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Deschutes River Alliance

Comments and Observations on:

Year 1 Data Summary Report- Lower Deschutes River Macroinvertebrate and Periphyton Study

Portland General Electric, The Confederated Tribes of the Warm Springs Reservation, and R2 Resource Consultants, Inc.

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With special thanks to our team of interns and volunteers. And to the Oregon Water Science Center for assistance with algae sampling and identification during our 2014 data collection effort.

Introduction

The Deschutes River Alliance is grateful for the opportunity to review and provide comments on the Year 1 Data Summary Report on the Lower Deschutes River Macroinvertebrate and Periphyton Study (henceforth referred to as the R2 study). We provide these comments after a review of the report, and having completed our own studies on the lower Deschutes River in the summer of 2014. These studies are pending publication.

In general, while the report accurately reports the findings, it fails to draw conclusions from the data. Although the report is preliminary, some analysis would allow the next year of study and data collection to be pursued in an intelligent and targeted way. In addition, we recommend some modifications in methodology and some areas for additional study.

Key Observations

Of particular concern after review of the R2 study, and in concert with our own findings, there appear to be ecological changes occurring downstream from the Pelton-Round Butte Hydroelectric Project. These changes appear to be subsequent to the change to Selective Water Withdrawal (SWW).

A major change for invertebrates is the apparent total disappearance of *Antocha* crane flies reported in the R2 study, and in our own findings. Other species appear to show changes in life history with unknown consequences, but may relate to the observed decline in adult insect numbers. Multivariate analysis of the current data, in combination with data collected in fall of 2014 and spring of 2015, will help assess population trends. In the meantime, the disappearance of *Antocha* crane flies, which were abundant throughout the lower Deschutes River until the past three years, indicates that they are particularly sensitive to the ecological changes that have occurred.

Another important change that is of concern is the large increase in round and flatworm populations, as well as snails, particularly at the lowest downstream sampling sites. This suggests changes in the periphyton community and general habitat conditions that these species depend on, and is typically associated with a decline in conditions for other invertebrates like mayflies, stoneflies, and caddisflies.

A shift in periphyton populations has been observed, though this was not obvious in the R2 study results. Our own data indicate a large growth of stalked diatoms during summer months throughout the river including in the lower river from Pelton Re-regulation Dam to the mouth. This was apparently under-

reported in the R2 study as sampling was done in seasons not favoring algae growth or proliferation. This shift could be problematic for many invertebrates due to habitat changes from the "smothering" effect of the dense growth and the non-digestible properties of the stalked material produced by these diatoms. In contrast other diatomaceous species are a major food source for the invertebrate community.

The shift in periphyton communities is likely an indicator of a change in water quality, primarily nutrient load. The R2 report suggests (without supporting data) on page 12 that eastside tributaries below the dam complex may make significant contributions to nutrient load in the lower river. Current data does not support this contention. Instead, we found in 2014 little spatial (from river mile 4 to river mile 99) difference in nutrient load related activity in the river as indicated by pH, dissolved oxygen levels, and algae proliferation. We would suggest instead that the bulk of this probable nutrient load is contained in discharge from Pelton Re-regulation Dam. It is highly possible that the level of nutrient load being discharged changed with the switch to Selective Water Withdrawal. In addition, water quality standards violations for pH, while present before SWW operation began, have not declined and have likely increased since the start of SWW.

More specific analysis of the R2 data will be needed, especially after the final data becomes available. Current information, however, continues to support the observations made by many long-time anglers and guides that the river's health has declined since SWW operations began. It is our hope that by combining findings of the R2 study, and our own study data, that we can effectively determine the magnitude and causes of the changes occurring in the lower Deschutes River. It is only with acknowledgement and understanding of these problems that solutions can be found and possibly more profound changes in the biology of the lower river averted.

Data of Particular Note

Changes in nutrients and temperature due to the SWW operation could be expected to cause a number of changes in the macroinvertebrate community, including: changes in adult emergence timing, changes in egg incubation timing, shifts in relative abundance of feeding guilds depending on changes in food conditions and increased abundance of some taxa, along with a decline in abundance of other taxa.

Because of the widespread drop in adult insect hatch activity there is concern about declining numbers of invertebrates. However, abundance is the most

variable metric for macroinvertebrates, especially when sampling a large river like the Deschutes. The variability in abundance is due to sampling methods, clumped distribution of invertebrates on stream bottom, and natural year-to-year fluctuations in abundance. As a result abundance data may not show "statistically significant" changes.

Nonetheless, the results of the post SWW sampling are instructive. Post SWW results show increases in abundance compared to pre-tower results for a number of taxa. Key examples include:

- *Ephemerella* - Fall only
- *Glossosoma* - Fall only
- *Hydropsyche* - Fall only
- *Cheumatopsyche* - Fall only
- Planariidae - Spring & Fall
- Oligochaeta - Spring & Fall
- *Fluminicola* - Fall only
- Vorticifex - Fall only

Declines in abundance from pre SWW results were seen for these major taxa:

- *Ephemerella* - Spring only
- *Rhithrogena* - Spring & Fall
- *Hesperoperla pacifica* - Spring only
- *Antocha* crane fly - Completely absent in post-tower sampling vs. substantial numbers in pre-tower spring samples.

Increases in abundance were most pronounced in the fall samples with little increase or declines in the spring for the following taxa: *Ephemerella, Glossosoma, Hydropsyche,* and *Cheumatopsyche*. This fall increase may be the result of earlier egg eclosion for these taxa due to shifts in the temperature regime, resulting in a high number of young larvae present during the October sample period.

There were large increases in abundance of flat worms (Planariidae) and Oligochaetes (segmented worms) in the post-tower samples in spring and fall, plus large increases of snails (*Fluminicola* and *Vorticifex*) in fall samples. Some of the largest increases in snail and Oligochaete abundance were seen at the lower river sites (below Warms Springs River and Sandy Beach) suggesting water from the dam may be altering conditions further downstream than pre-tower results indicated.

The following table summarizes the changes in macroinvertebrate populations as reported by R2.

Pre & Post SWW Macroinvert Comparison

Note: "Pre" values are the mean of 2-yrs data. The value for each taxon is the sum of 7 sites, which were sampled in all sampling events.

Taxa	Fall Pre (7)	Fall Post (7)	Spring Pre (7)	Spring Post (7)
B. tricaudatus	1026	3326	1383	2121
Ephemerella	169	2141	4221	2003
Rhithrogena	830	302	177	34
H. pacifica	545	627	673	270
P. californica	215	486	772	666
Amiocentrus	1328	2824	3555	5018
Glossosoma	249	6073	342	257
Hydropsyche	3789	17504	5103	3702
Cheumatopsyche	356	2949	354	470
Petrophila	196	132	18	8
Antocha	90	0	915	0
Orthocladiinae	1762	1333	14407	8933
Planariidae	3483	9484	1355	2137
Oligochaeta	1049	16942	1067	11699
Fluminicola	4734	9489	3140	3171
Vorticifex	9493	14769	1364	2241

The complete absence of *Antocha* crane flies also raises the question of changes in habitat quality for invertebrates.

The results of the biological sampling should be analyzed in the context of the water quality sampling.

Fall 2013 water quality sampling results show that dissolved oxygen concentrations were below 11 mg/L at the first five sites downstream of the Pelton Re-regulating Dam, the Crooked River site and the three gravel augmentation sites. If those sites are considered spawning and rearing habitat for that time of year, then these results indicate that the DO water

quality standard was not being met. However, if subsequent inter-gravel DO sampling at these sites results in DO concentrations above 8 mg/L, then the water column standard becomes 9 mg./L, and the water quality standard is met.

In the spring 2014 sampling, only the Crooked River site had a DO concentration below the 11 mg/L criteria for spawning and rearing habitat. Since the water temperatures recorded during this time appear to be a bit higher on average than temperatures recorded during the fall sampling, we would suspect the increased DO concentrations are related to increased photosynthetic activity throughout the study reach.

pH appears to be the biggest problem with 10 of the 15 sites showing pH readings above the water quality standard of 8.5, which again may be related to increased photosynthetic activity and an increased nutrient load.

Methodological Improvements

The variability of the invertebrate abundance data will make it difficult to identify "statistically significant" changes between pre and post-tower time periods using traditional statistics. Other metrics also show relatively large variability between years (between 2 years of pre-tower data). As a result it will be important to assess data using multivariate statistical approaches.

Sampling is heavily weighted to the "upper" portion of the lower river (Site 10, just below Warm Springs River, and above), with just two sites located below site 10 at Sandy Beach and Mack's Canyon. However, declines in macroinvertebrate adult activity, plus growth of nuisance stalked diatom species, has been equally observed in the "lower" portion of the river, from Maupin to the mouth. Thus future evaluation of water quality, algae, and invertebrates should include more downstream sites including from Mack's Canyon to the mouth

The methods used to sample the periphyton are those used by the USGS and EPA although the number of individual substrates sampled was small (5). The pre SWW study used different methods, so that will have to be carefully considered. Given the often spatial variability in periphyton abundance, especially in a large river, 10 rocks would help minimize this sampling variability. Adding periphyton biomass (chlorophyll-*a*) would provide data for

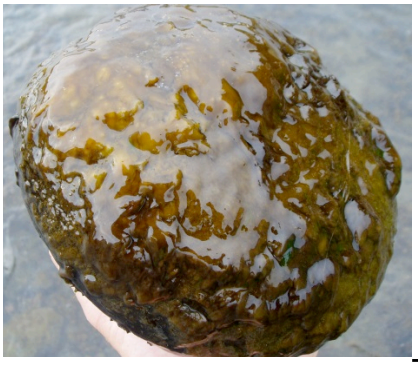
determining whether nuisance biomass levels are occurring, and to compare with other area rivers.

The analyses presented in the R2 draft report include basic summaries according to taxa density, biovolume, and richness. Future analyses could include ordination and other multivariate statistical approaches to better understand the algal assemblage structure, similar to what is probably envisioned for the invertebrate data.

Calculation of algal autecological metrics to gage the trophic and nutrient enrichment status of the periphyton, including organic N-heterotrophs and other metrics would provide useful information at individual sites and can identify longitudinal trends that can inform development of hypotheses.

Analyses focused on the relative biovolume of the whole assemblage, diatoms, and soft algae separately would be most meaningful. Biovolume emphasizes the amount of each species and is a better indication of the overall periphyton community than density. Although cell counts (density) is also commonly used, especially for lakes, density metrics for periphyton emphasize the small fast growing taxa that often comprise only a small percentage of the biomass. Separate analysis can be performed for the total periphyton assemblage, diatoms only, and soft algae only.

Data collection for the R2 study has so far included spring and fall seasons, which might explain the lack of *Gomphoneis* in the periphyton dataset (I have seen it in spring). Stalked diatoms, especially *Gomphoneis herculeana*, were dominant at Mecca Flat and Trout Creek during the DRA/ODEQ/USGS synoptic in July 2014 (see rock photos).



Mecca Flat

Beavertail

Mack's Canyon

Growths of stalked diatoms (*Gomphoneis* and *Cymbella*) were abundant at Beavertail and Mack's Canyon farther downstream. Other taxa that become potentially important during summer but were not well represented in the spring and fall samples include green algae, *Cladophora* (Beavertail) and nitrogen-fixing diatoms, especially *Epithemia*, which although present at all sites, was more abundant in the lower river. Periphytic biomass (chlorophyll-a) was highest at Beavertail (~110 mg/m^2 [USGS, unpublished data]), but chlorophyll may underestimate biomass of stalked diatoms as most of the biomass is stalk material. AFDM is likely a better measure for this system. Nevertheless this chlorophyll value is within the 100-150 mg/m^2 range considered to be a nuisance, which is consistent with the high pH values observed at RM 57 (> 8.5 units) and RM4 (~9.0 units; DRA data, written comm., John Van Sickle). No continuous data were collected at Beavertail.

To more completely fulfill the purpose of the study ("to provide a more comprehensive understanding of the ecosystem effects of changes in water temperature and quality downstream from the Pelton Round Butte Project following the implementation of selective water withdrawal") consideration should be given to going further downstream, not just to the point of temperature equilibration, but possibly to the mouth, to understand nutrient dynamics (uptake and regeneration) along the entire reach.

The timing for any one-time samplings is critical. Changes in flow or inclement weather can slow or even set back the periphyton community substantially, and it may take several weeks to recolonize and stabilize. Continuous monitoring of pH and DO at select sites (Maupin or and Moody) could provide a real time indication of that particular years' growing season condition and progress, which can then determine the best time to sample.

Conclusions and Next Steps

Again, the Deschutes River Alliance appreciates the opportunity to review the R2 report and provide comments. We are dedicated to working with PGE and the Confederated Tribes of the Warm Springs Reservation to gather information and undertake analyses that provide as full a picture as possible of the ecological processes of the lower Deschutes.

In particular, the algae study being planned by PGE and the second year of the macroinvertebrate study provide opportunities to deepen our collective understanding of the changes we are convinced are occurring.