

# Effects of the 1978 Freeze on Native Plants of Sonora, Mexico

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An observation trip to western Sonora was made February 22 to 25 to record evidence of the depth of the December 6 to 10 freeze of 1978 and the effects of this freeze on native desert plants. Observations were recorded at sites where previous collections had been made in research on desert plants of possible landscape use. Numerous visits had been made in the past to these areas in connection with the Hatch Project "Introduction, Breeding and Selection of Arid Land Plant Material for use in Desert Regions."

Cold tolerance in a desert species becomes a major criterion for rating potential value of the plant for general landscape use. Making observations in the natural environment of the plant, concerning damage (or the lack of it) after a major freeze, thus becomes very important.

## Indicator Plants

No temperature records are available for sites where collections have been made, since the sites are remote from established communities. Even in the occasional situation where a community does adjoin a collection site, data would not be particularly conclusive because of the diversified topography. To compensate for this lack of temperature data, a system of observing the condition of certain indicator plants (whose cold sensitivity is known) is used as a gauge for purposes of comparison. This procedure has been used successfully in previous freeze years to assess cold damage and to establish the extent of southward penetration into Mexico of these various major cold waves.

Typical native indicator plants are Brittlebush (*Encelia farinosa*) and Desert Lace-tree (*Lysiloma thornberi*) which sustain damage at about 25 degrees (F.) and Organ-pipe Cactus (*Lemaireocereus thurberi*) or Ironwood (*Olneya tesota*) which show foliage or new-growth damage at about 20 degrees (F.). Cultivated plants in town or village gardens are also useful indicators. Banana or Papaya foliage will frost back at 30-32 degrees (F.) while *Bougainvillea* and *Hibiscus 'rosa-sinensis'* will turn black at about 28 degrees (F.). Other useful indicators for temperatures in the 20 degree area are the Murray Red Gum (*Eucalyptus camaldulensis*), Tuna Cactus (*Opuntia ficus-indica*) and Mexican Fan Palm (*Washington robusta*). Although these plants mentioned are generally faithful indicators of the temperatures mentioned, other variables such as duration of freeze and time-of-year have an obvious bearing on degree of damage in some instances.

### Damage at Upper Elevations

Perhaps the most startling observation on this trip was the severity of frost damage in the upper elevations (three to four thousand feet) on either side of the international border. Such common native evergreen plants as Desert Broom (*Baccharis sarothroides*), Emory Oak (*Quercus emoryi*) and Mexican Blue Oak (*Quercus oblongifolia*) were often completely brown as a result of the freeze. This damage extended 18 miles south of the international boundary. These species were previously thought to be completely hardy and it will be almost summer before it will be possible to determine whether the damage is superficial to the foliage or whether it involves woody growth as well. (Tom Van Devender reports that as of mid May, there was only partial releafing, most not at all.)

A species which our research had shown to be a particularly valuable landscape prospect, Leather-leaf Sumac (*Rhus choriophylla*), was also brown in this same region, while the attractive Willow Groundsel (*Senecio salignus*) had lush green foliage, was budding out and was about to burst into showy yellow bloom. Common cultivated plants such as Casuarina (*Casuarina stricta*), Murray Red Gum (*Eucalyptus camaldulensis*), Olive (*Olea europaea*), Ornamental Date Palm (*Phoenix canariensis*), Date Palm (*Phoenix dactylifera*) and Aleppo Pine (*Pinus halepensis*) were heavily damaged while the Tuna Cactus (*Optunia ficus-indica*) was killed to the ground in many places.

### Damage at Lower Elevations

Actually the area of major interest was in much lower elevations but the condition of the Oaks and Desert Broom dramatized the severity of the freeze. Along the highway 25 miles below the border is a locale known to many Sonoran plantmen as "Dodona Hill." This is an important point at which to begin observations of cold-damage because of the borderline hardiness of Desert Hopbush (*Dodonea viscosa*.) This is one of the thickest and largest stands of *Dodonea* anywhere. It occupies a north-east-facing slope with excellent air drainage. The site could definitely be classed as a warm microclimate as there is no possibility of cold air pooling, yet the temperatures must have dropped into the low 20 degree (F.) region. Nearby cultivated Athel (*Tamarix aphylla*) trees were also severely damaged, indicating that possibly even lower than 20 degrees (F.) had been reached.

The first stand of Organ-pipe Cactus to occur along the highway was 44 miles below the border.

This colony showed damage to the ends of all branches. This damage appeared very similar to that on specimens growing in Tucson gardens. This again indicated that temperatures had dropped to 20 degrees (F.) at this site.

Frost-damaged cultivated plants were observed in the village 49 miles south of Nogales at the San Ignacio turnoff. Here, foliage and damage to new growth of *Eucalyptus camaldulensis* and *Optunia ficus-indica* was much less severe and in some cases only superficial.

The most serious general frost injury to cultivated plants was observed in the city of Magdalena, 55 miles south of the border. At this point many subtropical ornamental plants are first commonly seen and there are many species which are rarely seen in cultivation even in the warmer localities of southern Arizona. In Magdalena, light damage was observed to *Eucalyptus camaldulensis* and to young *Washington robusta* palms. More tender ornamentals like *Bougainvillea* and *Hibiscus 'rosasinensis'* were in some cases actually killed to the ground. Semi-tropical tree species such as Brazilian Pepper (*Schinus terebinthifolius*) and *Jacaranda* were also severely damaged. This was certainly surprising for this unusually warm citrus-producing area.

### Magdalena Palm Canyon

The evidence that low 20 degree (F.) temperatures had penetrated all the way to Magdalena was especially significant because of Magdalena's proximity to a most interesting plant-collecting site, Magdalena Palm Canyon. This unique plant community is situated 21 miles east of the city on the road to Cucurpe. Travelling east toward this site, more frost-damaged *Eucalyptus camaldulensis* and other tender cultivated plants were observed in dooryard gardens.

The canyon itself is a unique micro-environment created by its steep southwestern orientation and the giant boulder-strewn formations that abound there. It is not a typical water-eroded canyon and indeed does not have much of a watershed. The formation consists of a jumble of house-sized rocks surrounded by cliff-faces that concentrate runoff into many crevices and pockets. This concentration of extra moisture, together with thermal radiation from the rocks, produces a microclimate that supports an extremely diversified plant community. The most intriguing is the grove of *Brahea prominans* palms, a species generally found much further south in Mexico. This is a beautiful diminutive fan palm with slender trunk and delicate slightly blue-green fol-

iage. The diverse plant palette not only supports species associated with lower and warmer regions, but harbors plants from cooler and wetter climates as well, such as the evergreen cherry species (*Prunus serotina*) and a blackberry-like vine, a species of *Rubus*. Numerous other plants that look promising for landscape use are found growing here and for this reason the canyon was an especially important site at which to observe the 1978 frost damage. The area was first visited three years ago for initial collections, so no observations exist for previous freezes.

Indicator plants, *Encelia farinosa* and *Lysiloma thornberi*, are abundant here and were observed to have sustained severe foliage and twig damage in the 1978 freeze. This indicated that the much-heralded thermal-belt microclimate of Magdalena Palm Canyon had been no more dependable in a major freeze than similar thermal belts in the foothills around Tucson. Temperatures must have dropped close to 20 degrees (F.) in this area also.

Species noted in Magdalena Palm Canyon showing foliage and wood damage included the Copal (*Bursera fragilis*), Coral-bean (*Erythrina flabelliformis*), Limber bush (*Jatropha cardiophylla*), Organ-pipe Cactus (*Lemaireocereus thurberi*), as well as the previously noted *Lysiloma thornberi*. Most interesting was the observation that the Palms, *Brahea prominans*, had sustained very slight frost injury (this limited to new fronds) and that half the stand showed no damage whatsoever. In contrast, established clumps of Leatherleaf Sumac growing among the palms had their new growth blasted in many cases.

The fact that ample autumn rains, interspersed with warm temperatures, kept certain hardy plants in an off-season flush of growth, might partially explain the *Rhus choriophylla* foliage damage. This possibility was further reinforced by the fact that a large number of Ocotillo (*Fouquieria splendens*) plants retained dry, apparently frost-killed leaves. Since the latter plant bears leaves only during and immediately following moist periods, the retention of dead leaves suggested that this species too had been caught by the freeze in a flush of growth.

The road to Cucurpe has some other interesting species in addition to those found in the Palm Canyon. Some are unique to the region, such as the white-flowered *Hesperaloe nocturna*. Other species, Sonoran Palo Verde (*Cercidium sonorae*) and Ball Moss (*Tillandsia recurvata*) reach one of the most northern points of their range in this region. None of these species showed any frost damage.

### Geographic Extent of Freeze-damage

The evidence of the impact of the 1978 freeze seemed to evaporate rather suddenly in the next 20 miles south of Magdalena. This was most interesting since in the severe freeze of the early 1970's a similar check was made and frosted native plants were observed all the way to Guaymas. The most severe damage to low-elevation desert plants then was in the valleys north and south of Hermosillo. Observations made after that freeze showed the following plants suffering foliage and twig damage: *Bursera* species, *Forchammeria watsoni*, *Ipomaea arbore-scens*, *Jacaranda pungens* and *Lysiloma watsoni*. Even close to the gulf in the San Carlos Bay-Guaymas region, *Ficus palmeri* was injured. During the present trip, the same route was covered through the Hermosillo to Guaymas area, but no evidence of frost damage was observed this time. Tom Van Devender did see damaged *Encelia farinosa* just 35 miles north of Hermosillo in December 1978, but ample moisture and mild temperatures had erased this evidence by February.

A side trip was made 64 miles east of Hermosillo up the Rio Sonora to a site that had not been visited after any of the other major freezes. This area had been chosen as a collection site in more recent times because it represented perhaps the northernmost stand of a tropical deciduous-forest plant community containing *Acacia cymbaspina*, *Ceiba acuminata*, *Erythrina flabelliformis* and *Ipomaea arbore-scens*. Also found there were such evergreen trees as *Ficus palmeri* and *Piscidia mollis*. These plant communities showed no evidence of frost damage from the December freeze of 1978, though the *Ficus palmeri* plants had fairly large dead branch stubs that could have been killed in a freeze some years before.

Garden plants such as Bougainvillea and Hibiscus sustained some frost injury in the town of Ures, 45 miles east of Hermosillo and short of this collection site. Ures, however, is situated in a low valley location where cold air would settle, while the semitropical forest was on a steep mountain slope with good air drainage.

Dr. Lemoyne Hogan recently contributed the interesting note that part of a new Jojoba (*Simmondsia chinensis*) plantation between Hermosillo and Kino Bay was lost to the freeze and will have to be replanted. This is a further evidence of spot damage in the latitude of Hermosillo, and is surprising as Jojoba is considered to be hardy into the low 20°F zone.

### Conclusions

One conclusion was that this freeze, while very severe in southern Arizona and south to Magdalena, Sonora, did not penetrate nearly as far south as the other major freeze in the early 1970's. Rain and the warm weather preceding the 1978 freeze may have been partially responsible for the unusually severe damage in certain regions, as it apparently kept many normally hardy plants in a state of growth. This tender new growth rendered the plants unusually sensitive to the cold.

*Brahea roezlii* showed unexpected cold-tolerance even though it may have been exposed to low 20 degree (F.) temperatures. A reverse surprise was damage to evergreens in the higher elevations where

Desert Broom, Evergreen Oaks and Leatherleaf Sumac were damaged. Coming through with flying colors was the *Senecio salignus* whose blooming-period was not even delayed by the severe cold. The hardiness of this plant together with the excellent appearance of its foliage and bright early bloom make it rate comparatively high for landscape purposes.

Circumstances of every freeze year are different. Recording cold-tolerance and performance of the plants under study, after each major weather event, adds to the known data for use in evaluating these as potential landscape plants. Freeze years, unpleasant as they are, represent one of the most important tests of the plants being studied.