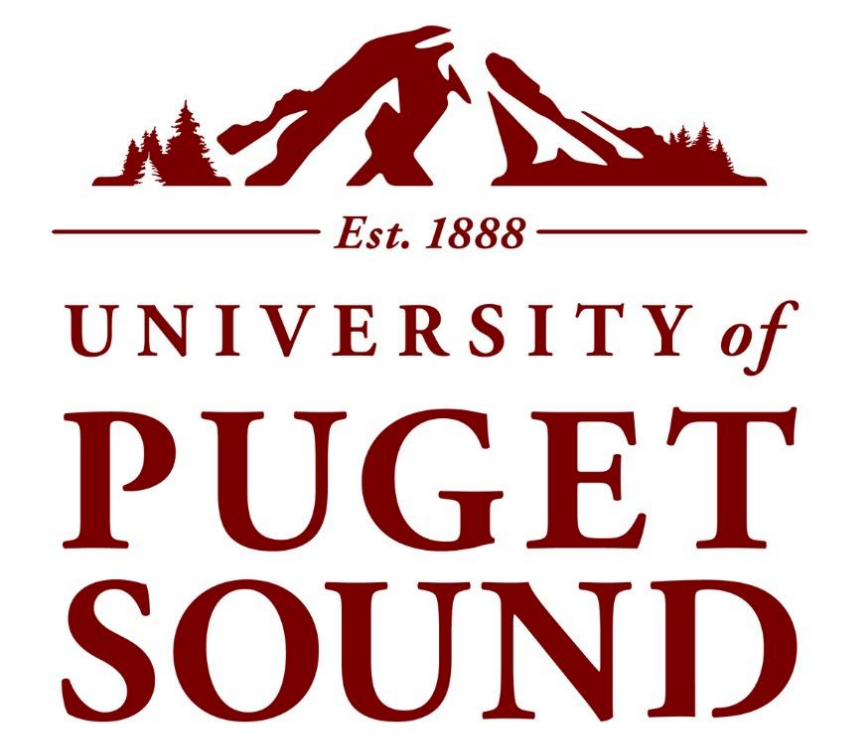




# Assessing the Potential Role of Beavers (*Castor canadensis*) in Mitigating the Effects of Wildfire on Stream Ecosystems

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## Background

### Wildfires:

- Wildfire prevalence and severity has been increasing in the western United States since the 1980s<sup>1</sup>
- Following wildfires, stream ecosystems often exhibit reduced water quality, sedimentation, channelization, higher temperatures, and lower macroinvertebrate and fish abundance<sup>2,3</sup>

### Macroinvertebrates:

- Macroinvertebrates occupy a central position in stream food webs
- EPT taxa (i.e. mayflies, stoneflies, and caddisflies) are sensitive to decreased water quality and are therefore used as bio-indicators
- Diptera (true flies), specifically Chironomidae, are pollution-tolerant and thus show higher relative abundances following wildfires<sup>2</sup>



Ephemeroptera (mayfly)



Plecoptera (stonefly)



Trichoptera (caddisfly)



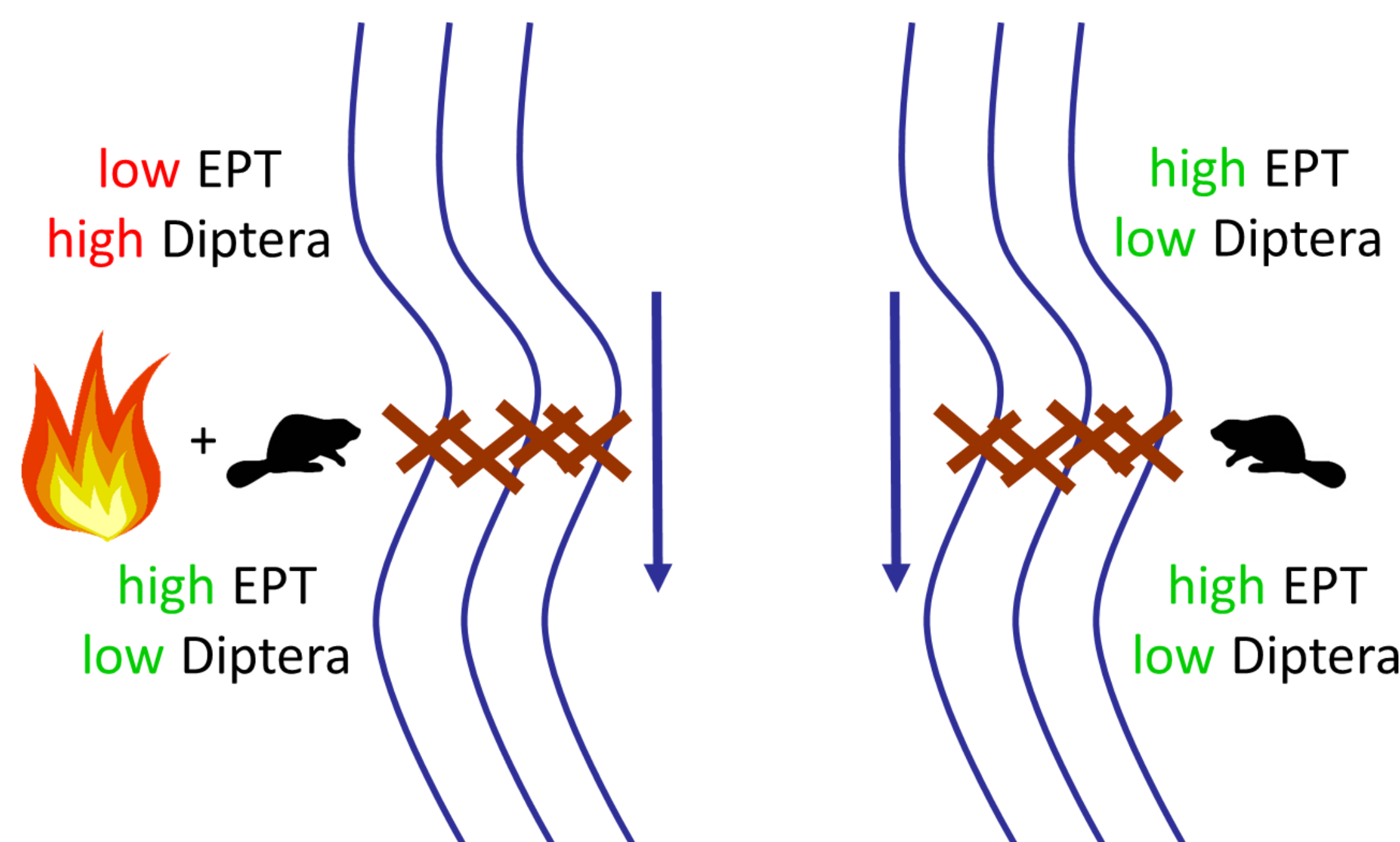
Diptera (true fly)

### Beavers:

- Beavers (*Castor canadensis*) act as ecosystem engineers by felling trees and creating canopy gaps, impounding water and expanding wetland habitat, and increasing habitat heterogeneity
- In the context of wildfires, beaver complexes may act as firebreaks, sequester sediments eroded after burns, prevent channelization, and maintain low stream temperatures

**Question: Do beaver dams mitigate the impacts of wildfires on stream ecosystems?**

**Hypothesis: Burned areas below dams will exhibit a higher prevalence of EPT taxa and a lower prevalence of Diptera relative to above-dam sites, and will be more comparable to unburned sites**



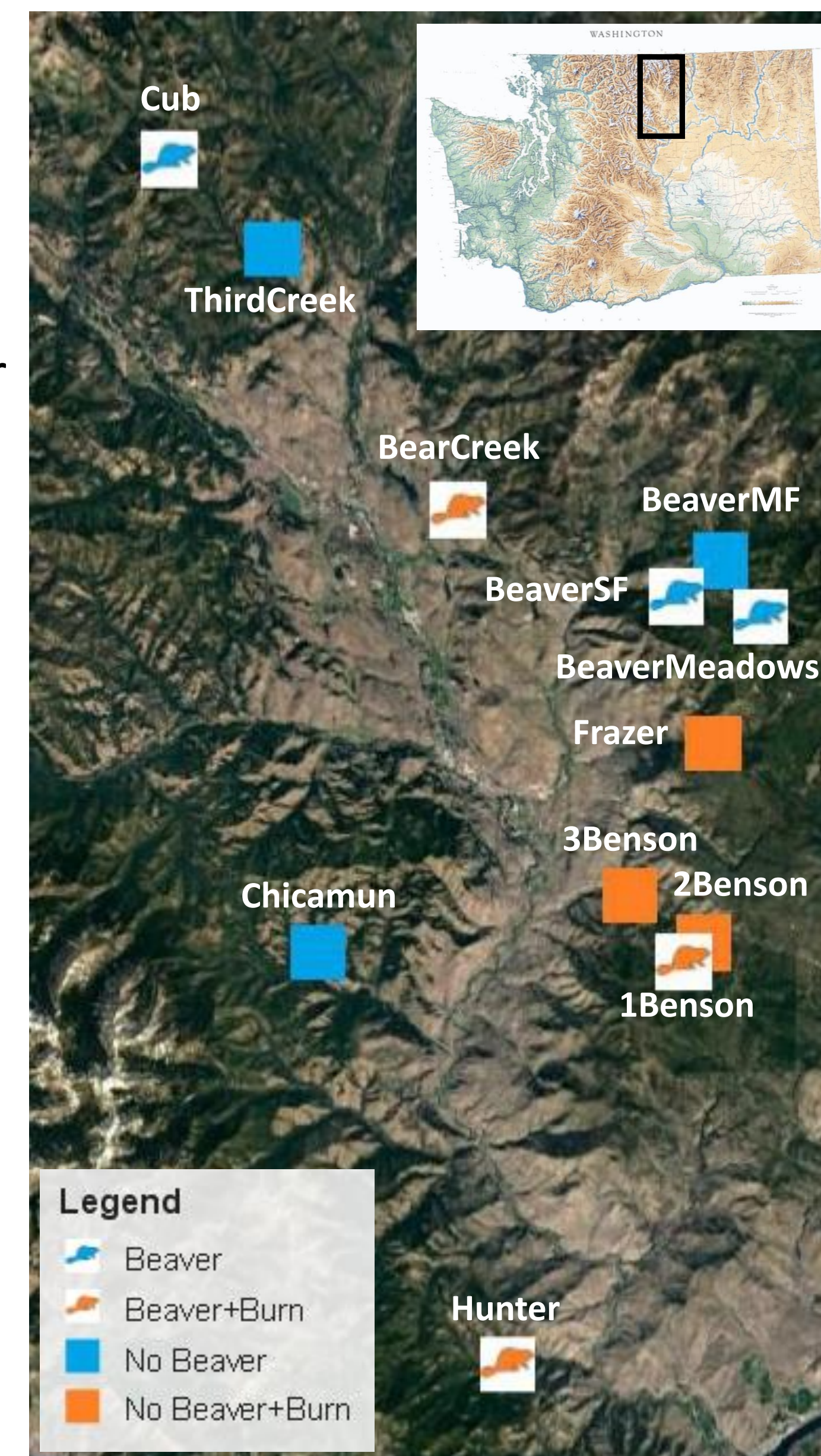
## References

- [1] Westerling, A. L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam. 2006. Warming and earlier spring increase western U.S. forest wildfire activity. *Science* 313:940–943.
- [2] Minshall, G. W., T. V. Royer, and C. T. Robinson. 2001. Response of the Cache Creek macroinvertebrates during the first 10 years following disturbance by the 1988 Yellowstone wildfires. *Canadian Journal of Fisheries and Aquatic Sciences* 58:1077–1088.
- [3] Lyon, J. P., and J. P. O'Connor. 2008. Smoke on the water: Can riverine fish populations recover following a catastrophic fire-related sediment slug? *Austral Ecology* 33:794–806.

## Methods

### Data collection:

- Research took place in the Methow Valley, located in north-central Washington
- Samples were collected at 3 burned and 3 unburned beaver sites, as well as at 6 matched non-beaver control streams (see map)
- Macroinvertebrates samples were collected in triplicate upstream and downstream of beaver dams as well as in non-beaver streams using a Surber sampler
- At each sampling location various stream characteristics including substrate size, water temperature and velocity, and canopy cover were recorded



### Data processing:

- All macroinvertebrates in ¼ of each sample's volume were counted to estimate abundance
- 100 macroinvertebrates were randomly selected from each sample, identified to family or genus, and grouped into morphospecies
- Various community characteristics, including overall species richness, EPT richness, % EPT, % Diptera, % Dominance, Shannon's diversity, HBI (Hilsenhoff Biotic Index), and B-IBI (Benthic Index of Biotic Integrity) were calculated
- Data were analyzed in R using 2-way ANOVA, PCA, and NMDS

## Results

- EPT richness in burned areas below dams was higher than in burned areas above dams, and was similar to unburned areas

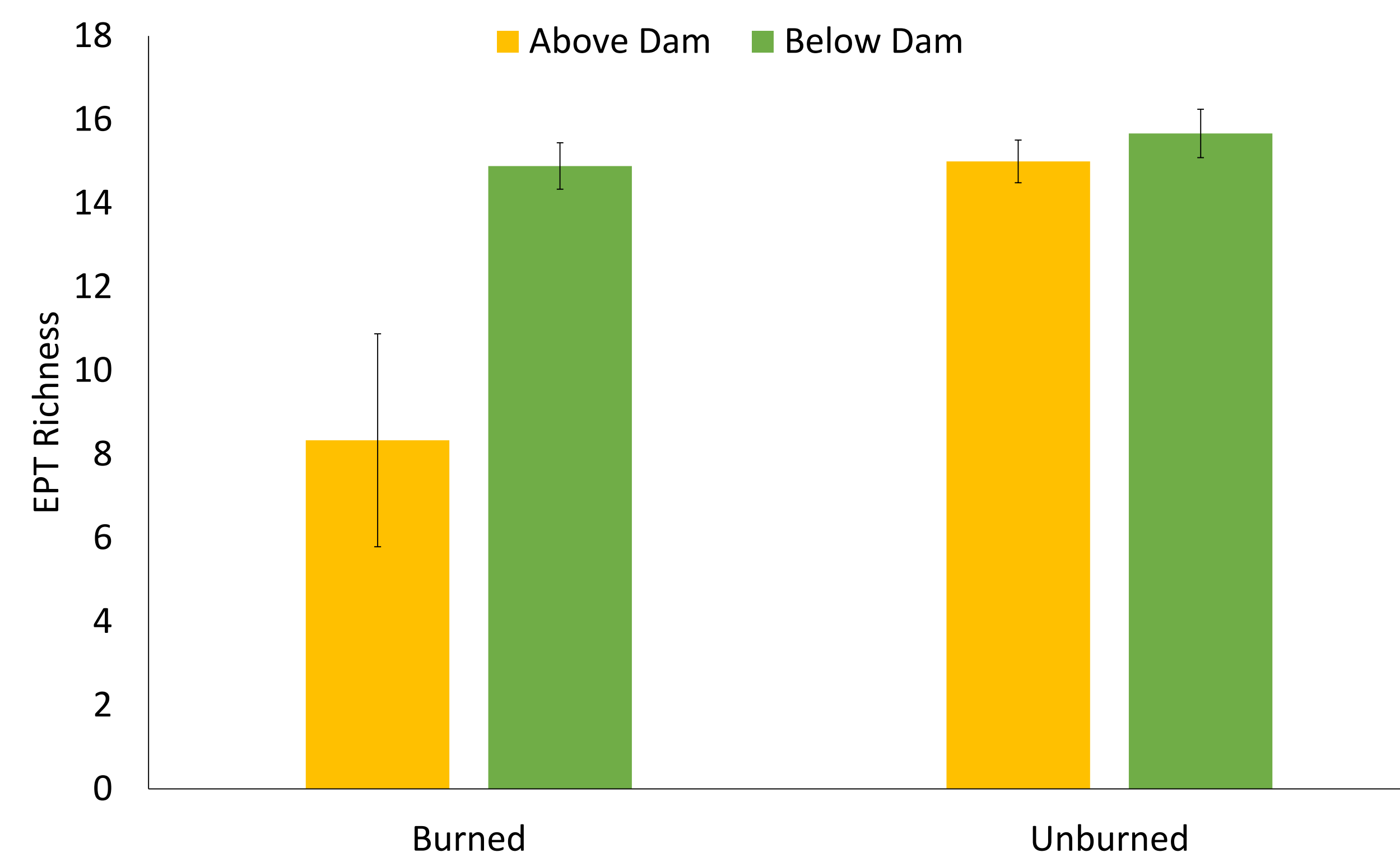


Figure 1. Average EPT richness in burned and unburned areas above and below beaver dams. Differences were marginally significant, with the effect of burns depending on whether the sample was collected above or below a dam (2-way ANOVA,  $F = 4.70$ ,  $df = 1,8$ ,  $p = 0.062$ ). In burned areas, EPT richness was 79% higher below vs. above dams ( $F = 6.33$ ,  $df = 1,4$ ,  $p = 0.066$ ), and above dams EPT richness was 80% higher in burned vs. unburned areas ( $F = 6.59$ ,  $df = 1,4$ ,  $p = 0.062$ ). Error bars show standard error.

## Results cont.

- Percent Diptera showed a noticeable but insignificant decrease below dams in burned areas

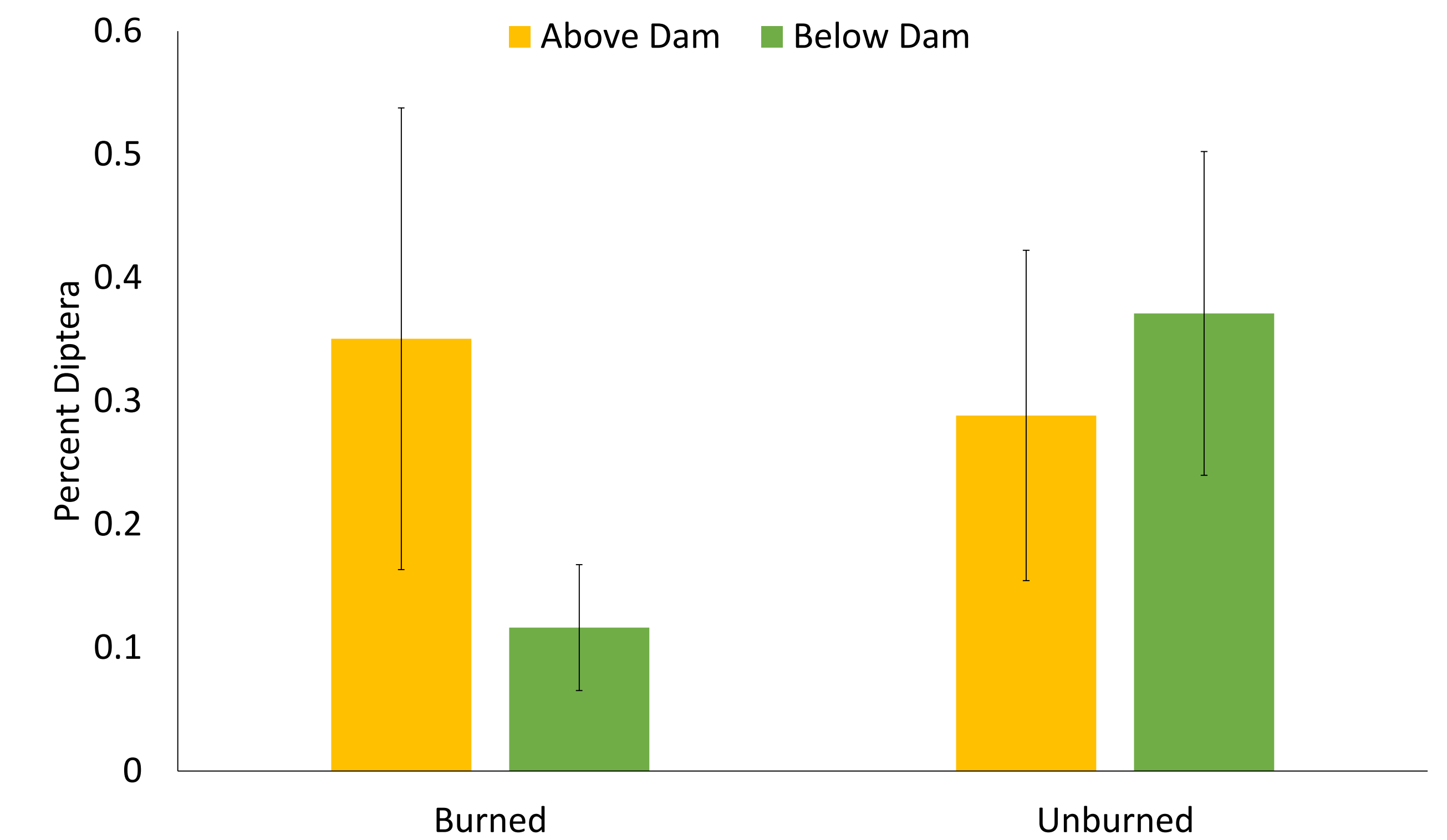


Figure 2. Average percent Diptera in burned and unburned areas above and below beaver dams. The effect of burns did not depend on whether the sample was collected above or below the dam, and there were no significant differences between burned and unburned sites or above-dam and below-dam sites. Error bars show standard error.

- Species composition varied the most between burned above-dam sites and unburned below-dam sites

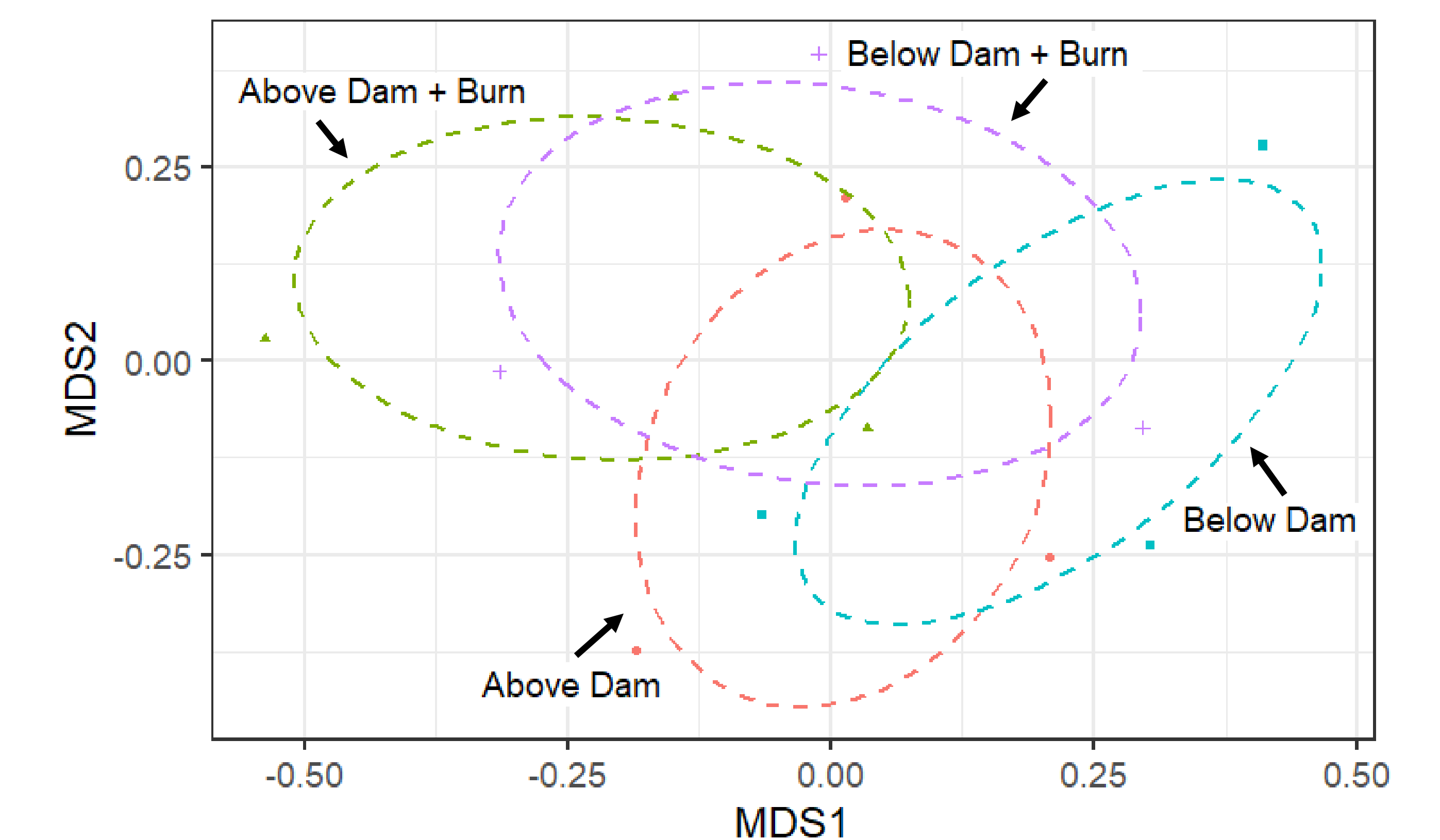


Figure 3. NMDS of species composition across different site types, with overlapping ellipses indicating similarity. Burned above-dam sites and unburned below-dam sites were the most dissimilar, while all other site types showed overlap ( $k = 2$ , stress = 0.187).

## Conclusions

- Burned streams in the Methow Valley exhibit altered macroinvertebrate community composition and structure when compared to unburned streams
- The effects of wildfire on macroinvertebrate communities appear to be buffered by the presence of a beaver dam upstream
- Restoration of beavers in fire-prone landscapes offers a potential means of reducing the impacts of wildfires on stream ecosystems

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