

DO or Die: Dissolved Oxygen Testing in Ross Creek

by Sandy Goldman (2020)

All animals and insects need oxygen to live and they acquire it in a variety of ways. They use it to convert nutrients into the energy they all need for life itself. Getting this oxygen is easy for terrestrial creatures, including humans. The air that surrounds us contains abundant oxygen (about 20% is oxygen) and we are well adapted for extracting what we need.

Getting essential oxygen is much harder for fish. Oxygen is not very soluble in water and fish can only access dissolved oxygen (DO). Worse, as temperatures rise, oxygen solubility goes down and fish requirements for it go up. DO is always an important factor in aquatic habitat quality for fish and in summer, when temperatures rise, it can become the critical factor in determining fish survival.

How does oxygen get into the water? Oxygen enters water from air or as a plant byproduct. From the air, oxygen slowly diffuses through the water surface or is mixed in quickly through aeration. DO is also a

byproduct of photosynthesis from aquatic plants. As a result, DO levels can fall at night, when there is no photosynthesis, and rise during the day. Winds contribute to DO by aerating the water when they blow over it. Waterfalls and riffles also aerate water. Abundant, well-aerated groundwater inputs can both cool the water and directly contribute more DO.

Why measure dissolved oxygen? We measure DO because it is so critical to the health, and the very survival, of fish. We measure DO as milligrams per liter (mg/L). DO

levels and how they vary throughout the day are important in monitoring environmental quality and determining needed management actions. DO requirements vary with fish species, stage of development, temperatures at which prior acclimation occurred, and activity level. As noted above, DO levels and fish metabolic rates both depend on temperature: as temperature increases, the saturation level of DO in the water decreases, but fish become more active and their DO requirements increase. The table below summarizes information about steelhead trout in our watershed.

In general, salmonids incubated at low DO levels are small with slower development, are weak, and abnormal structural growth is more common. For juveniles and adults, low DO can result in reduced fecundity and even prevent spawning. (Salmonids are also affected by many other factors: water depth, pH,



Board member Parker Pringle (left) and Drake High student Logan Smith with a DO logger inside its protective casing, just before it was installed. Every effort is made to hide the loggers to prevent vandalism and theft. Photo by Sandy Goldman

velocity, turbidity and gravel characteristics for spawning. Assessments of streams for suitability consider all these parameters.)

Friends has been measuring temperature and DO in the watershed since 2008. While we have logged the temperature at 15minute intervals, we measured DO only a few times a year when we installed and downloaded the temperature loggers. DO measuring equipment is expensive and challenging to maintain, which is why we used it infrequently. However, the amount of DO in creek water is as important as temperature as a measure of habitat quality.

On March 7 of this year Friends installed three loggers in Ross Creek that record both temperature and DO. We set them to record every 15 minutes. These instruments are fitted with a pre-calibrated optical sensor that will last 6 months. Collecting these data will greatly improve our DO records. We also installed three loggers that record only temperature, continuing our long-term temperature monitoring. Sadly, over the years we have had three temperature loggers stolen and several removed from the water.

Measurements of DO, taken during the March day when we were installing temperature loggers, showed very low levels of DO in the water that emerges from the release valve at the base of Phoenix Lake, with generally higher levels downstream, the result of natural aeration. However, as the summer progresses, water levels fall and temperatures rise, leading to generally lower DO levels throughout the creek. The continuously monitored DO at three separate locations will provide more detailed information and perhaps suggest ways to improve conditions for fish in Ross Creek.

We extend our thanks to the Marin County Fish and Wildlife Commission for funding the purchase of our new DO loggers and, over the years, half of our temperature loggers.

Much of the technical information came from Fondriest Environmental, Inc. 2013. *Dissolved Oxygen. Fundamentals of Environmental Measurements.*



Structures such as this log, installed in Ross Creek, do triple duty: provide shelter for fish, protect the creek bank from erosion, and are convenient places to attach temperature gauges. Photo by Sandy Goldman

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