Evapotranspiration Demands of a Restored Hetch Hetchy

The Hetch Hetchy reservoir is in Yosemite National Park. Built in 1938 to hold the reservoir that supplies San Francisco with drinking water, the dam is one of few located inside National Park boundaries. Prior to the construction of O'Shaughnessy dam, Hetch Hetchy was a montane meadow environment like the popular Yosemite Valley area of the park. As the process of floodplain and montane meadow restoration becomes more popular, it is important to understand the potential changes in water budget balance should Hetch Hetchy be restored to its natural state.

Figure 1. Hetch Hetchy before and after construction of O'Shaughnessy Dam.

An important aspect of montane meadow water budgets is understanding the evapotranspiration (ET) demands that would come with restoring Hetch Hetchy and the native vegetation. ET is the main component of water loss in water budgets, and it consists of two parts: evaporation, which is water in the surface soil being lost to the atmosphere by solar radiation, and transpiration that comes from plants releasing water through their stomata back into the atmosphere during photosynthesis. There are many ways to calculate ET, including weather monitoring stations called eddy covariance towers, lysimeters that are built into the ground and weigh the soil, and remote sensing from cameras on board satellites or aerial platforms.

If Hetch Hetchy were restored to its original montane meadow environment, the ET demands would increase. As California faces a changing climate and water sustainability issues, it is important to understand what these new demands would entail. There have been several meadow and floodplain restoration projects in the Sierra Nevada mountain range that serve as a good comparison for what restored Hetch Hetchy evapotranspiration requirements would be.

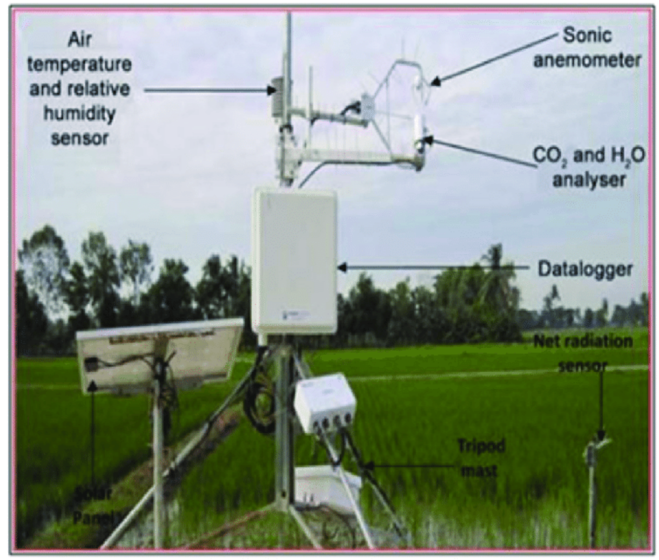

Figure 2. An Eddy covariance tower used to measure ET.

A similar site would be a meadow restoration project in Bear Creek that encompassed a 230-hectare area in northeastern California and used hydrological models to determine changes in the watershed for pre and post restoration. The study found that the restoration of the meadow channel restored shallow groundwater levels that are associated with montane meadow environments. The project also resulted in the restoration of the natural flow regime and channel-floodplain connectivity, primarily reflected in the increased frequency and duration of floodplain inundation (Hammersmark et al, 2008). This floodplain restoration works to mitigate the effects of future flooding events but was also found to raise the groundwater levels that allows for more short grass and shallow root vegetation.

A study by Lucas et al (2015) found that meadow vegetation generally has lower and less variable evapotranspiration rates than forests do. They also found that restoring a degraded meadow system to a healthy one raises the ET of the entire watershed by 0.03-0.05%. This combination of lower ET demands than the surrounding landscape, making up only a small area of the total watershed, and the net increase of ET rates being less than 0.1% means a restored Hetch Hetchy would have very little negative impacts on the water budget from an ET standpoint.

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