Irrigation Efficiency of Santa Rosa Island Cloud Forest Restoration Project

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Introduction

Since the introduction of sheep and cattle ranching in the 1800s, Santa Rosa Island (SRI) of the Channel Islands National Park has experienced significant devegetation of slopes and erosion of top soil.

The Cloud Forest Restoration Project aims to control erosion with structures such as wattles, leaf litter fences, and silt dams. Additionally, they use fog capturing fences and a drip irrigation system to supply water to recently transplanted native chaparral.

The project will experimentally monitor the growth and survivorship of these transplants to compare the effectiveness of three treatments at four different sites: (1) wattle, (2) wattle and fog fence, and (3) control (no structures). However, all three treatments have irrigation installed, using pressure compensating emitters. At each site, each treatment has 3 irrigation lines with emitters, for a total of 9 irrigation lines per site.

Although the emitters being used have an expected flow rate of 1.9 L/hr, the four sites vary in elevation, slope, and diameter and length of irrigation lines. These potential sources of variation led us to ask:

Do emitter flow rates vary among different sites? Additionally, do rates vary depending on how many irrigation lines are turned on at a site?

Methods

1. Place jar under emitter, start timer
2. Allow water to flow for ~1 min
3. Remove jar, stop timer
4. Measure amount (mL) of water using a graduated cylinder
5. Calculate rate by dividing amount by time
6. Repeat procedure with 1/3, 2/3, and all of the irrigation system turned on

Materials:
Glass jars
Graduated cylinder
Timer
Calculator
Data sheets

Figure 5

Figure 1

Figure 3

Figure 4

Figure 2

Results

Figure 6: Average flow rates when 3, 6, and all 9 irrigation rows are turned on

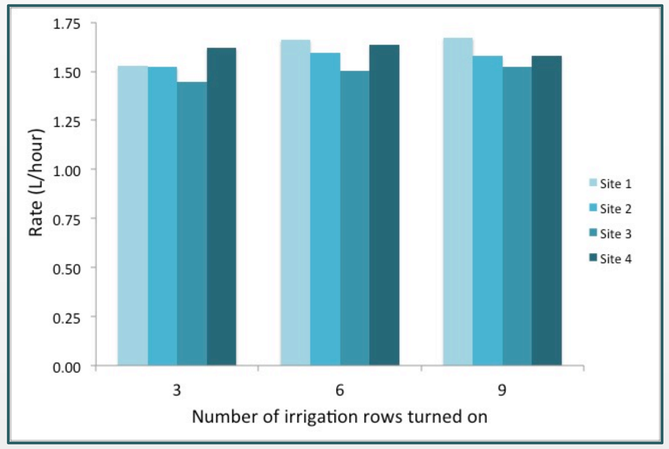

Figure 7: Comparison of average flow rates between all four sites

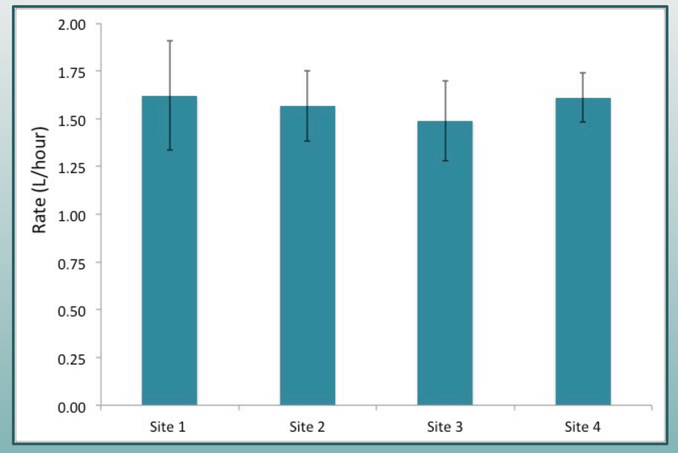

Figure 1: A map of the entire irrigation system on Soledad Ridge. Blue lines indicate the ¾" or 1 ½" polyethylene tubing, which covered 4150 feet along the slope.

Figure 2: Two 550 gallon water tanks that are the main sources for the irrigation system. On the map, they are indicated by a navy blue dot.

Figure 3: An example of how water was collected from an emitter to measure the flow rate.

Figure 4: Fog fences in action! When fog drifts over these fences, it condenses and drips into the soil below. Downslope of the fences is a coconut fiber roll called a 'wattle'.

Figure 5: Panoramic view from our research site on Soledad Ridge, overlooking the south side of SRI.

Conclusions

The average flow rates across all sites were relatively consistent at 1.53 L/hr, 1.60 L/hr and 1.59 L/hr for 1/3, 2/3 and the whole system turned on, respectively (Figure 6). Average flow rates by site were 1.62 L/hr, 1.57 L/hr, 1.49 L/hr and 1.61 L/hr for sites 1, 2, 3 and 4, respectively (Figure 7).

Although one might expect the addition of more irrigation line and emitters to decrease water pressure and thus the flow rate of individual emitters, the flow rates of emitters were found to be unaffected, indicating the effectiveness of the pressure-compensation.

However, the flow rates of emitters were consistently lower than their 1.9 L/hr rating.

In conclusion, the irrigation system is currently providing equal water to each of the transplants, but at a rate lower than expected. The project has responded by increasing watering times by about 20% to compensate for the lower-than-rated emitter flow.

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