium, White thorn, Hopseed, Creosote, Fairy duster, Triangle-leaf* and *White bursage,* and *Buckwheat.* Some of these plants would not be considered desirable from the viewpoint of increasing forage production for livestock, but they are necessary for a viable population of wildlife and birds.

Some of the exotics that have been found successful are native to the Mohave or California deserts and are not normally found in Arizona while others are native to Australia and other desert regions of the world. Among the saltbushes found successful are *Oldman saltbush, Torry saltbush, Muller saltbush, Sweet saltbush, Australian saltbush, Glauca saltbush,* and *Swamp saltbush.* These are all quite easily established and regenerate well. *Australian acacias* are very easy to establish and grow rapidly to cover the ground surface. *Eucalyptus* and *Chilean mesquite* trees grow very fast, require very little water, and have good commercial values for fuel wood. *Ruby sheepbush* is a very prolific seeder and spreads rapidly. Salt cedar can form a very dense stand in the very worst of soils and provide an excellent windbreak.

Various exotic grasses that have become naturalized to the arid southwest and are successful are: *Lehman's lovegrass, Blue panicgrass,* and *Bufflegrass.* Other exotic grasses that do quite well are: *Bermuda grass, Filaree, Alfalfa, Sweet clover, Mediterranean grass,* and *Indian wheatgrass.*

There are very few native grasses commercially available for revegetation programs in southern Arizona. Some that are occasionally available and have some practical application include: some of the *Grama grasses, Plains bristlegrass, Sand dropseed,* and *Alkali sacaton.* Most other native grasses do not have sufficient seed available in commercial quantities. With many native species, the lack of seed dependability is due to uncontrollable climatic factors. This makes it exceedingly difficult to achieve a desirable species composition year after year.

Taking species selection one step further, experiments are underway to test the commercial aspects of certain crop species for mine waste revegetation. If mine wastes can adequately produce commercial crops, the consumer and society would benefit greatly. These studies are directed toward changing the disturbed areas to a stabilized and productive capacity. The big question is whether these areas can produce a viable economic crop with sufficient yields to warrant commercial investment. To answer these questions the physical characteristics of the mine wastes and physiological requirements of various commercial crops must be studied. Surprisingly, there are a number of crop species adaptable to these harsh site environments that could potentially produce a commercial crop. These include: *wine grapes, pistachios, pecans, olives* (for oil), *jojoba,* and as previously mentioned, *Eucalyptus* for fuelwood. Other potential commercial crops might be certain pine trees for Christmas trees or pulpwood, *Euphorbia* for petroleum extracts, and *Gauyle* for rubber latex. Preliminary results are encouraging. We are beginning to understand the problems and learn the

techniques for successfully growing these crops. For example, one of the biggest problems requiring remedial action was the preleaching of excessive salts from the planting sites. We also learned that it was better to plant larger, more vigorous, healthier, and hardier nursery stock than might be required for a less harsh environment.

There is also hope for the future in new genetic research to develop new hybrid species with higher salt tolerances and other characteristics which will enable the plant to grow in these harsh environments. Even though mine wastes may never become the "bread baskets" of America, the potential to produce commercial food crops warrants further research and development. Research is also needed to determine the utilitarian values of some new species and new markets need to be developed for commercial uses.

In southern Arizona the present species composition of native plants is far different from that which dominated the landscape a century ago. The ecosystems that exist today have been forever altered by man and nature. Nothing is static. So long as prudent judgement is used in the selection of species for mine waste revegetation, no species should be automatically exempted. Who knows, the exotics of today may become the natives of tomorrow.

Biomass Distribution at Grassland and Shrubland Sites

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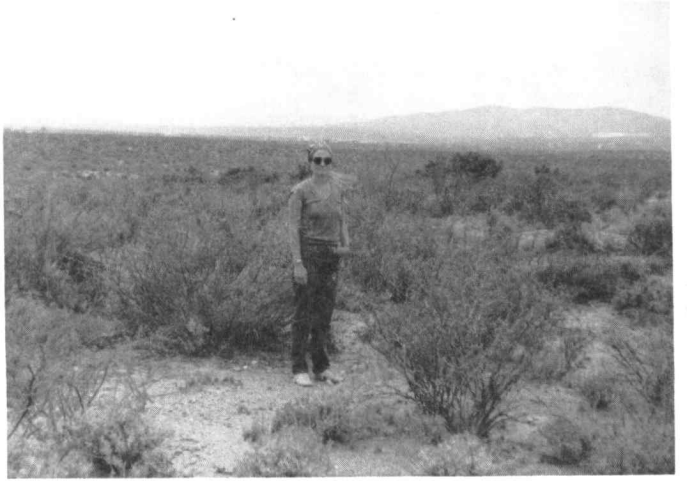
The only permanent water sources in the Upper San Pedro Valley Basin prior to 1850 were associated with a meandering stream along the valley floor. At that time, upland vegetation was dominated by perennial grasses. A permanent water source was developed near Tombstone, Ariz., about 1875, and livestock populations dramatically increased between 1860 and 1885. Livestock grazing decreased with distance from these permanent water sources, and in time, the upland grasslands near water were dominated by shrubs. While uplands where permanent drinking water was unavailable remained as perennial grasslands.



Shrubland area.

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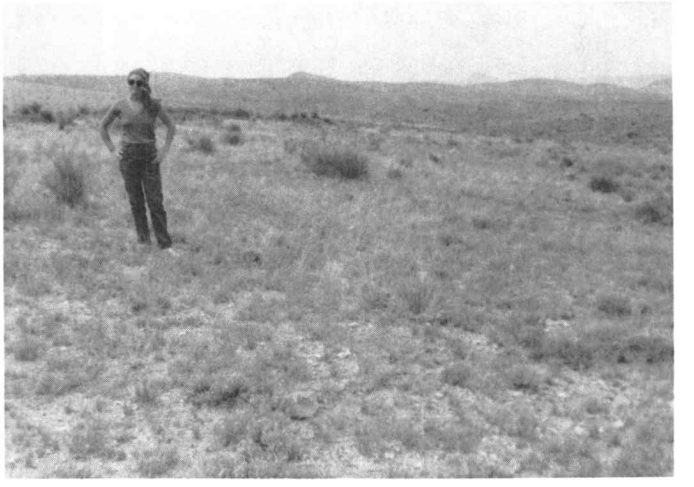

Grassland area.

As perennial grass populations decreased and perennial shrub populations increased, ranchers used rails, cables, plows, disks, and chains to reduce shrub competition. In most instances the treated areas were sown with seeds of native and introduced perennial grasses. In wet summers the seed would germinate and produce plants, but with poor range management practices the plants did not persist and treated areas were eventually redominated by shrubs.

The failure of perennial grasses to persist or adequately compete for moisture and nutrients with shrubs has resulted in these general beliefs: (1) a greater amount of aboveground biomass accumulates after brush invasion, (2) a greater amount of below-ground biomass accumulates after brush invasion, (3) shrub roots are at greater depths within the soil profile, and (4) shrubs produce more fine roots, or