Plant Propagation in an Animal World©

Christy Powell
San Diego Zoo, P.O. Box 120551, San Diego, California 92112-0551
Email: cpowell@sandiegozoo.org

INTRODUCTION

The 100-acre San Diego Zoo is dedicated to the conservation of endangered species and their habitats. The Zoo also manages the 1,800-acre San Diego Zoo's Wild Animal Park, which includes a 900-acre native species reserve and the San Diego Zoo's Institute for Conservation Research. The San Diego Zoo's Botanical Collections are accredited by the American Association of Museums and hosts a wide range of plant species from around the world due to its favorable climate and location. The Botanical Collection consists of the following: 46 taxa of *Erythrina*, 796 taxa of orchids, 106 taxa of cycads, 32 taxa of gingers, 135 taxa of aloes, 254 taxa of palms, 38 taxa of *Acacia*, 71 taxa of *Ficus*, and 74 taxa of bamboo. The San Diego Zoo's collections include 47 taxa of imperiled species representing 2,761 individuals. Regional and specialty gardens are also found on Zoo grounds such as the Mediterranean Garden, Hawaiian Garden, South American Garden, Madagascar Garden, Bog Garden, Butterfly and Herb Garden, and Vegetable Garden.

Zoo horticulture is a unique facet of the horticulture industry. There are two departments within San Diego Zoo horticulture, Horticulture and Browse, with a total of 41 staff. Their duties range from transplanting plants to managing the compost facility to harvesting food (browse) for the animals. Several hundreds of plants are grown in the Zoo's greenhouse, nursery and micropropagation lab each year from seed, cuttings, and through micropropagation to support the Zoo's Botanical Collection and Browse program. This document will outline the details for the propagation of these plants.

PROPAGATION DETAILS

Propagation by Seed — Botanical Collections. Seeds of rare and unusual species are collected on Zoo grounds, collected in the wild, received from other botanical institutions, or received as border confiscations from the U.S. Fish and Wildlife. Most cycad seeds are received as border confiscations and are germinated in a plastic bag in moist media and then transplanted to the greenhouse. Several Madagascar native seeds have been sown in the greenhouse to plant out in the Zoo's Madagascar garden. *Pachypodium lamerei*, Madagascar palm, was not given any pre-treatment, sown in the greenhouse with bottom heat and mist, and germinated between 3–7 days. *Vangueria madagascariensis* (syn. *V. edulis*), Spanish tamarind, was sown shortly after they were harvested and germinated in 21 days with 77% germination. *Euphorbia maritae*, listed as Vulnerable on the IUCN red list, was sown from fresh seed with no pre-treatment. The pots were placed in the greenhouse without bottom heat and germinated within 26 days. Some other plants that were grown from seed in the nursery include the following: *Moringa oleifera*, horseradish tree one of the world's most nutritious trees from India; *Terminalia kaernbachii*, okari nut native to New Guinea; and *Morinda citrifolia* f. *potteri*, noni, a plant grown for its medicinal properties native to SE Asia. Hawaii is

a very biodiverse area and is home to hundreds of unique plants found no where else on the globe. Some of the Hawaiian native seeds that were sown at the Zoo include *Brighamia insignis* (cabbage on a stick), *Pritchardia kaalae*, and *Erythrina sandwicensis*. *Brighamia insignis* is currently "Critically Endangered" in its native habitat and is close to being extinct in the wild as this species has only one single wild plant on the cliff side of the island of Kauai. The flowers in the San Diego Zoo's collection were hand-pollinated and seeds were set. The tiny seeds germinated within 15 days and had 67% germination. There are as many as 25 endemic species of *Pritchardia* on the Hawaiian islands. Fresh *Pritchardia* palm seeds were soaked for 1 to 4 days in water and then cleaned. Sometimes, the fruit was hit with a hammer so the seed slipped out of the fruit. The seeds were sown in coconut coir and small perlite (1 : 1, v/v) medium and placed in the greenhouse with bottom heat. *Pritchardia kaalae* took close to 2 months before the seeds began to germinate. *Erythrina sandwichensis* seeds were nicked with a dog nail clippers (a method learned from Alvin Yoshinaga, curator of the seed bank at Lyon Arboretum in Hawaii) and sown in coconut coir and small perlite (1 : 1, v/v) medium and placed in the greenhouse without bottom heat. The seeds germinated within 7–16 days.

Propagation by Seed — Browse. The San Diego Zoo also grows and harvests plants for its browse program, to provide primary and supplemental food for our animals. Each year truckloads of plant material are harvested including 28 tons of bamboo culms for giant pandas and red pandas, 104 tons of 12 *Ficus* species for Zoo and Wild Animal Park elephants, tapirs, okapis, gorillas, bonobos, and forest buffalo, 26 additional tons of fresh ficus foliage cut and shipped for Sumatran rhinos at the Cincinnati Zoo and White Oak Conservation Center, 20 tons of *Acacia* species for giraffes, elands, takins, and other hookstock and primates, and 200,750 4-ft pieces of 34 *Eucalyptus* species for koalas, with additional pieces cut and shipped for koalas at other U.S.A. zoos. Acacia seeds are placed in hot (not boiling) water and allowed to cool overnight. The next day, they are placed in an electric seed scarifier, a rock tumbler-like machine coated with sandpaper on the inside. They are then sown in trays containing 200 cone-tainers. Eucalyptus seeds are ordered from several different companies as the 30-plus species they prefer are sometimes hard to find in the nursery trade. The seeds are sown in the same manner as the *Acacia* except that the seeds are not scarified and a thin layer of sand is used to cover the seeds. The seeds are misted once a day with overhead irrigation and germinate after 6–8 days. School groups and summer camp classes help sow the browse seeds and transplant them to treepots which are later planted in the ground. With some of the Zoo's conservation projects, seeds are brought back of species that the animals were observed eating or native species to the area. In 2004, 2005, and 2007 seeds were brought to the San Diego Zoo that were collected from the Turks and Caicos Islands, located southeast of the Bahamas. Some seeds were collected from scat from the native Turks and Caicos iguana (*Cyclura carinata* subsp. *carinata)* others like the Islands' national flower, *Limonium bahamense*, island heather, were collected as part of the botanical collection.

Propagation by Cuttings — Botanical Collections and Browse. Some species in our botanical collections do not produce viable seed or the plant does not set seed very often as is the case with our *Ficus* and bamboo collection. Other species like *Erythrina* and *Aloe* collections hybridize readily in cultivation. In both cases,

cuttings or divisions are taken from these species to ensure true species representation. Ficus cutting material range from small, 3-in. long shoot tips with 1/4 to 3/4 in. diameter cuttings 8 in. in length. Two different rooting hormones were used, 1500 ppm IBA and 1:10 rate of Dip'N Grow® at a 5-sec dip. Both treatments were successful overall, however, some species tended to prefer one hormone over the other. For example, *Ficus coerulescens* had more vigorous growth in the 1500 ppm IBA treatment, but *F. casapiensis* rooted better with the Dip'N Grow® treatment. *Ficus americana* cuttings were not treated with a rooting hormone and rooted fine without any treatment. Bamboo culm cuttings were taken middle to late summer with one node and cut just below the next node. The branches were cut off at the node and the cutting was placed in the medium in a 1-gal pot with bottom heat in a greenhouse. The culms started pushing new growth from the nodal region and rooted after ~3 months. The success rate varied (10% to 80% rooting) depending on the species and time of the year the cutting was taken. Seedling bamboo of *Dendrocalamus sikkimensis* have also been divided when they were very young and in 6-in. pots. When a new culm started to push up and was about 3–6 in. above the ground, the plant was taken out of the pot and cut, removing the new culm and a few side shoots around it. *Erythrina* species are typically rooted from cuttings 1/2–1 in. in diameter using either 1 : 5 Dip'N Grow or 1500 ppm IBA. Some species rooted better after being left to callus overnight before being stuck in the medium. Cuttings were placed in a coconut coir and small perlite (1 : 1, v/v) medium and placed in a mist chamber with bottom heat. Cuttings rooted after 2 months. *Aloe* species are either divided or cuttings are rooted. *Aloe barberae* (formally known as *Aloe bainesii*) is a tree aloe native to South Africa. Cuttings were 1 1/2 to 2 in. in diameter and were taken and allowed to callus over for 2–7 days. The cuttings were then placed in pumice in the greenhouse or outside under shade in the summer and rooted in 3 to 4 months. Clumping aloes in the collection were divided by removing offsets and placing them in a pot until they were established as a new plant. Other species propagated from cuttings including many succulents and *Hibiscus*, *Acalypha*, *Pisonia*, and *Tibouchinia* species.

Propagation by Micropropagation. The micropropagation lab began in 2005 after the San Diego Zoo received a $5,000 grant from the Association of Zoological Horticulture (AZH). The funds were used to purchase a laminar flow hood and other equipment and supplies. Micropropagation at the San Diego Zoo began with orchids and has grown to encompass other species. Currently, research and micropropagation are being conducted on orchids, bamboo, coral bells, and other plant species. A six-step sterilization procedure is used for disinfecting *Erythrina* shoot tips; running water for 2 min, deionized water and a drop of Tween for 2 min, 20 $g \cdot L^{-1}$ NaDCC for 30 min, 5% sucrose for 20 min, 40 $g \cdot L^{-1}$ NaDCC for 5 min, followed by three sterile distilled water rinses. Imperiled orchid species in the collection are hand-pollinated, harvested as green seed pods or dry pods, sterilized, and propagated in vitro. Protocorms (orchid seedlings) were also received from other micropropagation labs such as the Orchid Seedbank Project in Arizona.