Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2017-693-AC1, 2018

Hydrology and Earth System Sciences Discussions

Open Access

HESSD

Interactive comment

Interactive comment on "Working backwards from streambed thermal anomalies: hydrogeologic controls on preferential brook trout spawning habitat in a coastal stream" *by* Martin A. Briggs et al.

Martin A. Briggs et al.

mbriggs@usgs.gov

Received and published: 5 March 2018

We thank the Reviewer for their broad and helpful analysis of this manuscript. The public comment period for HESS-D extends until March 15, but it seemed prudent to develop a roadmap for our revision now, in case the Reviewer has any further specific feedback that could help us shape a more clear paper. After the comment period ends, we will also follow up with a detailed record of revisions made to an updated version of this manuscript. It is clear the Reviewer recognizes the extensive methodology and expertise that went into this study of why certain groundwater discharge zones host repeated trout spawning, while a multitude of other focused discharges within the same stream system do not. As you note, the inclusion of these various interdisciplinary methods in one paper is challenging, and we need to do a better job at clarifying the underlying story. This can start with an updated title, for which we suggest: "Hydrogeochemical Controls on Brook Trout Spawning Habitat in a Coastal Stream". This new title puts the emphasis on understanding the structural controls on why some discharges are oxygen rich along this coastal stream, yet most are oxygen poor. Trout utilize the former for spawning, as the eggs need dissolved oxygen to survive and properly develop. This relationship between trout spawning and bed sediment oxygen is already known, and discussed in several of the references we cite, so that point alone is not the focus of this research. In this study we could have sampled the 40+ focused groundwater discharges (identified with fiber-optic heat tracing) for parameters such as DO and EC, and compared to the n=3 that have been observed to repeatedly host trout redds. That could likely have resulted in the kind of pore water chemical dataset for which it would be appropriate to do various statistical analysis to indicate trout chemical preferences in a more systematic way than we have done. Instead, which was not made clear enough in the initial submitted text, we are operating under the assumption that for trout to use groundwater discharge zones for spawning shallow pore water must be oxic. Our main goals are then to use our unique multidisciplinary toolkit to understand why those specific groundwaters have dissolved oxygen, and how discharge patterns develop at the meter-scale. As the reviewer is likely aware, many statistically-based ecological studies result in empirical relationships between fish and habitat attributes, but not necessarily process-based understanding that can be readily transferable to other systems and future scenarios. We feel our study is valuable in showing trout in this coastal stream directly utilize discharges on meander bends that cut into mineral soils, as depicted in Figure 1a. This conceptual understanding, supported by various data types and not known previous to this study, is powerful as it can directly be used to guide stream restoration and to identify possible spawning zones in other coastal streams using surficial soils maps and high-resolution elevation data such as LIDAR.

Printer-friendly version

Discussion paper

Further, we show how the physical discharge of groundwater creates slumped alcoves outside of the main river flow that may offer additional favorable aspects for redd formation, such as reduced bed shear stress. We agree that revision of the main stated objectives is in order to best frame the motivation and results of this study. We suggest: 1. Identify preferred brook trout spawning locations, and determine if they are directly associated with the discharge of oxic groundwater through interface sediments. 2. Develop a hydrogeochemical understanding of trout-preferred groundwater discharge zones that can aid in their identification in other less-studied systems. The revised focus of Object 1 puts the emphasis on understanding if/how trout appear to use the discrete spatial zonation of focused groundwater discharges. Through considerable effort, we show through the modeling of multi-year summer bed temperature records that groundwater fluxes are highest directly at the cut bank margin, and fall off strongly over just a few meters toward the stream channel, as bed oxygen is also reduced. We use ground penetrating radar to map bed peat deposits that offer a processes-based explanation for both reduced upward water flux (low hydraulic conductivity) and dissolved oxygen (carbon source). We agree with the bulk of the Reviewers specific comments, and will make appropriate edits to address them. In regards to the term “short circuit discharge”, although it may sound informal, this was introduced by the highly cited Conant 2004 paper to describe groundwater discharge in a similar hydrogeologic setting with low-K organic lenses. Again, we thank the Reviewer for the thoughtful and helpful review, and look forward to submitting a more clear and useful manuscript as a result.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2017-693, 2018.