IN-RESERVOIR SUMMER CONDITIONS AT FALL CREEK AFTER DEEP DRAWDOWN

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Change to the drawdown regime of Fall Creek Reservoir to below conservation pool has improved downstream passage of Chinook Salmon and survival for Chinook Salmon through Fall Creek Dam. We are examining whether there are impacts to reservoir ecology and food webs upon refilling of Fall Creek Reservoir. Summer conditions within the reservoir are especially important because many Chinook Salmon juveniles rear in Fall Creek Reservoir for an extended period of time and have high growth rates while in the reservoir. The data being collected can be used to both examine the effects of modified drawdown regimes on food web dynamics and in-reservoir conditions as well as to parameterize models exploring how these changes may affect rearing Chinook Salmon.

We are studying physical, chemical, and food web dynamics nutrients following deep drawdown in Fall Creek Reservoir (FC) and using Hills Creek Reservoir (HC) as a reference site. We expected that drawdown to streambed might increase the export of zooplankton, which serve as food for the juvenile Chinook Salmon, and reduce the availability of food resources the following summer. We also expected that drawdown might lead to changes in sediment dynamics and nutrients – either increasing availability and turbidity by resuspension or decreasing through washout – and that these responses would decrease over time with repeated deep drawdown.

We found that zooplankton in FC had lower densities than HC in early summer, but that by late summer these densities had rebounded. *Daphnia* abundances were over 700 individuals/m^3 in August in both reservoirs. The peak densities in both reservoirs occurred 5m below the surface and water temperatures between 22 and 24 $^{\circ}$C. In both 2013 and 2014, FC had a shallower thermocline than HC at the end of the summer full pool; thermocline depths were 9m in FC in August 2013 and 2014 and 22m and 21m in August 2013 and 2014 in HC, respectively. The differences in thermoclines and temperature distributions between reservoirs were consistent with greater light attenuation in FC during full-pool than in HC. Light attenuation (k) in FC was similar in August in 2013 and 2014 ($k = 0.49 \pm 0.04$ and 0.54 ± 0.12, respectively); we observed a shift to greater attenuation in 2014 at HC ($k = 0.29 \pm 0.03$ and 0.39 ± 0.05, respectively). Fine suspended particulates appear responsible for the increased light attenuation in FC and would be

consistent with resuspension during the deep drawdown. Also, during August, FC showed decreasing oxygen at depth (down to 24% saturation, or 2.8mg/L, at 37m in 2014). Light plays a critical role in both thermocline structuring as well as in productivity and biotic interactions. The effects of light in FC could be expected to impact Chinook Salmon both directly (foraging reaction distance) and indirectly (proximity of optimal temperatures and high zooplankton availabilities).

Although the zooplankton have similar distributions in these reservoirs, they may be more or less available to the Chinook Salmon because of the temperatures at specific depths. We are exploring with bioenergetic modeling whether the observed thermocline differences across reservoirs could alter the access to zooplankton prey by Chinook Salmon. In both years following deep drawdown in FC, optimal temperatures for Chinook Salmon growth (12-18°C) are near to where their prey, *Daphnia*, are in highest abundance. In HC, the cooler zones of water were further from high densities of zooplankton. We use these physical and biological data as inputs to foraging and Wisconsin bioenergetic models to compare relative Chinook Salmon growth as a function of availability of *Daphnia* at optimal temperatures. This will increase our understanding of possible responses by Chinook Salmon to changes in water level with reservoir management. We will be conducting similar research and modeling to evaluate responses to extended drawdown at Lookout Point Reservoir over the next several years.