

# Oak Woodland Restoration on Lagoon Island

In 2006, nearly 2000 acorns from collected from local Coast Live Oaks were planted along the north facing slopes of Lagoon Island and Campus Point. These acorns were planted within blue plastic cylinders or “tree tubes” that extend approximately 1.5 ft below ground and 1.5 ft above ground. The tubes help protect the seedlings from gophers, ground squirrels, brush rabbits, and other herbivores. In addition the tubes provide shade and collect moisture which is beneficial for the young seedlings. Since germination of the acorns was expected to be fairly low, two acorns were planted within each tube. The height and condition (health) of these oaks has been monitored annually since they were planted. Height is measured in millimeters, while condition is assessed on a scale of 1 to 4 (see table 1).

Condition Value	Definition
1	High: green leaves, new buds
2	Medium: some insect damage, moderate defoliation
3	Poor: dried leaves, leaf loss, drying stem
4	Dead

Table 1: Condition ratings and definitions.

In the summer of 2006, 727 (73%) of the tubes contained oak seedlings . The seedling count dropped to 665 in 2007, but in 2008 a total of 716 seedlings were recorded. The drop in seedlings in 2007 was probably because many of the oaks are difficult to find i.e. some are planted under coyote brush , and Eucalyptus trees have fallen over some tubes hiding them from view, in addition, poison oak has grown over/around some tubes causing them to be inaccessible. The increase in trees from 2007 to 2008 indicates that more trees were found during monitoring in 2008 and/or more seeds germinated during this year. In January of 2009, 113 additional acorns were planted in an area of Lagoon Island where the trees had established particularly well. The increase in number of trees in 2009 shows that many of the newly planted acorns had germinated when monitoring was conducted in July 2009.



Figure 1: Oaks were planted in in blue plastic tubes to protect against herbivores.



Figure 2: Volunteers helping to plant acorns in 2009.

### Number of tubes with trees

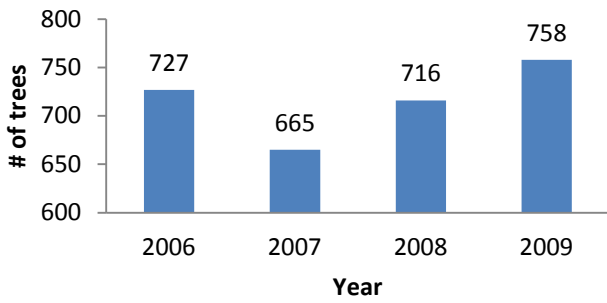


Chart 1: Number of tubes with trees from 2006 to 2009.

### Average Height of Trees

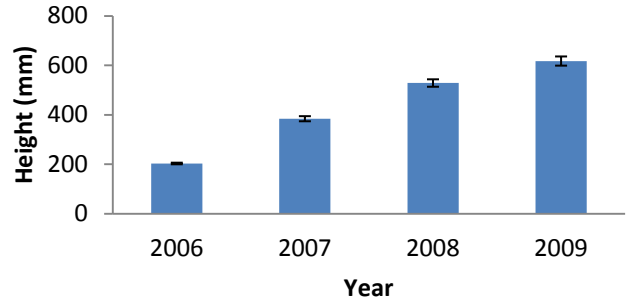


Chart 2: Average height of oaks from 2006 to 2009.

Tree height has increased steadily over the years. Interestingly, in one particular upland area of lagoon island the trees have had much higher growth than average with trees reaching heights of up to 3 meters in 2009. In 2008 we began to notice that some of these particularly tall trees were suddenly dying. The cause of death was discovered by gently pulling upwards on the trunk of the tree and finding that it easily could be removed from the ground because all of its roots had been eaten by a gopher. It seemed that only trees that were taller than average were targeted by gophers. It turns out that the tree tubes, within which the acorns were planted, do a good job at protecting the oak seedling when it is small, but once it gets tall enough (almost 1 meter), its roots begin to grow out of the tube and reach up towards the surface, into the foraging range of gophers. When a gopher finds the root it will follow the root while consuming it up into the tree tube until no roots are left. While gopher damage has only resulted in the deaths of a few trees so far, we expect gophers to have more of an impact in future years as more trees get large enough that their roots extend out of the tube and into the range in which gophers like to forage.

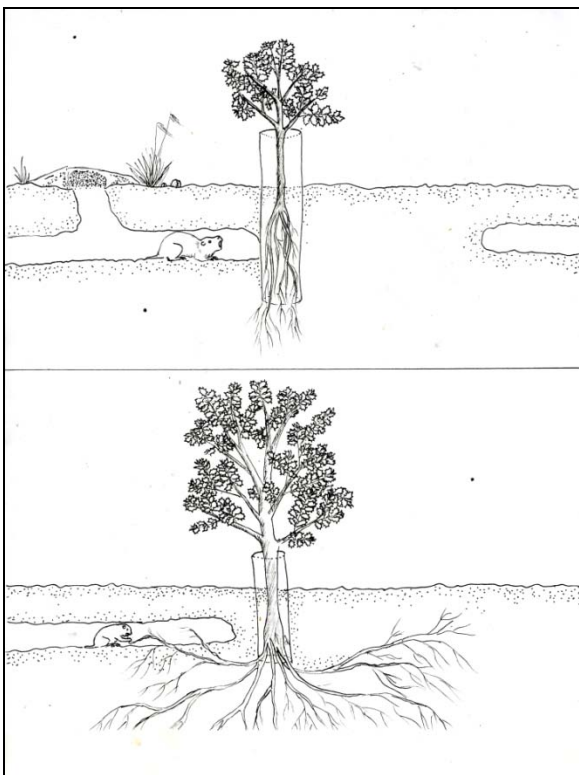


Figure 3: Tree tubes protect young oaks from gopher herbivory, but when the oaks grow larger their roots may grow towards the surface where gophers forage.



Figure 4: Gophers consume the entire root, following it into the tube.

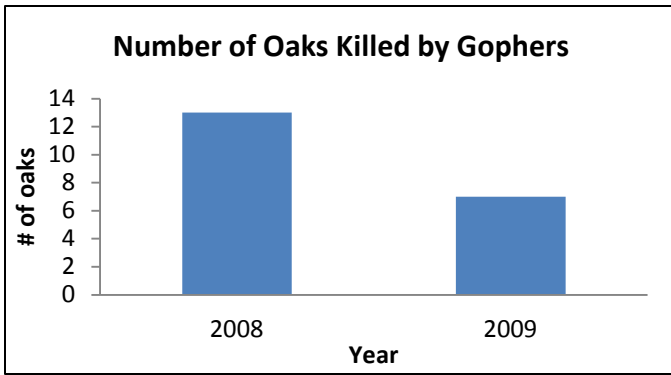


Chart 3: Number of oaks killed by gophers in 2008 and 2009.

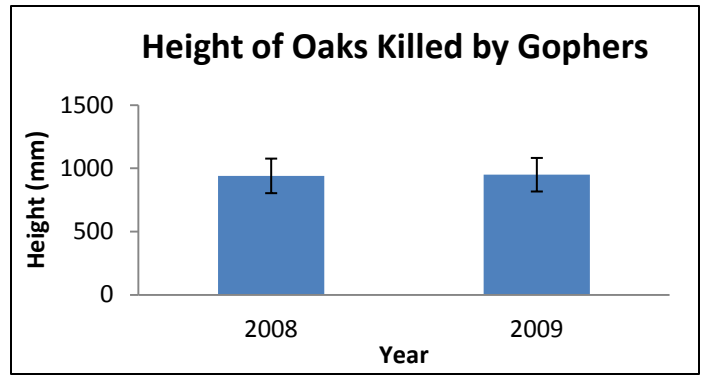


Chart 4: Average height of oaks killed by gophers in 2008 and 2009.

Oak survival has been very high over the past four years, with the majority of the oaks being in good or medium condition. Only 6% of oaks were recorded as dead in 2009 and very few (4% in 2009) oaks recorded in poor condition. Approximately, one fourth of the oaks either never germinated or were not found during monitoring surveys.

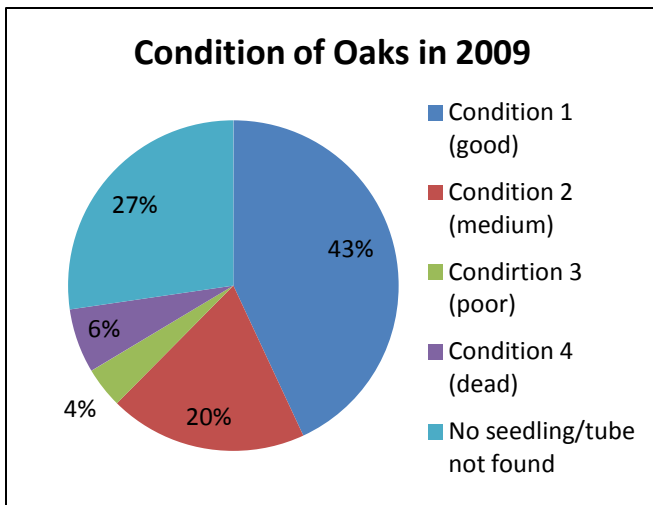


Chart 5: Condition of oaks in 2009.

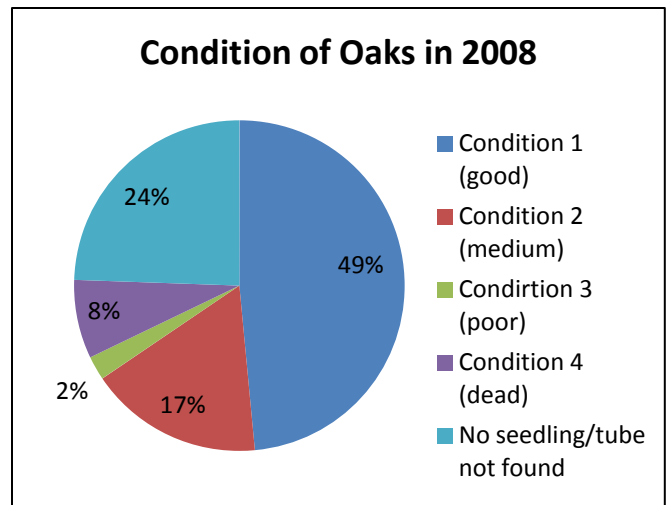


Chart 6: Condition of oaks in 2008.

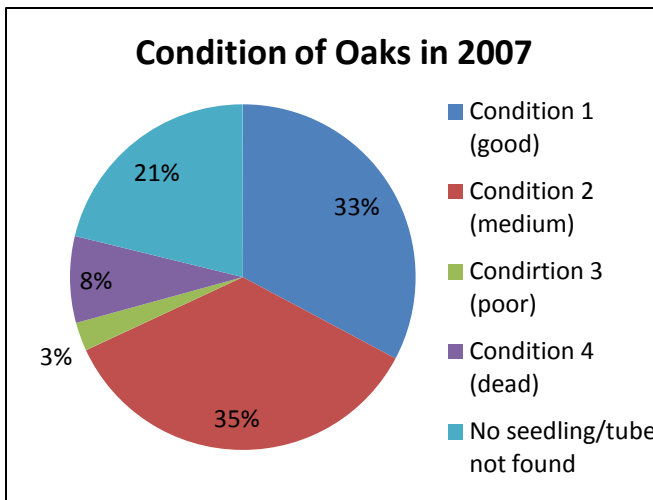


Chart 7: Condition of oaks in 2007.

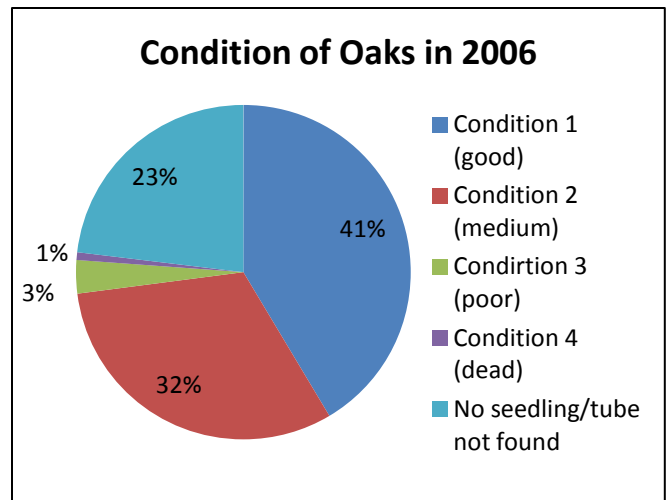


Chart 8: Condition of oaks in 2006.