1997-98 UPPER DESCHUTES R-EMAP TEMPERATURE SUMMARY

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Technical Report No. BIO98-02
November 1998

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Introduction

Water temperature is influenced by both natural and human factors. Natural influences can include climate, geology, channel morphology, and hydrology. Human disturbance can involve such issues as livestock grazing, lack of adequate riparian buffers and land development. Temperature is an important element in stream biological and chemical function. Changes in temperature cause stress in biological communities, often altering biological function and structure. Chemically, parameters such as dissolved oxygen and pH are strongly correlated to temperature. Since it plays such a vital role in streams, Oregon DEQ has established a statewide temperature criteria of 64°F (17.8°C) based on cold water fish tolerances.

This report summarizes the 1997 and 1998 temperature data collected for the Regional Environmental Monitoring and Assessment Program (REMAP) located in the upper Deschutes River Basin.

Methods

Continuous monitoring units

VEMCO Limited, Inc.'s Minilog temperature dataloggers (hereon referred to as VEMCOs) were used to monitor in-stream temperature at various sites throughout the upper Deschutes watershed, Oregon. VEMCOs were deployed in streams selected for the 1997 and 1998 Deschutes REMAP during the reconnaissance effort in June of both years. A few VEMCOs were deployed later in the season, but before the expected temperature peak (late July and August).

Ideally, units were placed in a well-mixed area such as riffles or fast glides. However, at some sites these conditions did not occur and VEMCOs were placed in pools. A field audit was taken at least twice (at deployment and retrieval). In most cases, additional audits were recorded during biological surveys. Units were programmed to log every half-hour during the deployment period.

Study Sites

The REMAP project was located in the upper Deschutes River basin (above Lake Billy Chinook). VEMCOs were deployed at 52 randomly selected sites in 1997 and 1998 (no target reference sites were surveyed). VEMCOs were recovered and downloaded from 48 sites. Site elevations ranged from approximately 2,100 ft to 6,200 ft. The REMAP sites are located in the Eastern Cascades Slopes and Foothills, Blue Mountains, and the High Desert ecoregions (Pater et. al 1998). The upper Deschutes River basin is typically warm and dry. The dominant land use is open-range livestock grazing, however, logging and urbanization activities occur as well.

Data Processing

Procedures followed DEQ standard protocols for temperature downloading (Allen Hamel, DEQ Laboratory, pers. com.). In the laboratory, each VEMCO was subjected to a pre-season temperature check to investigate possible temperature differences. VEMCOs were downloaded using the DOS based Minilog program. After downloading, a post-season temperature check was conducted in the laboratory. All VEMCOs passed pre and post season checks. Continuous temperature data, along with temperature audits, were plotted monthly for each site. The maximum seven-day moving average, changes in daily temperature, and maximum and minimum temperatures were calculated. A 7-day moving average calculation smoothes a time series by averaging temperatures taken during a 7 day period. Calculating the change in daily temperature (delta T) determines the daily temperature oscillation in a given stream.

Only VEMCOs that were immersed during the peak summer temperatures were compared. One site was not included in the summary statistics due to the stream drying before peak summer temperatures. In the final analysis, temperature data from 47 VEMCOs was analyzed.

Results and Discussion

Maximum 7-day moving average summary

Figure 1 is the site location map. Temperature data from randomly selected sites were plotted. Sixty-eight percent of all sites did not meet the 17.8 °C temperature standard (Figure 2). All 8 streams in the Metolius Basin met DEQ's temperature standard; all 26 streams in the Crooked River Basin violated temperature standards. Stream water temperature in those located in other areas of the upper Deschutes basin varied (6 above, 7 below standard). Most that met the standard appeared to have significant groundwater influence, particularly those in the Metolius River basin.

Elevation and maximum 7-day moving average.

Site elevations range from approximately 2,100 ft to 6,200 (Figure 3). The data is grouped in two main clusters, the Metolius basin and the Crooked River basin. The 15 sites that met temperature standards are most likely either groundwater influenced (especially those located in the Metolius Basin) or at higher elevations. Some higher elevation sites may have been receiving glacial runoff. There is not, however, an obvious elevation correlation. Other factors that may distinguish temperature data differences in the Deschutes basin may be groundwater systems, watershed characteristics, and human influence.

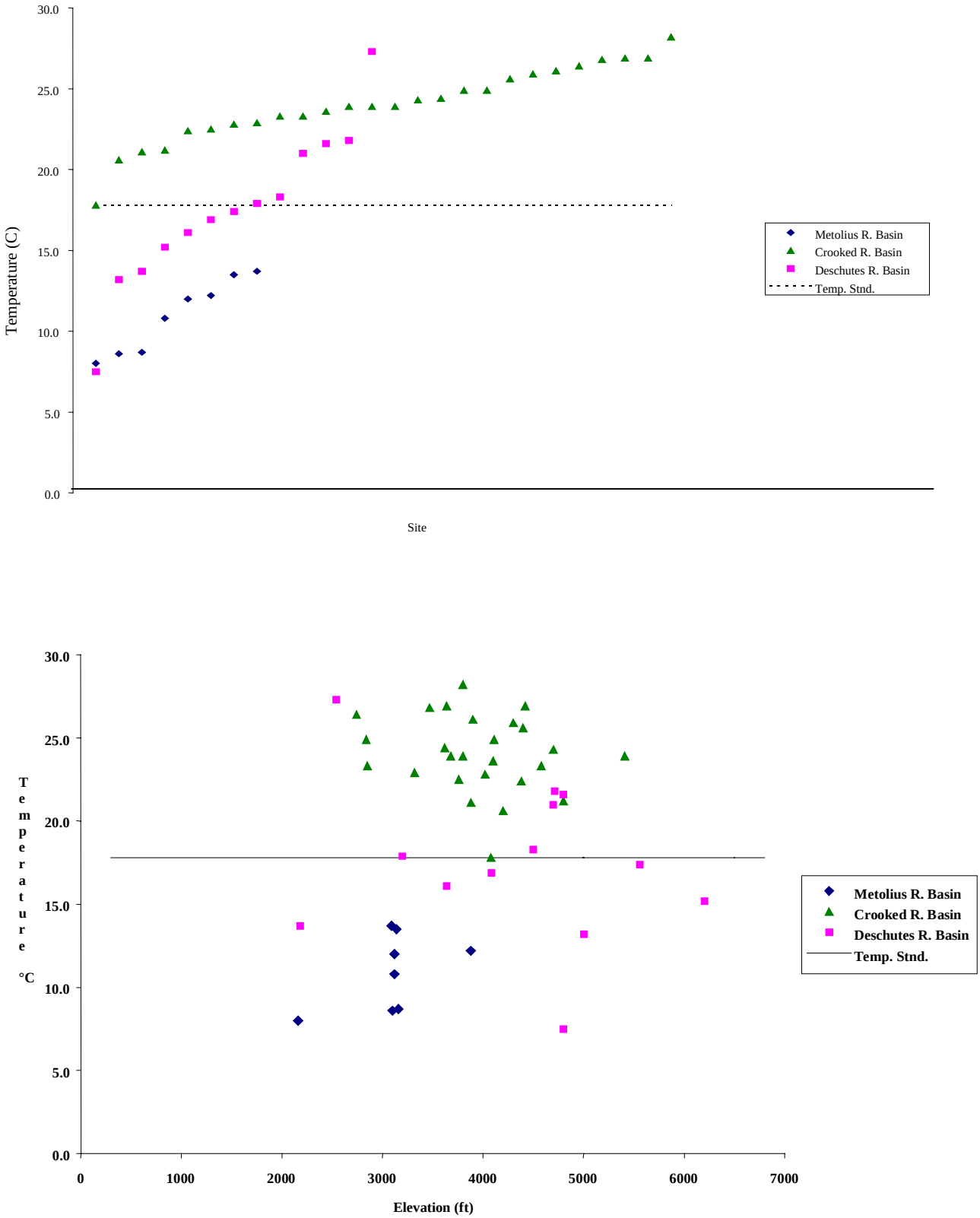

Figure 3. Elevation vs. maximum 7-day moving average temperature for 1997 and 1998 REMAP sites

Elevation and maximum daily change in temperature

The maximum change in temperature (delta T) gives an indication of the daily fluctuations that occur in lotic systems. This can be dependent on such factors as stream shade, groundwater input, and human disturbance.

Delta Ts ranged from approximately 2°C to 22°C (Figure 4). VEMCOs placed at sites in the Metolius River basin (around 3000 ft) recorded low delta Ts. The majority of the sites in the Crooked River basin had larger daily fluctuations ranging from 6°C to

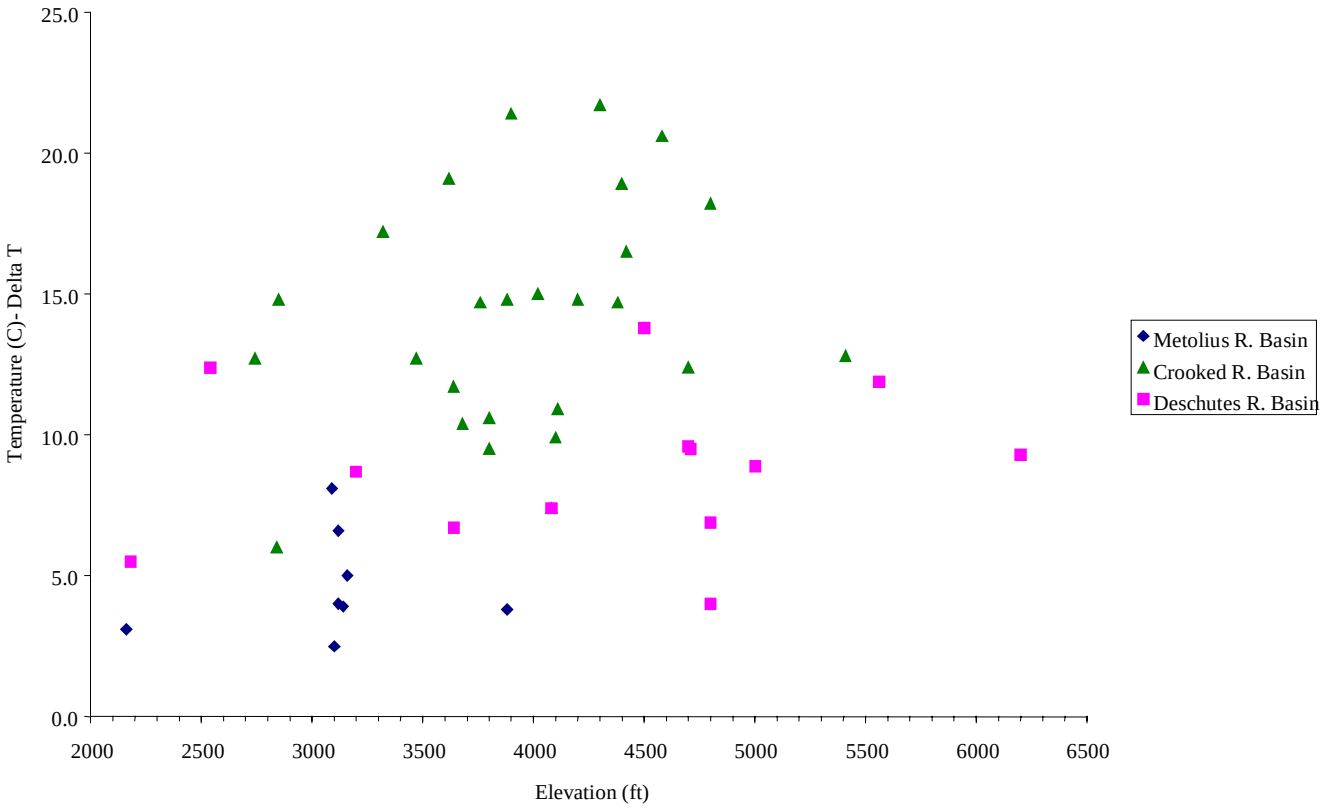

Figure 4. Elevation vs. maximum daily temperature change (delta T) for 1997 and 1998 REMAP sites

22°C. Factors that may influence the large delta Ts in the Crooked river basin include, cattle grazing, lack of adequate riparian buffers and hydrology. Elevation alone does not appear to correlate with daily temperature changes in the upper Deschutes basin. Higher elevation streams recorded relatively high delta Ts. While elevation may influence

changes in temperature, differences may also be related to the inherent variable nature of higher elevation systems; small high elevation streams may be more influenced by factors such as discharge and sun exposure.

Conclusions

There are many interesting findings that can be gathered from this preliminary analysis. Sixty-eight percent of REMAP temperature collection sites violated Oregon's water quality standard. All sites in the Crooked River basin were above the standard in contrast to all the Metolius Basin sites which were colder than the standard. Sites in the Crooked River basin also had the largest diurnal temperature fluctuations (delta T). This preliminary analysis indicates that elevation does not appear to have a dramatic effect on maximum seven-day moving average, especially since the standard was met in both high and lower elevation systems. Elevation also did not seem to affect maximum daily temperature change. This would suggest that there are other factors influencing temperature such as riparian buffers (shading), human influences (cattle and logging), hydrology and geology.

Further data analysis: Compare temperature (7-day moving maximum and delta Ts) to environmental factors such as stream cover, width and depth ratio, fish and macroinvertebrate assemblages.

Future considerations. There are several factors that may influence the VEMCOs that need to be addressed. First, placement may make a difference in changes in daily temperatures as well as maximum temperature. Variation between width and depth of stream should also be investigated. Finally, stream geology and hydrology, such as bedrock and groundwater fed systems, and the influence of stream cover on VEMCO's data recording needs to be studied.

References

Pater, D.E., S.A. Bryce, T.D. Thorson, J. Kagen, C. Chappell, J.M. Omernik, S.H. Azevedo, and A.J. Woods. 1998. Ecoregions of Western Washington and Oregon. (Map poster). U.S. Geological Survey, Reston, VA.

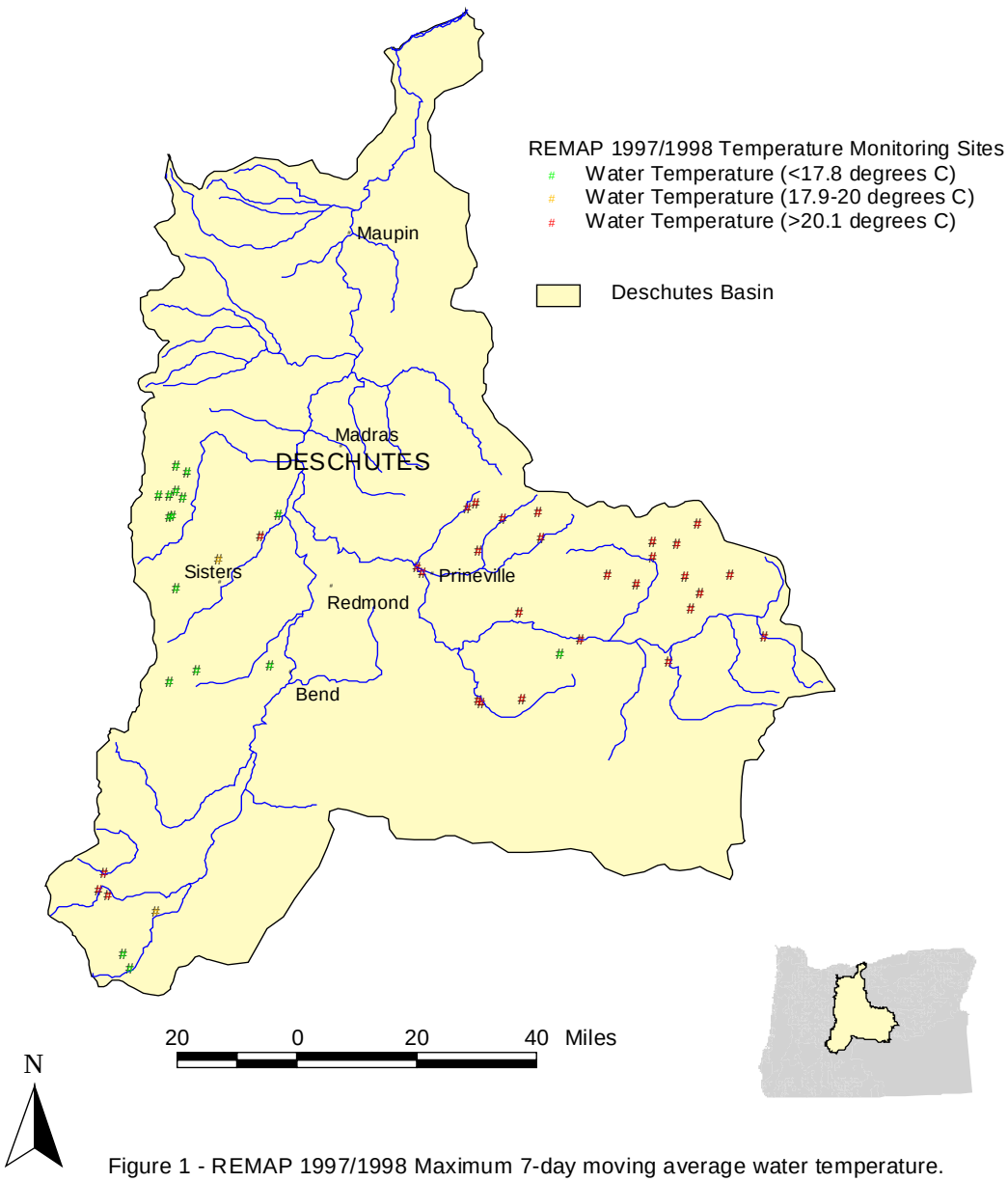

Figure 1 - REMAP 1997/1998 Maximum 7-day moving average water temperature.