

## Climate Ready Reforestation Project

The Torrey pine is a candidate for federal listing and red listed as Critically Endangered by the IUCN - and Torrey Pines State Natural Reserve (the Reserve) boasts the main population of this rare tree. Unfortunately, this population lost 12 percent of trees between 2006 and 2018 and little recruitment has occurred to recover this loss. Adult tree death is largely due to a combination of drought stress and pest infestation by the California 5-spined engraver beetle (*Ips paraconfusus*). Low precipitation and higher than average temperatures create evapotranspiration stress, make the trees more susceptible to beetle infestation. A cause for the lack of recruitment is less clear. Areas of clustered die-off have occurred along popular trails, impacting visitor experience and piquing visitor interest.

With climate change, the San Diego region will remain vulnerable to drought, experience a longer summer period subject to heat waves, and shift the climate warmer and possibly drier overall. It is unclear to what extent a changing climate will impact the persistence of Torrey pines at the Reserve. Currently, staff from California State Parks are working with scientists and staff from the San Diego Zoo Wildlife Alliance, U.S. Forest Service, and other partners to use a pilot restoration program, ecological modelling, and microsite studies to inform future habitat enhancement.

### Torrey Pines Planting

From 2021-2023, over 450 Torrey pine seedlings and 581 native shrubs grown in the nursery at the San Diego Safari Park are being planted in different locations around the Reserve. Not only do we hope that these trees will eventually increase the number of trees in the Reserve - especially in those areas hit by the bark beetle infestation - but, that we can learn something about seedling survival and recruitment from the seedlings planted. Though pines have often been planted to supplement natural recruitment, there wasn't always data taken on where these plantings occurred and what types of habitats they didn't survive in. By monitoring these trees for many years, and taking specific data on their sites, including temperatures and soil, we hope to learn more about the trees.

### What are the blue cones for?

The blue, plastic tube tree protectors are a way to protect newly planted shrubs and trees, such as the Torrey pines and various shrubs planted in the Reserve. Many people immediately think that what the cones protect from are animals, which is true. But they also protect young plants from drying out by trapping moisture and preventing wind desiccation.

With the cones, and with the State Parks staff providing supplemental water, we are providing extra protection to the Torrey pines and other plants during their first year, as they transition from regular care and nursery soil to establishing roots in the wild. Soon, they will be on their own, like other native trees, dealing with bouts of rain and drought, winds, and more.

### **Why are the Torrey pine trees planted so close together?**

The pines are planted more densely than is likely to occur in an adult grove to account for loss of trees before they reach adulthood. But, they are not so dense that a fungal infection or other event could wipe out a whole group if one is infected. There should also be enough space that should neighboring trees survive, they will not interfere with each other's physical growth (though competition for light will definitely increase as they grow).

Like many long-lived species, Torrey pines experience high death rates in their smallest size classes. A research project at the Reserve conducted with the 2006 census of the trees found that only 62% of seedlings found in 2006 survived through 2007. Most of these seedlings were older than one year, meaning this wasn't just loss from massive or rapid germination that often happens in tree species. In planting trees to replace or supplement a Torrey pine stand, we tried to account for losing over half the planted trees in their first five years.

### **Besides Torrey pines, what other species were planted?**

At the west-facing bluff near the lookout on the Guy Fleming trail, and stretching around to the south-facing slope, a variety of plants were added to the landscape. Sea dahlia, jojoba, lanceleaf liveforever, fingertips (San Diego dudleya), lemonade berry, coast lilac, and San Diego mountain mahogany were planted. Plants were spaced together in groups of 3-5 individuals, following natural clustering of plants on the landscape. Plants growing on these exposed slopes stay small due to the constant exposure and seabreeze, and limited soil moisture. Though they appear close together, there should be enough space for the individuals to grow should all the plants in a group survive.

### **Torrey Pine Stand and Beetle Monitoring**

San Diego Zoo Wildlife Alliance is working with State Parks and the U.S. Forest Service to learn more about which trees and areas within the Reserve are more susceptible to Torrey pine loss, identify potentially resilient trees, and learn more about when beetles pose the biggest threat. To do this we are starting monitor the growth and health of some of the trees. Looking back at years of data on captured beetles and pairing that with what we know about the weather conditions, and landscape features. If we increase our understanding of the dynamic of trees and beetles to climate and the landscape, we can adapt management strategies to help mitigate the beetle threat.

### **What are the metal bands on the trees?**

These are dendrometer bands. Dendro = tree or related to trees, and meter = measurement. The dendrometer bands are used to monitor the growth of trees in the Reserve. The band is attached to a spring and overlaps itself; as the tree grows, the spring stretches and the area of band overlap shrinks. In any one year, the growth of a tree may not be perceptible to the human eye, but by measuring every few months

the scientists can detect even very small amounts of growth by measuring the change in overlap.



*A window is cut into the part of the band that is on top in the overlapped section of the band. As the tree grows and the overlap decreases, the gap in the window increases. We can measure this increase to see how much the diameter of the tree has grown.*

### **Why are you studying growth?**

The scientists will match growth data to weather data and other variables to see how trees in different areas around the Reserve respond to their environment and changes in that environment. Ultimately, the scientists want to know which trees are most susceptible to drought stress - and thus most susceptible to beetle infestations.

Knowing what areas of the Reserve are most susceptible guides where Torrey pines should be planted in the future to ensure Torrey pines continue to persist at the Reserve despite the changes in climate and the beetle threat.

### **Why are only some trees banded?**

There are thousands of Torrey pine trees in the Reserve, so we only need to monitor the growth of a subset of the trees. We can apply what we learn from the few trees banded to the other trees at the Reserve. The science team identified 12 areas that represent a variety of conditions found at the Reserve, and selected 20 trees, of a variety of sizes, in each of those areas, to get bands.