

## A PRELIMINARY SUMMARY OF 1998 OREGON PLAN AND REMAP TEMPERATURE DATA

### 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 cattle 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 1998 temperature data collected for two DEQ stream monitoring projects. The Oregon Plan for Salmon and Watersheds, and the Regional Environmental Monitoring and Assessment Program (REMAP).

### 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 Oregon. VEMCOs were deployed in streams selected for the 1998 Oregon Plan and Deschutes REMAP during the reconnaissance effort in June 1998. 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 two times (at deployment and retrieval). In most cases, additional audits were recorded during biological surveys at the same sites.

#### *Study Sites*

Oregon Plan. The 1998 Oregon Plan for Salmon and Watersheds was based in the Oregon Coast Range and the Lower Columbia region. A total of 69 unique sites were surveyed. Of those sites, 48 were randomly selected and 21 were non-randomly selected and used as reference sites. Due to logistic problems, only 53 VEMCOs were deployed. Site elevations ranged from close to sea level to approximately 3,700 ft. While the majority of the Oregon Plan sites occurred in the Coast Range ecoregion, sites also were surveyed in the Klamath Mountain, Cascades, and Columbia Plateau ecoregions. The climate is diverse, ranging from temperate rainforests to areas of long summer droughts.

Land use is also variable, but is predominately silviculture. Dairy farming and residential uses are also present.

REMAP. The REMAP project was located in the upper Deschutes River basin (above Lake Billy Chinook). Thirty randomly selected sites were surveyed in 1998 (no target reference sites were surveyed). VEMCOs were deployed at 25 of the 30 sites. Site elevations ranged from approximately 2,500 ft to 6,200 ft. The REMAP sites are located in the Eastern Cascades Slopes and Foothills, Blue Mountains, and the High Desert ecoregions. The upper Deschutes River basin is warmer and drier than the Oregon Coast Range. The dominant land use is open-range cattle grazing, however, logging and urbanization activities occur as well.

### *Data Processing*

Procedures followed DEQ standard protocols for temperature downloading (see Draft: Data processing of temperature procedures). VEMCOS were downloaded using the DOS based Minilog program. 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 basically smoothes a time series by averaging several points (in this case, 7 days). Calculating the change in daily temperature (delta T) determines the temperature oscillation in a given stream.

A few sites were not included in the summary statistics due to VEMCO failure (4 units), streams drying before peak summer temperatures (3 units), or VEMCOs deployed for a short time period (1 unit). Only VEMCOs that were immersed during the peak summer temperatures were compared. In the final analysis, the Oregon Plan had 47 sites (32 random, 15 reference) and REMAP had 24 sites.

## **Results and Discussion**

### *Maximum 7-day moving average summary*

Oregon Plan. Maximum 7-day moving average temperature information was plotted by site for 32 random sites and 15 reference sites. The majority of the sites that violated DEQ's temperature standard are located in the South Coast (Figure 1). Fourteen total sites were above the standard for cold water fish rearing (17.8°C or 64°F) (11 random and 3 reference sites; Figure 2). Thirty-four percent of random sites were above the temperature standard.

REMAP. Temperature data from 24 randomly selected sites was also plotted. All streams in the Metolius Basin met DEQ's temperature standard; the Crooked River Basin had the highest number of streams that violated temperature standards (Figure 3). Sixty-three percent of all sites were above the temperature standard (Figure 4). 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.*

Oregon Plan. Stream sites that were above the standard included both low and high elevations (Figure 5). While the elevation of the reference sites varied, all but 3 sites were below DEQ standards. The random sites that violated temperature standards ranged in elevation from about 100 ft to 2700 ft. These data do not indicate a strong correlation between temperature and elevation. They also show that streams in lower elevations do meet DEQ temperature standards.

REMAP. Site elevations were higher in the upper Deschutes, ranging from approximately 2,500 ft to 6,200 (Figure 6). The 8 sites below temperature standards are most likely groundwater influenced, especially those located in the Metolius Basin. Some higher elevation sites may have been receiving glacial runoff. There is a large temperature difference (almost 3°C) between sites that met temperature standards and those that did not. There is not, however, an obvious elevation pattern. Groundwater systems, watershed characteristics, and perhaps human influence (mostly cattle grazing) heavily separate temperature data patterns in the Deschutes basin.

*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, amount of primary productivity, and human disturbance.

Oregon Plan. The majority of the sites recorded low delta Ts (below 5°C) regardless of elevation (Figure 7). The reference sites, which were expected to have low delta Ts, ranged from approximately 1°C to below 6°C. The delta Ts at random sites varied from approximately 1°C to almost 12°C. There are 5 random sites that range from 5°C to 10°C, clearly separating themselves from the majority of the random sites. These same five sites also recorded high maximum 7-day moving averages. Results suggest that changes in elevation had little effect on the daily temperature change.

REMAP. Delta Ts ranged from approximately 2°C to 17°C (Figure 8). The few systems that recorded low delta Ts were those in the Metolius River basin (around 3000 ft). Visually, there appears to be a trend indicating a positive relationship between daily temperature changes and elevation. This is interesting because this relationship is not apparent in the coast range sites. 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 flow and sun exposure.

## Conclusions

There are many interesting findings that can be gathered from this preliminary analysis. The Coast Range had more sites that were below DEQ's temperature standard than did the upper Deschutes basin. Most chosen reference sites fell below the standard, strengthening that the majority of those sites are valid reference sites. Elevation did not appear to have a dramatic effect on maximum seven-day moving average in the Coast Range or the Deschutes. While elevation did not seem to be related to maximum daily changes in the coast range, there appears to be positive correlation in the Deschutes. However, since stream width to depth ratio and shading has not yet been taken into account, it is premature to make too many deductions.

Issues to be worked on: Graphically separate sites according to location (north, middle and south coast, sub- ecoregion or watershed). Compare temperature (7-day moving maximum and delta Ts) to environmental factors like 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 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.

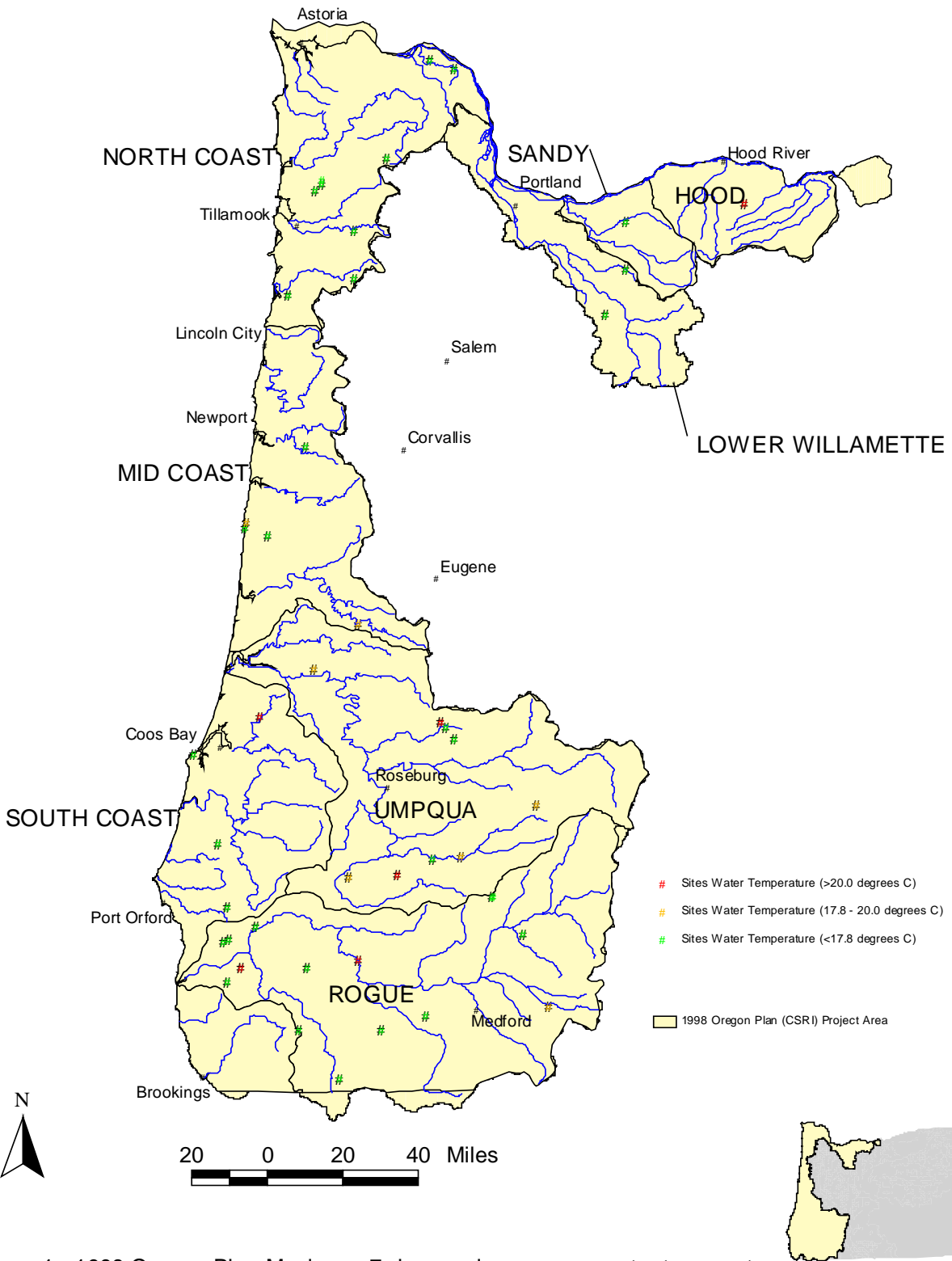
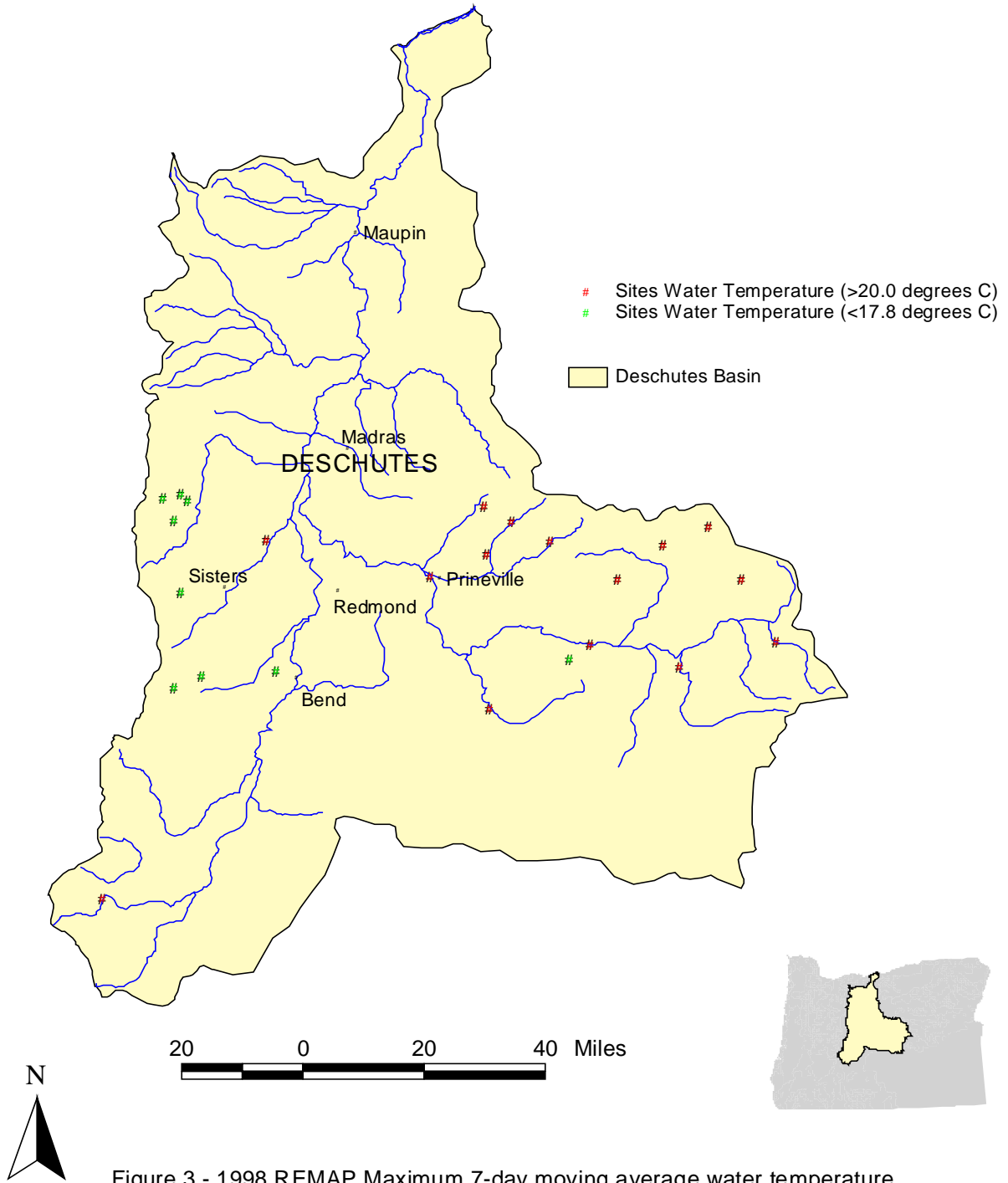


Figure 1 - 1998 Oregon Plan Maximum 7-day moving average water temperature



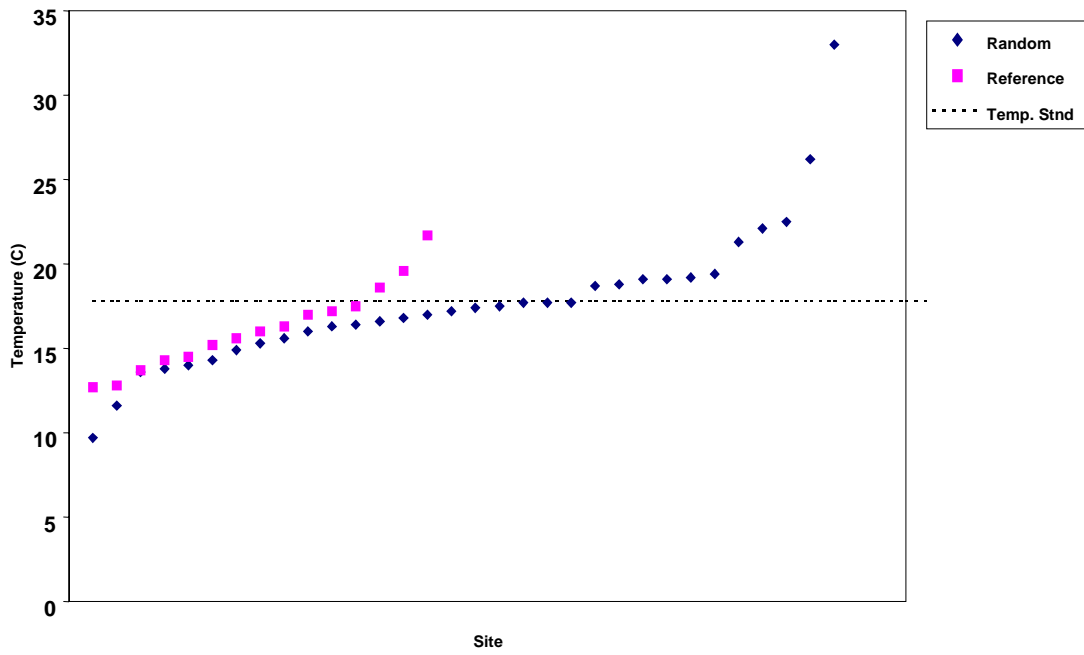


Figure 2. Maximum 7 day moving average temperature for Oregon Plan

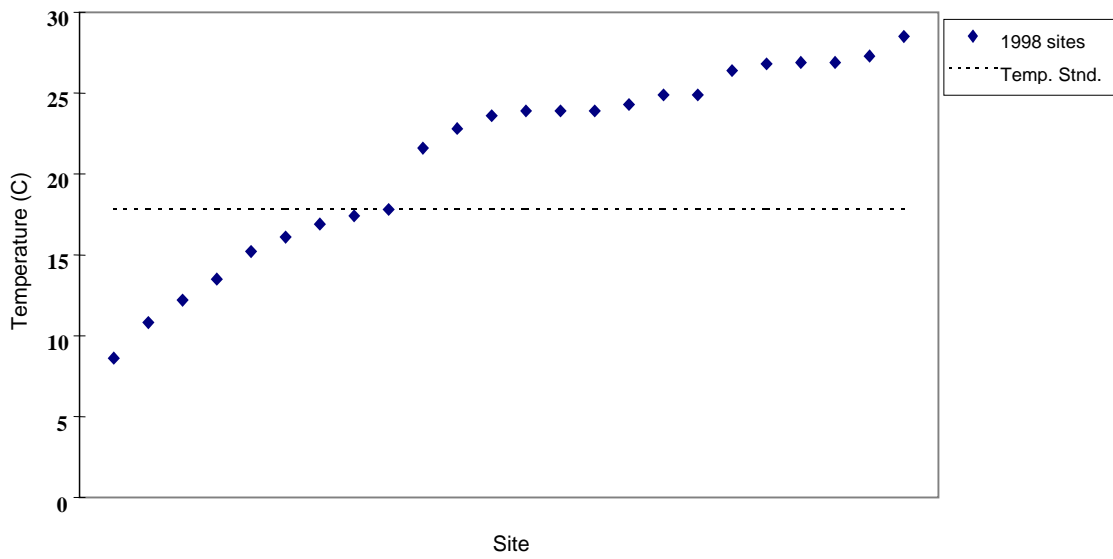


Figure 4. Maximum 7-day moving average water temperature for 1998 REMAP sites

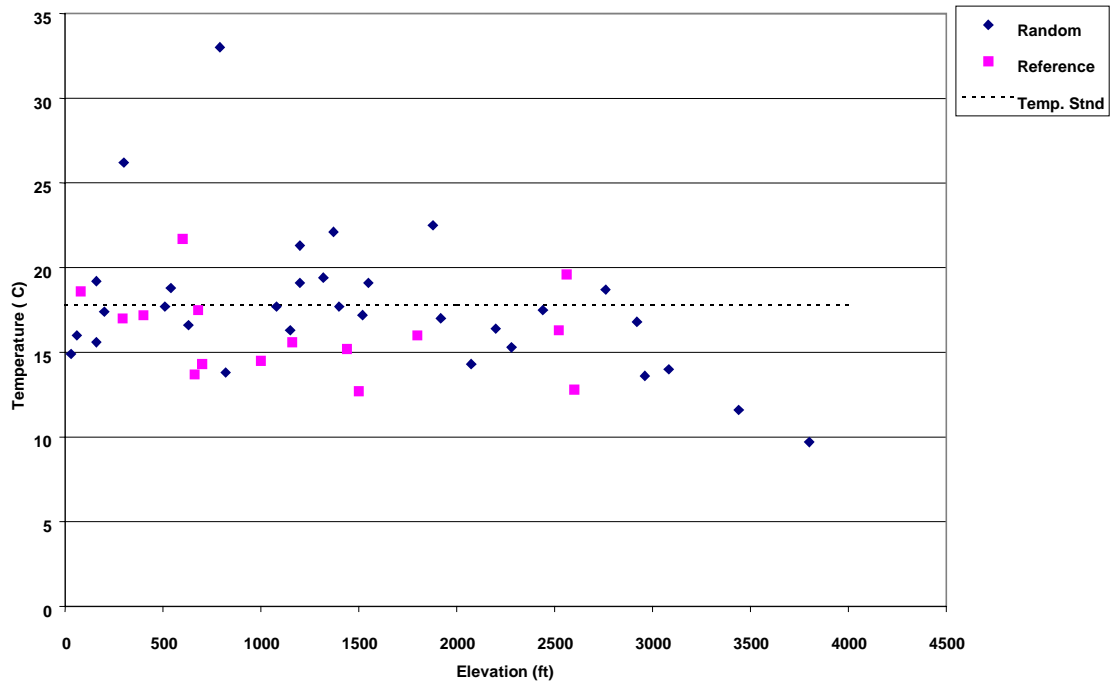


Figure 5. Elevation vs maximum 7-day moving average temperature of Oregon Plan sites

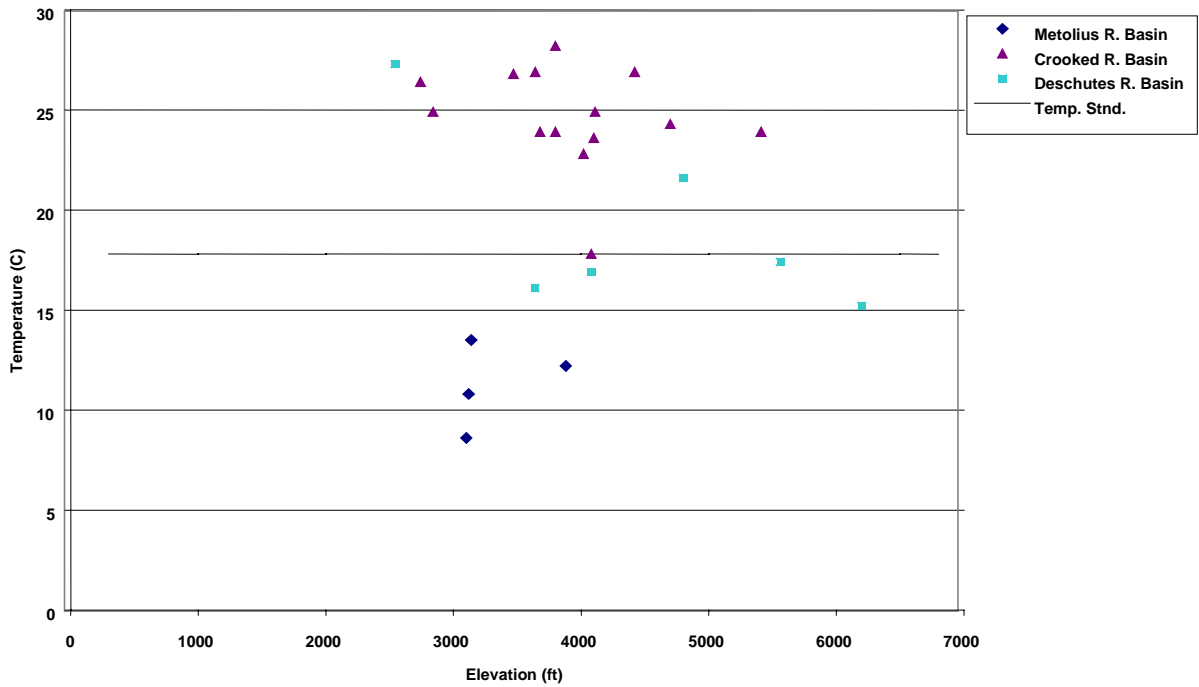


Figure 6. Elevation vs. maximum 7-day moving average temperature for 1998 REMAP sites

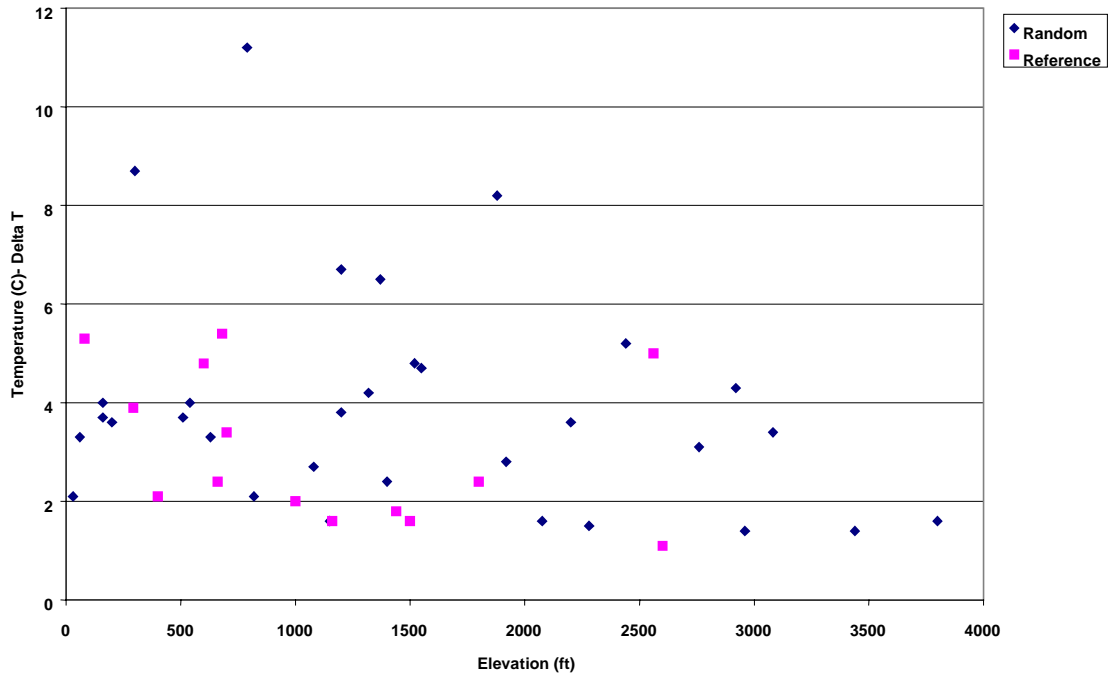


Figure 7. Elevation vs. maximum change in daily temperature (delta T) for Oregon Plan

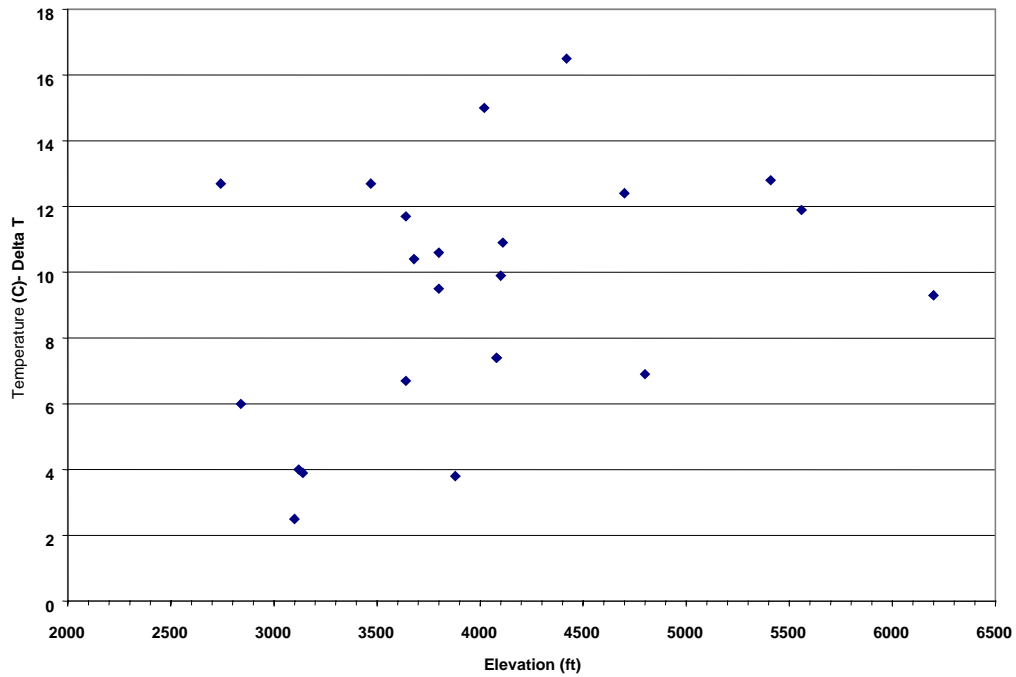


Figure 8. Elevation vs. maximum daily temperature change (delta T) for 1998 REMAP sites