Propagating Desert Plants[1]

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Abstract.— In the mid 1980's, arid land restoration was considered unfeasible by many in the National Park Service. A major road work proposal in Joshua Tree National Monument (henceforth JTNM) alarmed the Resources Management Division because it did not include mitigation for vegetation damage caused by the construction. We began pioneering methods and practices for desert plant propagation to mitigate these concerns. In the end, our procedures have proven useful to others revegetating disturbed lands.

INTRODUCTION

...arid...barren...infertile...wasteland... That is how the thesaurus defines the word "desert." Tell that to the more than six hundred seventy-five species of plants inhabiting Joshua Tree National Monument. The Monument, in central Southern California, is where two deserts (the Mojave and the Colorado) converge. The federal government established this half-million acre unit of the National Park Service in 1936 to protect the unique plant communities found in this transition zone.

Prior to JTNM's establishment the region was used for cattle grazing and mining. The vegetation restoration program at Joshua Tree began in 1985 to mitigate still-visible historical damage in over 200 miles of mining road scars, closed mines and borrow pits. We are also revegetating areas disturbed by recent work on the Monument's 80 miles of paved roads.

During the 80's, Resources staff began researching the feasibility of restorative planting in the desert. We found very little information on the restoration of desert ecosystems, and no wholesale growers or government nurseries who dealt in native desert specimens. These plants were considered commercially undesirable and hard to grow. Because the National Park Service has a mandate to protect and preserve natural (i.e., native) resources, the use of non-native plant material (oleander, for instance) was not an option. The solution was to start our own nursery.

In 1986, with only minuscule funding (a small kit greenhouse and a self-built lath house), and a research library containing two references ("Trial and Error" and "Growing Plants the Hard Way"), Joshua Tree's Native Plant Nursery became a reality. Today we successfully grow over 70 species of desert plants, as well as species found in other desert parks and local mountains.

MATERIALS AND METHODS

The Park Service preservation mandate requires genetic integrity for all planted material. This means that seeds and cuttings from within monument boundaries must come from the same area to which they will be returned. We also feel that plants from seeds collected locally will be better adapted and grow more vigorously when they're planted out. Seed production is dependent on local rainfall — the better the annual precipitation, the more productive the plants. Because we cannot predict how many seeds will be produced in a given year, we collect and store all we can from anticipated project areas. We collect all seeds by hand and put them in various sized paper and plastic bags for storage.

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Once seeds are brought back to the nursery they require a delay period allowing the fruits and inflorescences to dry. Although this period varies from one species to another, the basic procedure is similar for all. The seeds are placed in paper bags and stored in a hot, dry enclosed area for four to six weeks. Then, the seed cleaning team (also known as the seed collecting team, the propagating team, the transplanting team and the out-planting team) works its magic with various hi-tech cleaning equipment: pans, rolling pins, sieves, fans and fingers. Because of high daily summer temperatures in Twentynine Palms (95-105° F), we must store all cleaned seeds in refrigerators. When properly treated, some seeds have proven viable 5-10 years after collection.

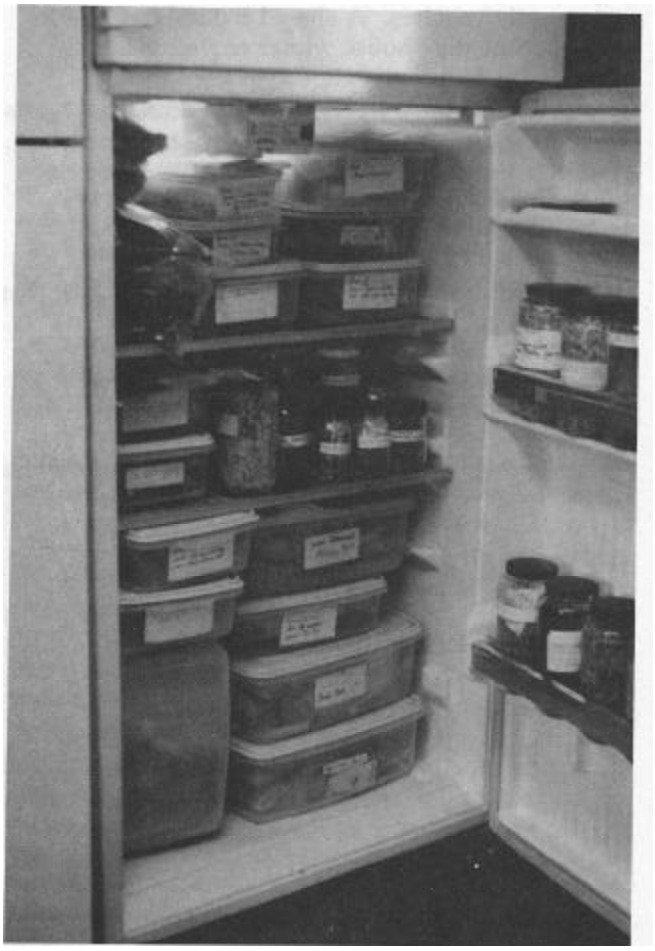

Figure 1 After collection, seeds are cleaned and sorted according to area of origin then stored in refrigerators.

Due to the harsh desert environment and the abundance of predators, desert plants have developed a fascinating diversity of ways to protect themselves and their progeny. Plants facing these harsh desert realities must germinate at the precise "right" moment to survive. Their germination is triggered by such variables as soil moisture, number of cold days, or by being tumbled against sand grains (as would happen in a desert flood). In the nursery we must find ways to mimic these conditions.

Many seeds just need a little soaking to induce germination, but most demand something more ingenious to break their dormancy. Seeds with a thick, waxy coat must be clipped (scarified) before soaking. Seeds with a chemical germination inhibitor that cannot be soaked off pose a special problem. After much trial and many errors, we tried leaching seeds for 12+ hours in running water. This worked, for example, with the previously difficult *Larrea tridentata* (creosote bush), a main component of Mojave and Colorado plant communities. Leached in this manner, *Larrea is* now grown with great success. Some seeds require a cold, moist substrate for germination; these we inspect regularly during the stratification process for germination. For new, untried species in the nursery, we use a standard battery of propagation tests that cover a wide range of seed germination strategies.

Once seeds go through pre-germination requirements, they are placed between sheets of seed germinating blotter paper in nursery flats and wrapped in plastic bags to prevent drying. With this system we can easily observe the germination process and ensure only viable seed is sown into pots.

This brings us to the unique container system used at Joshua Tree's Native Plant Nursery. We had tried growing desert plants in Styrofoam cups, 2" plastic pots, peat pots and milk cartons with only marginal success. Suggestion for a solution came from JTNM Resources Management Division Chief, Bob Moon. Bob is a successful home gardener and thought about his garden's tomato plants. Moon, the nursery's founder, suggested a specially designed newspaper pot, because desert plants, like tomato plants, grow better in containers that permit unrestricted downward root growth. Today, germinated seeds are gently removed from the toweling and planted into newspaper cylinders that measure 3" diam. by 11.5" high. The cylinders are covered with polyvinyl food wrap and filled with our standard soil mix. The paper pots allow a root to shoot ratio of about 10:1, and the desert seedlings benefit from such an auspicious beginning. The idea revolutionized seedling growth and JTNM's Native Plants Nursery.

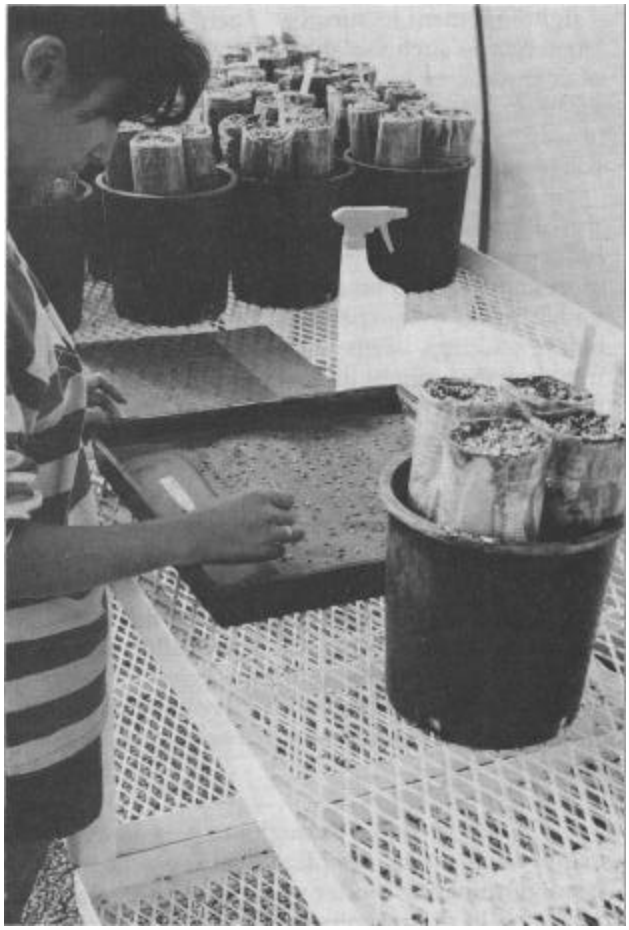

Figure 2 Germinated seedlings are taken from propagating trays and planted into newspaper pots where they will continue growing until ready for transplant into 30" PVC "tall pots".

After the seedlings spend from 8 to 12 weeks in the paper pots, their roots are usually growing out of the soil at the open bottom of the pot. At this time the entire paper pot, minus the plastic wrap, is ready for transplanting into pots. Once again, we had to develop new methods because conventional black plastic 1, 2, and 5 gallon containers did not allow enough vertical root development. We tried wrapping tar paper around 5 gallon pots to make them taller, but the paper disintegrated before it was ready to be planted. We finally hit on 6" thin-walled PVC sewer pipe cut to 30" lengths. These "pots" are merely PVC extensions of the paper pot but they are functional, strong, and have dramatically increased planting success.

In constructing the tall pots we drill holes at the bottom rim for two crossed wires which hold a circle of hardware cloth — this becomes the bottom of the pot. Two larger holes, drilled at the top rim, allow us to insert hay hooks for transporting the pots. The plants are generally grown in these tall containers for 9-12 months before they are planted on a variety of sites within JTNM. Often the roots are growing through the pot bottom ensuring the same root to shoot ratio at out-planting as in the paper pots.

The Native Plants Nursery is located at JTNM Park Headquarters in Twentynine Palms, CA, with a climate between the cooler, higher Mojave Desert and the lower, hotter Colorado. Rainfall averages between 2" and 4" annually, with 250 frost-free days. We have two small green-houses; a mist house for starting seedlings and cuttings, and a larger structure for hardening plants and winter storage. Both are cooled independently by evaporative coolers. A shared natural gas heater controls the mist house winter environment and warms the larger greenhouse to keep the temperature above freezing during occasional blasts of arctic air. In the months of intense summer heat, tall pots are placed outside under 50% shade cloth and watered by an automated drip system. We program the system to irrigate every other day, delivering 1/3 gallon of water weekly, with occasional deep watering to help leach out salts that might accumulate.

Figure 3 Drip irrigation tubing in newly-transplanted *Ambrosia dumosa*.

Our current potting mix was developed after encountering problems using pure desert soil because high caliche clay content and poor drainage inhibited the plant growth. The sheer weight of the desert soil also made the pots nearly impossible to maneuver around the nursery. A new mix was created to solve these problems combining two parts washed sand, two parts perlite, one part humus and Osmocote fertilizer (the longest lasting formulation). This soil-less mix allows for better drainage favored by desert plants.

The plants are grown in the nursery for approximately one year before field planting in late winter or early spring. Out-planting is labor intensive, because we use a two-person auger to drill a hole large enough to contain the root system. A four to six member crew plants, irrigates and cages (to prevent herbivory) each plant.

Although the transplants face severe heat and drought, we have a success rate of roughly 70-80%. We feel their success in this harsh environment is due to using more mature plant material (at least 1 year old). Hardened plants with well-developed root systems and tops can better withstand the rigors of planting and growth in an arid environment than younger, more tender material. We have examined specimens three years after planting and found the roots had lost the cylindrical pot shape and had invaded the surrounding soil. A few of our 3-year old plants had the appearance of 80-year old shrubs. We have attained visual restoration on some sites planted in 1988 and we expect full visual restoration on all sites within 7-10 years.

JTNM was designated an International Biosphere Reserve under UNESCO's Man and the Biosphere Program. Under this program Joshua Tree established the Center for Arid Lands Restoration, a clearinghouse for ideas and information on desert ecosystems and rehabilitation. The Center also delivers presentations and hosts tours through the nursery facility and revegetation sites. In the summer of 1992 the Center hosted a researcher from the Kuwait Institute for Scientific Research, studying restoration techniques for damage sustained there in the war. We are currently cooperating in a mining revegetation study for southwestern deserts with the U.S. Bureau of Mines.

In the past, forests, prairies and wetlands were the primary focus of restoration attention. Deserts and their unique ecosystems have only recently attained important status in restoration ecology. Work done at JTNM's Native Plants Nursery has inspired others to undertake desert revegetation projects that would otherwise have been deemed impossible. The nursery has shared in research that culminated in the introduction of several desert plant species and their propagation requirements to the wholesale horticultural market. The Center for Arid Lands Restoration, JTNM's Native Plants Nursery and revegetation programs will continue to provide important information and practical horticultural techniques for restoring fragile desert ecosystems. The thesaurus definition of "desert" is not quite correct -people are discovering the desert is the next, great frontier. It is a rich wonderland of plant and animal life, that happens to be arid as well.

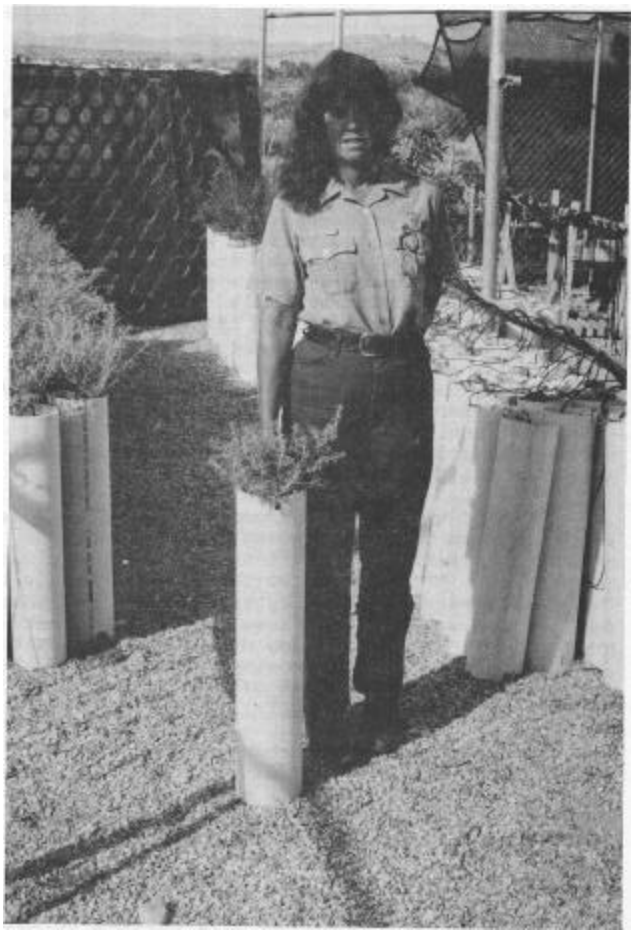

Figure 4 Left, five month-old *Ambrosia dumosa* in Joshua Tree's "tall pot". Right, Bio-Tech.