MISSION MANZANITA, QUEEN OF THE ELFIN FOREST: IS THE SPECIES IN DECLINE?

by Lee Gordon, Richard W. Halsey, Jon E. Keeley, Jon P. Rebman, Delbert Wiens, and Arne Johanson

Mission manzanitas (*Xylococcus bicolor*) have worried some botanists for years because there has been no reliable evidence that the species has been successfully reproducing. The species is common now, but are populations dwindling? This was on our minds in late January 2015 as we walked a trail to visit one of the largest and most beautiful mission manzanita specimens in San Diego County.

This tree stands 20 feet tall above Peñasquitos Canyon at the entrance to a mission manzanita elfin forest. This miniature forest extends hundreds of feet upslope to the east and west. The climb to get there is difficult, but the effort is well worth it.

Stands of mixed chaparral usually form impenetrable tangles of branches and leaves, but old-growth stands of mission manzanita monocultures are different. They hold their foliage high above the ground. Under the canopy, the forest opens up with vistas of smooth, slender, reddish-brown stems. You are inside an enclosed room, shut off from the world. This is a place to linger, to ponder, and to reflect. The plants' stems are the columns of an ancient cathedral which support the green leaves that form the roof above. A redwood forest creates this on a grand scale, while a mission manzanita forest does so in miniature.

Mission manzanitas, a prominent species in San Diego chaparral, deserve to be considered the queen of the elfin forest because of their exceptional beauty. Inside a mission manzanita forest you experience the halls of the elfin queen.

FACING PAGE: **A tall mission manzanita stands at the entry to a forest of mission manzanita in Los Peñasquitos Canyon, San Diego. Photograph by Steve Miller.**

Beneath the foliage, mission manzanita forests create a calm space for contemplative seclusion. All photographs by Lee Gordon unless otherwise noted.

MISSION MANZANITA SPECIES AND HABITAT

Mission manzanitas are one of many members of the Heath family (Ericaceae) found in San Diego County. They were at first classified as true manzanitas (*Arctostaphylos*), but now they have their own genus, *Xylococcus*. Mission manzanitas have smooth trunks like most true manzanitas, but their thin bark has a browner tint. The leaves have a shiny, deep-green top and a whitish matte underside, hence the species' name, *bicolor*. Another member of Ericaceae in San Diego County, summer holly (*Comarostaphylis diversifolia*), looks similar but has a rough trunk, serrated leaves, and red berries. The

HOW TO GROW MISSION MANZANITAS FROM SEED

Mission manzanitas have been notoriously difficult to propagate from seed. Nearly all nursery plants are grown from cuttings, but plants grown from seeds better preserve genetic diversity. However, it turns out to be easy to get mission manzanitas to germinate. All they need is moisture and a period of cooler temperatures. The following is a short summary, and you can find more in Gordon (2015).

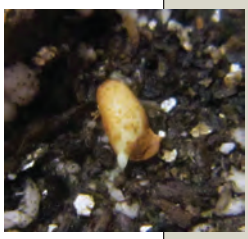
The first step is to remove the thin, fibrous, gooey outer layer of the fruit from the stone inside. If you put the fruits into water in a blender, it will take several minutes at high speed to clean the stones of this outer material. High speed blending leaves stones less than a year old intact. Sharp wire cutters can then be used to break the stones apart to release seeds. Because stones are brittle, around half the seeds can be released undamaged and fertile.

Seeds that are damaged in this process are susceptible to fungus and other pathogens, which can travel through a batch and kill them all. You can reduce this by soaking them for a day in a solution of 0.3% hydrogen peroxide and copper soap. The water soak also accelerates germination. Seeds germinate best when stratified at 55°F. They will not germinate at room temperature. You can stratify the seeds in small refrigerators by packing the lower half of small plastic food storage containers with fine, moist potting soil and laying the seeds on top of the soil. About half typically germinate in less than two weeks.

When radicles appear, move the seeds directly to pots containing a commercial potting soil mixed with additional perlite to improve drainage. At this point they are delicate and they need shade and periodic mist. In a few weeks cotyledons rise and expand inside fibrous sheaths. When the sheaths fall off, you can remove them from the mist, but they still need some time in the shade as their roots develop.

This method is slow and laborious, and not well suited for nurseries. We need to find a less labor intensive procedure that triggers uniform germination. The stone creates a nearly impenetrable barrier for water. A valuable improvement will come if we can find a physical or chemical procedure that enables water to penetrate.

—Lee Gordon



Mission manzanita propagation from stone to seedling. • TOP PHOTO, CLOCKWISE FROM TOP LEFT, stone and seed: A whole stone with the thin layer of fruit removed; stone broken longitudinally to reveal five seeds, two of which remain inside; a seed; a piece of stone showing the seed cavity. The grid is 0.1 inch. • OTHER PHOTOS, TOP TO BOTTOM: After 13 days of stratification, a radicle begins to protrude. • In a few weeks, the cotyledons begin to eject a fibrous sheath. • Real leaves grow above the cotyledons after about 6 weeks. • This seedling germinated in May 2014 and by February 2015 had become nine inches tall.

rare Baja California birdbush (*Ornithostaphylos oppositifolia*) is a third interesting member of the Ericaceae in the county. The species is restricted to one mesa and slope area just north of the California-0Baja border, although it is more common further south. It differs from the mission manzanita in that it has a whitish bark and smaller white flowers.

Like other Ericaceae, mission manzanitas produce white to pinkish urn-shaped flowers that make quite a show when they are in full bloom. Their berry-like fruits are drupes, a fruit with seeds inside a hard stone. Mission manzanita drupes are roughly 1/4" in diameter, red/green in the spring and then brown by the fall. The drupes tend to hang on the plant until the following year. The name *Xylococcus* comes from the Greek words "wood berry" which refers to the hard stones that can hold up to five seeds each.

Mission manzanitas are most common in the western half of San Diego County, with isolated populations in Los Angeles and Riverside Counties and Catalina Island. Their range also extends into northwestern Baja California from Tijuana south to El Rosario and on Cedros Island in the Pacific. They also occur on sky islands farther south on the peninsula. The isolated populations suggest the species was once more widespread. Distribution maps also show them extending into Tulare County, but after a careful investigation, Keeley concluded that this was likely the result of misidentification. Individual shrubs grow best on north slopes, which are cool and moist during the growing season, but they can also be found on hotter, flatter exposures. They grow in both sandy and clay soils as long as there is adequate drainage.

Mission manzanitas grow to 20 feet tall, but most are less than 10 feet. Their wood is tough and hard, decaying slowly, so it is common to find decades-old dead branches on live specimens. Mission manzanitas resprout from an underground lignotuber or burl after the above ground portion of the plants have been burned and killed during high-intensity crown fires that are char-

acteristic of the chaparral ecosystem. The magnificent tree we found in Peñasquitos Canyon was able to attain its size because the area has been free of fire for at least 80 years. It is unusual for chaparral populations to go this long without fire given the increasing frequency of human-caused ignitions.

ARE MISSION MANZANITA POPULATIONS IN DECLINE?

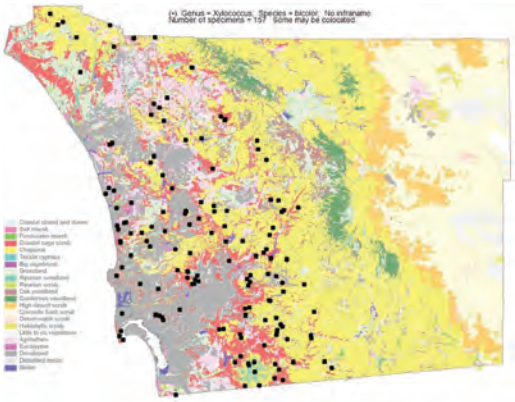
Mission manzanitas have long puzzled scientists, because although they produce abundant fruit, botanists and chaparral ecologists have reported never finding seedlings in the field (e.g., Keeley and Davis 2007). In addition, seeds are difficult to germinate with traditional propagation techniques. Hence, as is the case with the propagation of many native shrubs, nursery plants are nearly all grown from cuttings.

Intrigued by the mystery, in 2004 Halsey began searching for mission manzanita seedlings throughout San Diego County by establishing study quadrats in stands on Cowles and Bernardo Mountains and along Del Dios Highway near Lake Hodges. He also conducted post-fire surveys after the 2007 Witch Creek Fire, but found no seedlings. This confirmed previous observations by others, including Keeley and P. Zedler (personal communication, 2014).

LEFT: **The delicate-looking, bell-shaped flowers of mission manzanita hang in small clusters. Photograph by Steve Miller.** RIGHT: **Red-green berry-like fruit are from January 2015, and brown fruit are a year older. Photograph by Lee Gordon.**

Wiens, et al. (2012) observed that each chaparral fire kills a small proportion of the red shanks (*Adenostoma sparsifolium*) population, but red shanks do not appear to reproduce as a result of fires. Human-caused ignitions have greatly increased the frequency of chaparral fires, and red shank's natural reproduction rates has been insufficient to sustain its population in the face of this increase. The same process could lead to a slow decline in mission manzanitas. Wiens found red shank's low reproduction rates to be associated with a high rate of seed abortion (about 97%) and the inability of the rare seedlings to survive. In 2011, Wiens investigated the viability of mission manzanita seeds from five San Diego County sites. He found that 61% of the stones had at least one seed filled with live endosperm. In contrast to red shanks, mission manzanitas appear to have no problem regarding seed viability.

FIGURE 1. DISTRIBUTION MAP OF MISSION MANZANITAS, SAN DIEGO COUNTY, 2015.



Source: This map is based on specimens collected and deposited in the San Diego Natural History Museum Herbarium as part of the San Diego County Plant Atlas project: sdplantatlas.org.

Another hypothesis suggested that the seeds needed to be scarified by passing through the gut of the now extinct grizzly bear. Or alternatively, the seeds needed to be released from the hard stones by the bears' strong teeth during mastication (Halsey interview by McFee, 2008). Of course considering the antiquity of this plant there are a slew of potential seed dispersers that are now extinct that could have played a similar role.

Field observations offered another possibility—the plants may depend on vegetative reproduction through root sprouts. Halsey found one such sprout on a lateral root approximately six feet from a mother plant in Mission Trails Regional Park, San Diego.

The search for the answer to the mission manzanita mystery accelerated after a fortuitous discovery during the May 2008 Bioblitz in San Diego. The Bioblitz is a 24-hour biological survey by volunteers to count as many species as possible in a particular area. During the event, Rebman found two possible mission manzanita saplings in Florida Canyon, an open space area near the San Diego Natural

History Museum in Balboa Park. He brought Halsey to the site where they found another possible sapling and 53 seedlings growing in the leafy litter under a medium sized mission manzanita shrub. As they continued their search, a few more seedlings were found under other manzanitas, but at lower numbers than under the first plant. A survey the following February found none of the 2008 seedlings, but did find a smaller number of new ones. None of these survived a full year.

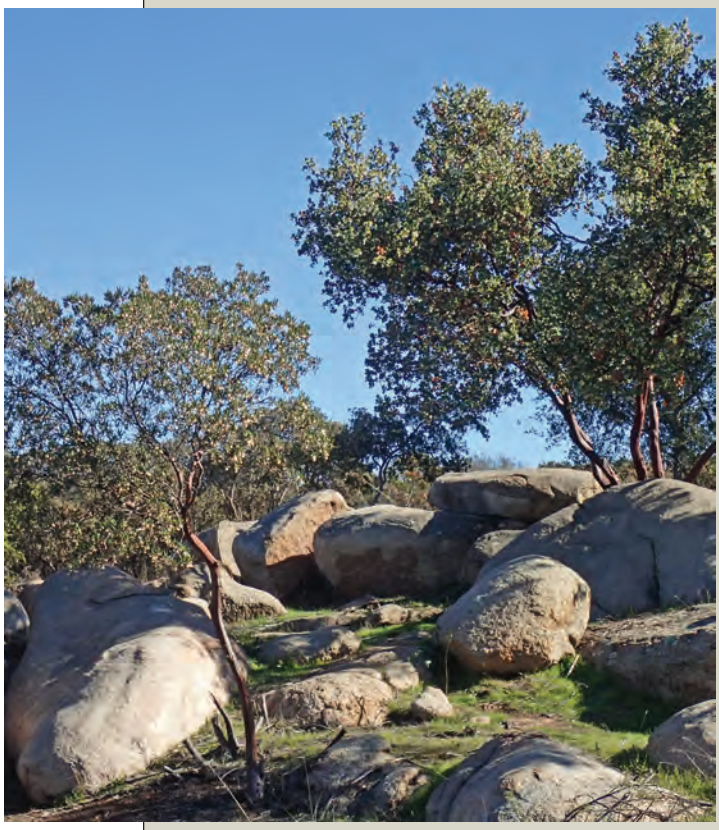
EXCAVATION OF A YOUNG PLANT

Mission manzanitas are common in the Artesia Creek watershed southwest of Lake Hodges in San Diego County, where they grow in consolidated clay sandstone with hot sunny exposures. Many of the plants there are small, less than a foot tall, and have no obvious burl. Gordon, Halsey, and Johanson wondered what the roots of a small mission manzanita would look like. They found a small, desiccated, scruffy

MISSION MANZANITAS IN LANDSCAPES

To learn about mission manzanitas in garden landscapes, we contacted some well-known native plant landscape designers including Clayton Tschudy (horticulturalist at the Water Conservation Garden at Cuyamaca College, El Cajon), Greg Rubin (California's Own Native Landscape, Escondido), Scott Jones (Plants Comprehensive, San Diego), and Wes Hudson (North Park Native Plants, San Diego). Designers have mixed feelings about mission manzanitas in their designs because they grow slowly and are finicky about the soil they grow in. If they are not cared for properly, some may consider them less than attractive. Rubin, Hudson, and Jones use them in their designs, but they are all careful about the sites they select, how they are planted, and how they are watered (see Rubin and Warren 2013).

The glossy green foliage and large berries of mission manzanita are attractive in gardens. Photograph by Ed Rubin.



A mission manzanita at the left and a big berry manzanita (*Arctostaphylos glauca*) at the right have been trimmed by a homeowner who is designing his landscape around selected plants growing in native chaparral.

Mission manzanitas are exceedingly drought tolerant, so they need little dry season irrigation, but infrequent summer irrigation keeps them green and attractive and accelerates their growth. Greg Rubin recommends that you "make them feel like they have been in a thundershower." When you water the plant, also water the area around it, then leave it alone for long intervals. In optimal situations, mission manzanita grows six inches to a foot each year to become an attractive foundation plant. People who are willing to take the long view include them in their gardens and are rewarded for their patience. Mission manzanitas can be one of the most beautiful plants you can grow in a garden.

Some people are fortunate enough to have native mission manzanitas already growing in their yards. Fire regulations require that vegetation be thinned and trimmed near homes, but not that you remove all vegetation. Mission manzanitas are ideal plants for vegetation management zones because they naturally hold their foliage high above the ground. They are beautiful, require little care, and are relatively fire resistant if properly thinned.

—Lee Gordon

plant at the side of a dirt road where it cut into the hill.

The plant could not have been older than the road, but they wondered: did it grow from a seed or did it sprout from the root of a neighboring plant? The road provides access to power transmission towers and is approximately 30 years old (SDG&E technician, personal communication, 2015). They knew the plant would be killed sooner or later by future road grading, so it was removed for further study. A few months later, the road was graded and the spot where the plant once stood was obliterated.

After washing the soil from its roots, the authors were surprised to discover that the plant was much older than it appeared. Under the soil, it had grown a one-inch secondary burl at the base of a larger one that had burned eleven years earlier. Given the relative sizes of the two burls, they speculated the specimen was about the same age as the road. Its roots all radiated downward, not sideways, and it had nothing like the lateral root sprout Halsey had once found. They concluded that it had germinated from seed in the bare dirt of the road bed and had grown to a stately 12 inches. This plant offers the possibility that mission manzanitas are still capable of regenerating from seed and surviving.

The specimen spent the summer in a three-gallon pot, and in the fall of 2014 sprouted leaves both from the branches and the burl. It is now a beauty, covered with deep green leaves and growing vigorously in a habitat restoration area. Its success demonstrates the durability of the species.

HOW OLD CAN MISSION MANZANITAS BE?

The largest mission manzanita we have found thus far is located in central San Diego County. It is growing out of a 63" x 58" burl, as measured by the portion exposed at the surface. We estimate its stems to be around a century old, based on the average 21.4" stem circumference. Our estimate is based on growth ring studies we have performed on other stem samples. The underground burl is likely much older than the stems themselves.

This mission manzanita in San Diego's Mission Trails Park grows out of a five-foot diameter underground burl. Photograph by Richard Halsey.

Burls develop over time in a cycle of growth and fire. The small plant from the Artesia Creek watershed demonstrates that new growth can start at both the top and the bottom of a burl. Most burls that survive fire are charred on the top with new shoots arising at the periphery of the old burl. In time, these new stems enlarge at the base to replace the old burls. The burl expands step-by-step as this process repeats itself.

It is difficult to quantify the age of an old mission manzanita because burls do not have neat tree ring histories as do bristlecone pines or redwoods. In addition, the stems can only be dated to the last fire event. On the other hand, there is no obvious limit to the age of individual mission manzanitas. The burl of the largest specimen we found in San Diego County is clearly ancient. We know of no reason why the species cannot grow for hundreds of years.

SURPRISE IN THE ELFIN FOREST

When we climbed up to the mission manzanita specimen we found in Peñasquitos Canyon in January 2015, there was a surprise awaiting us. There under its canopy grew a dozen tiny seedlings. We clambered further into the forest beyond and found many more. Later, we visited Mission Trails Regional Park, Balboa Park, a hill in Scripps Ranch, and Torrey Pines State Park. We found seedlings in all the sites we searched, though seedlings were present only under some of the shrubs at each site. Most were under parent plants, but a few were as far as 20 feet from the nearest individual.

We found seedlings growing in all kinds of conditions. Some were in shade, while others were in the open. Some grew in bare clay soil, some in bare sandy soil, and others in six-inch deep composting leaf litter. What they had in common, however, was exposure to the recent weather pattern. August and September thunderstorms may have provided the initial stimulus. A wet December kept the soil moist through all of a dry January. De-

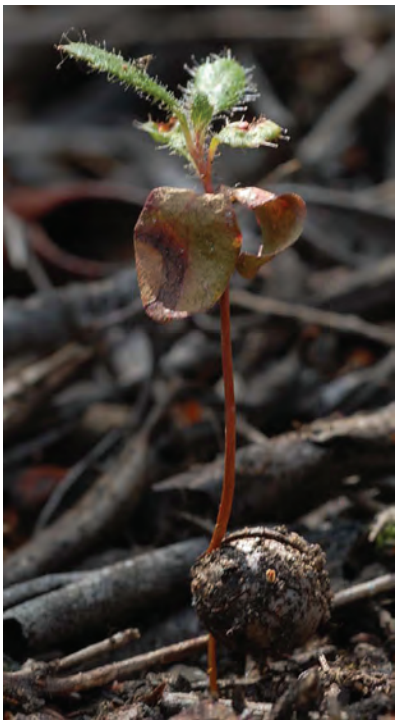
cember frosts may also have been a factor.

There is no doubt now that mission manzanitas can grow from seeds, but there is still much to learn about how they develop into mature plants. With seedlings sprouting in so many different areas this year, it will be interesting to see which, if any, survive. Do these seedlings need summer rain? Most of the seedlings we found were directly under a parent plants' canopy, and we have found no evidence that seedlings under mature shrubs ever live beyond the first year. In the six weeks since we found seedlings, the majority have already disappeared. It remains a mystery what conditions result in significant reproduction of this species, and it is obvious that it persists by its ability to vigorously resprout from substantial basal burls.

TOP: **A small mission manzanita, removed from the ground in March 2014 to study its roots. A one-inch live burl grows next to a larger older burl that was burned in a 2003 fire. • BOTTOM: It was replanted in November 2014 after new sprouts appeared from its branches (top and left) and the burl (bottom). The burned burl is visible at the bottom. The photograph was taken in mid-January 2015.**

Keeley and Halsey returned to the field again in early March 2015 to survey eight different populations of mission manzanitas in San Diego County, for a total of 100 shrubs. They found seedlings too, but they were considerably less widespread than what we saw in January. Five populations had none at all. In general they were only present on moist north-facing slopes or in ravines.

We know now that mission manzanitas can produce seedlings, but we are still searching for evidence that its seedlings survive to become mature plants. Given that mission manzanitas can potentially live for centuries, they may have sustained their populations in the past in spite of a low rate of reproduction. Our concern for the future is whether the increasing frequency of chaparral fires will cause mission manzanitas to slowly decline. In the meantime, we must exercise good stewardship over the open spaces where the species now lives.



Mission manzanita seedlings are usually found under a parent plant. This seedling discovered in San Diego's Balboa Park was among the first to be reported. Photograph by Richard Halsey.

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