

NOVEL HYDROLOGIC REGIMES DISRUPT INSECT LIFE HISTORY STRATEGIES: EFFECTS OF HYDROPEAKING ON INSECT OVIPOSITION

Scott Miller^{1,2}, Matt Schroer^{1,2}, Theodore Kennedy³,
Jesse Fleri²

¹BLM National Aquatic Monitoring Center

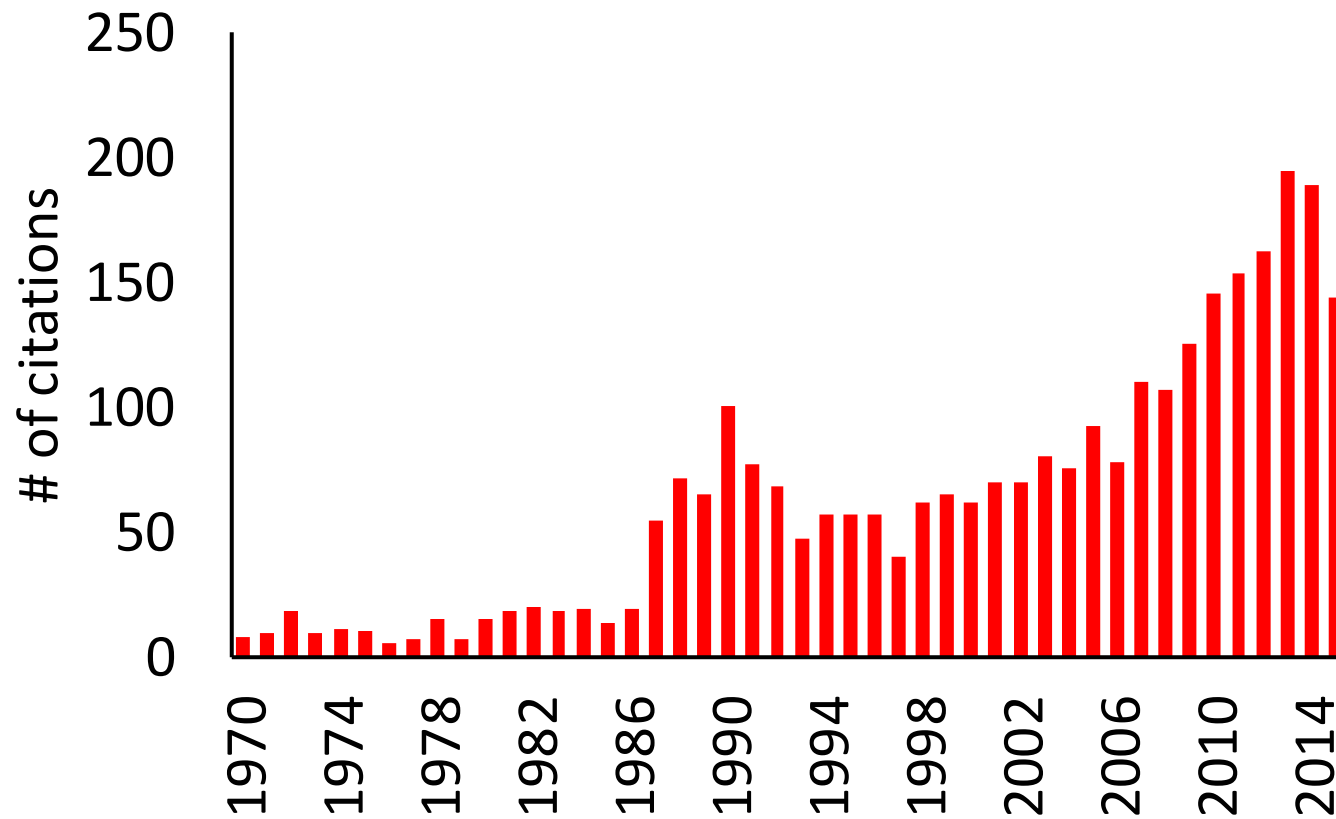
²Department of Watershed Sciences, Utah State University

³USGS, Grand Canyon Monitoring and Research Center



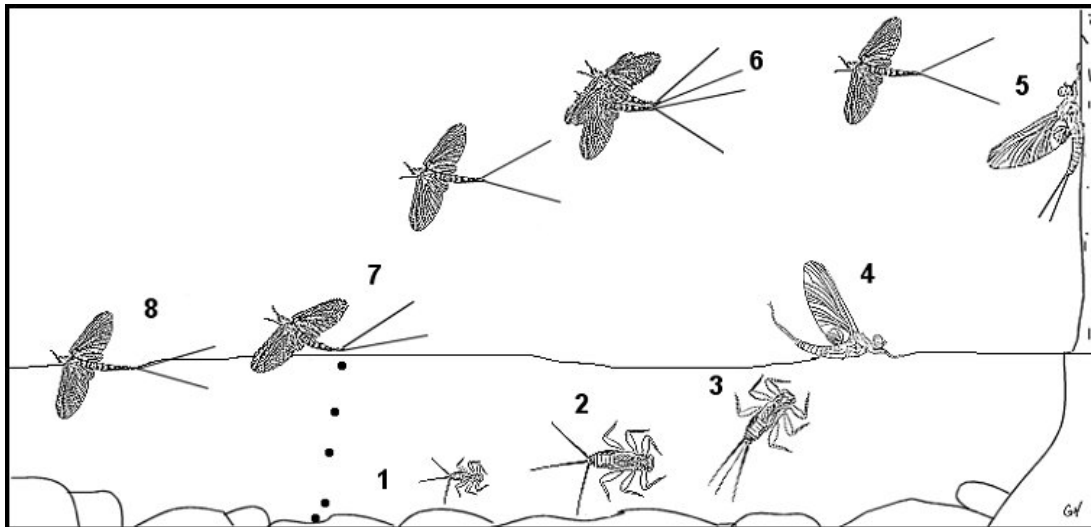
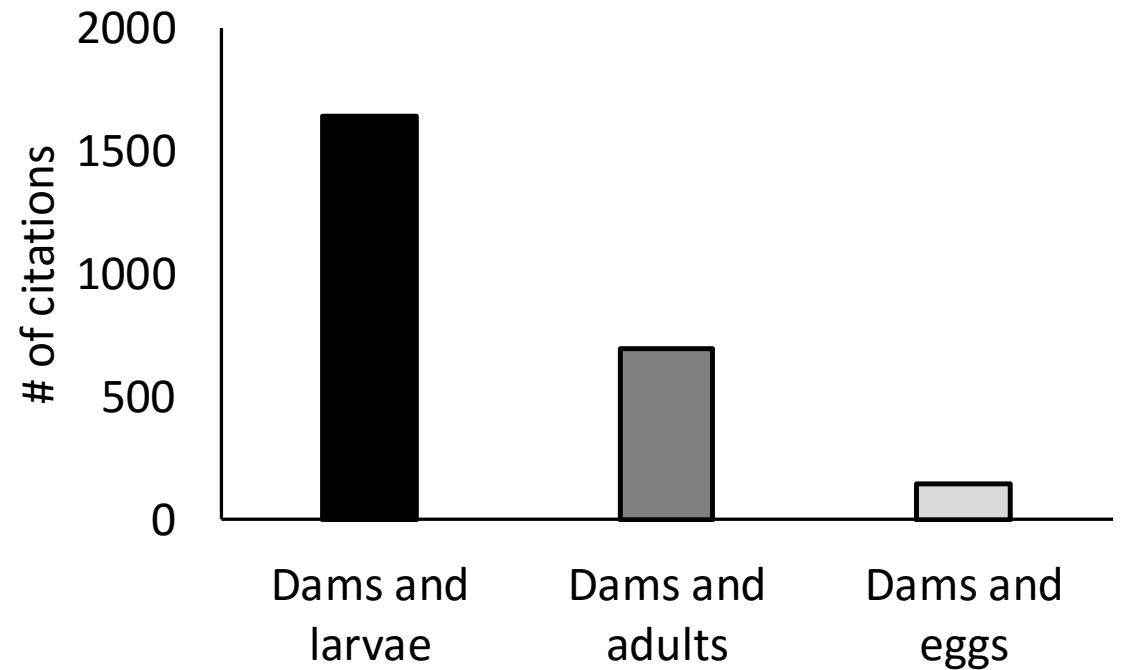
Introduction

Over 3,557 papers published on 'dams' and 'macroinvertebrates' since 1970



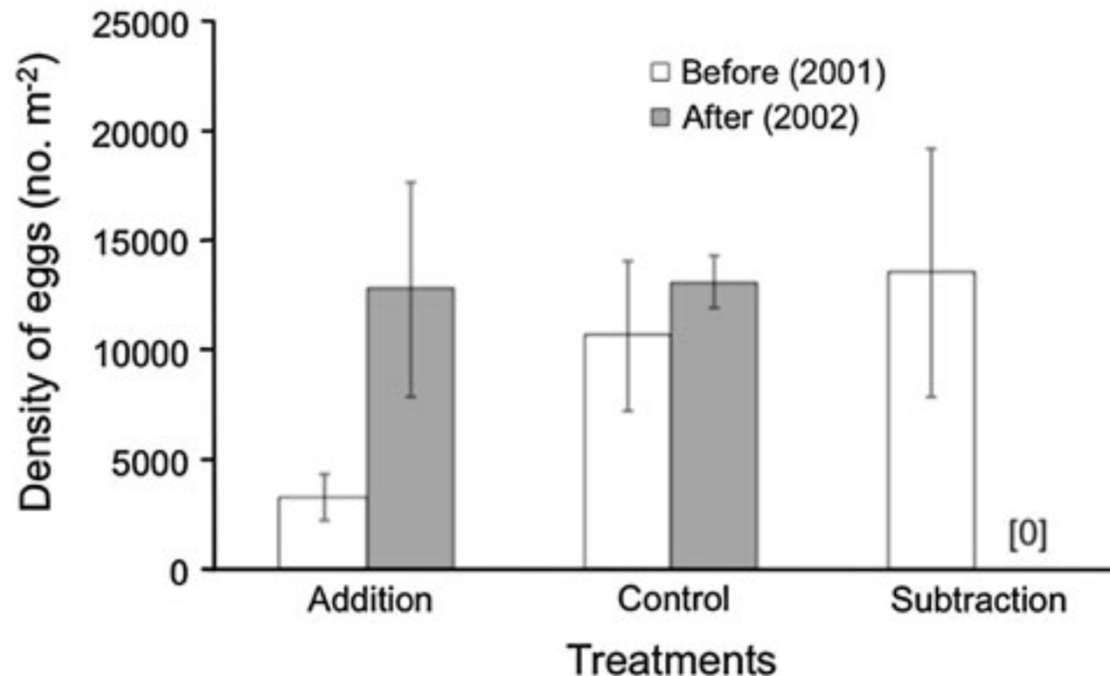
Introduction

Invertebrate studies disproportionately focus on larval life stage



Introduction

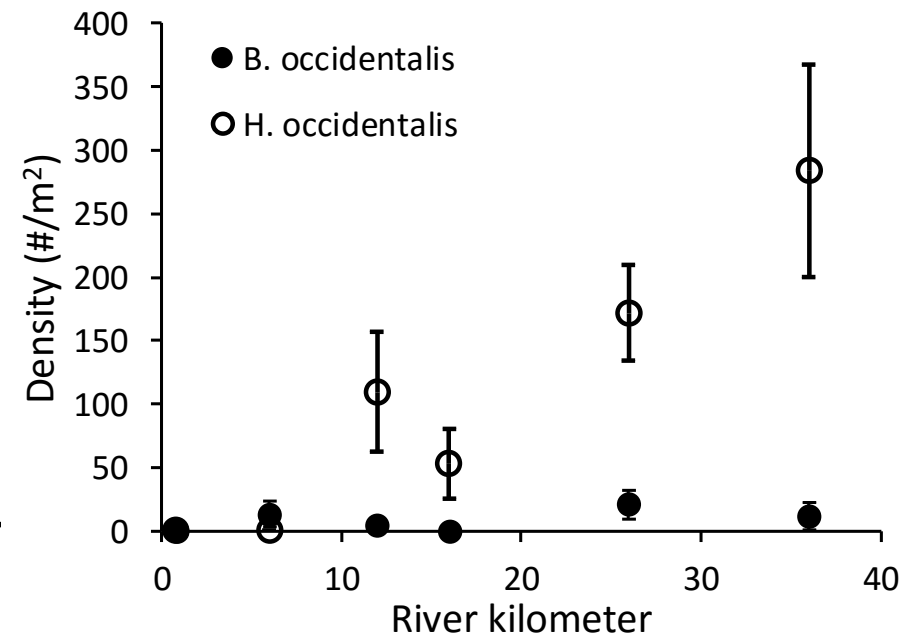
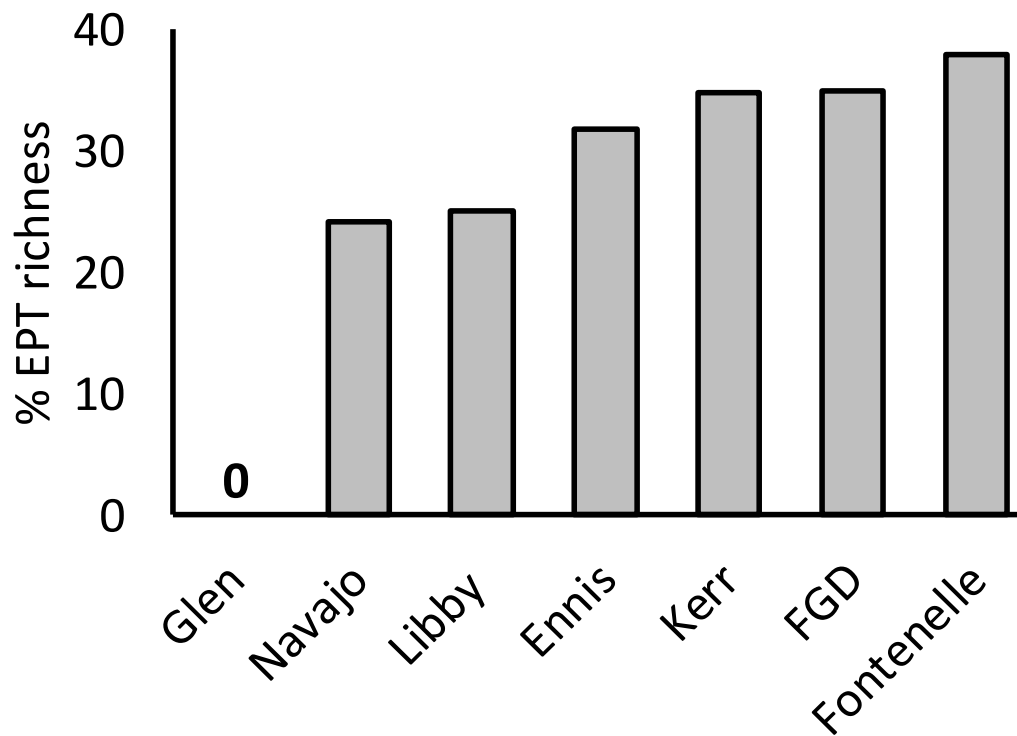
Removal of emergent rocks reduced *B. bicaudatus* egg #s to zero



“Given the sensitivity of population size to the availability of preferred oviposition substrates...human influences such as those caused by hydro-peaking dams have the potential to disrupt the recruitment process.” Encalada and Peckarsky 2011

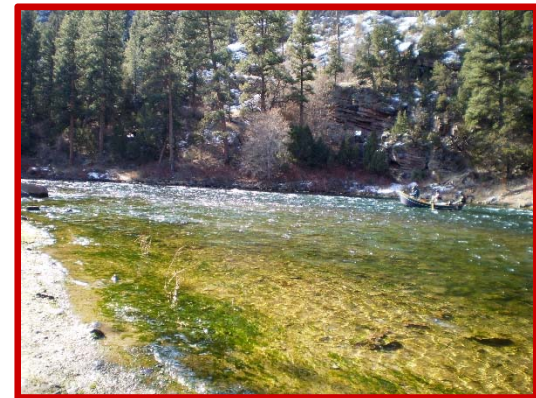
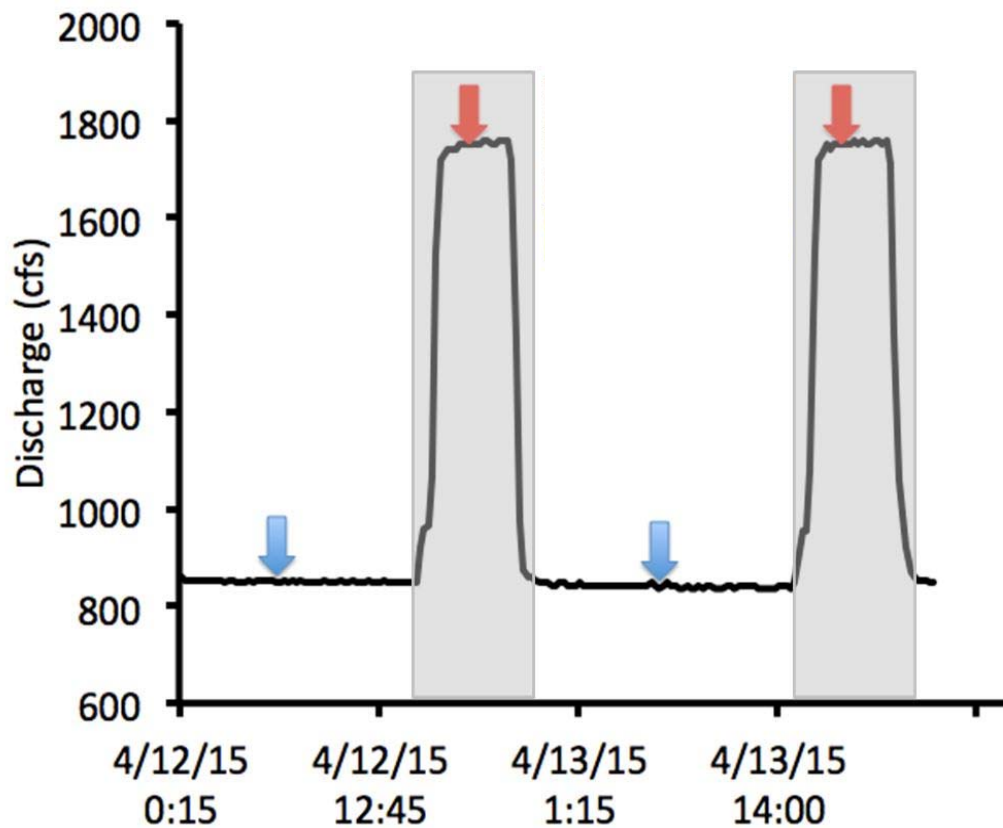
Introduction

Variable response and recovery patterns within and among systems



Hypothesis and research questions

Hypothesis: Hydropeaking limits recruitment success of aquatic insects, thus altering assemblage composition



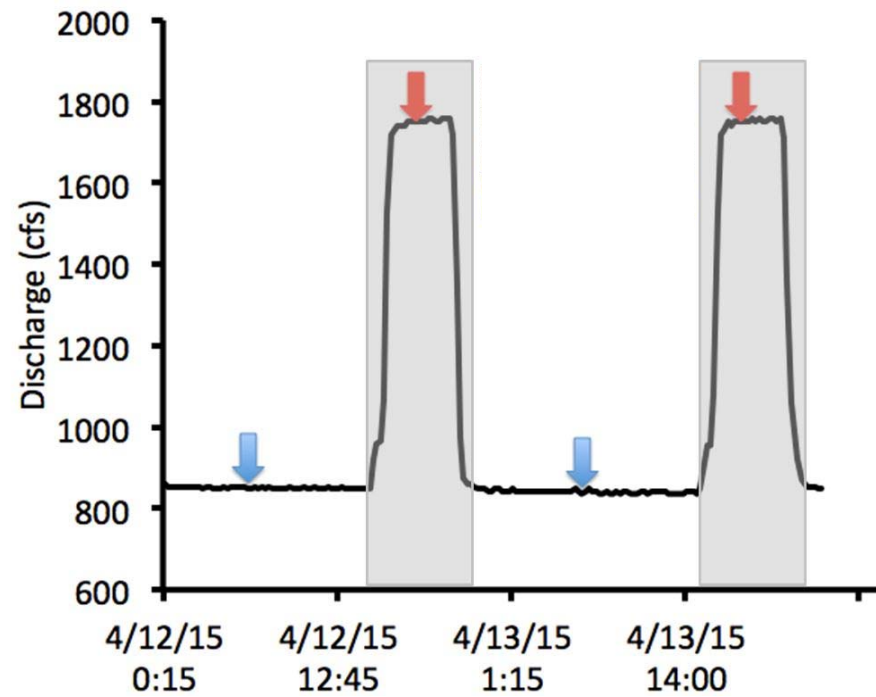
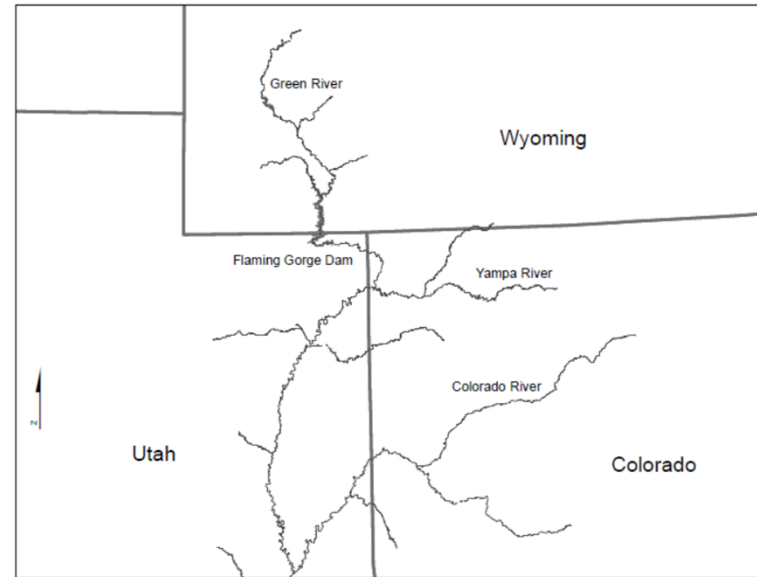
Hypothesis and research questions

Hypothesis: Hydropeaking limits recruitment success of aquatic insects, thus altering assemblage composition

Research questions:

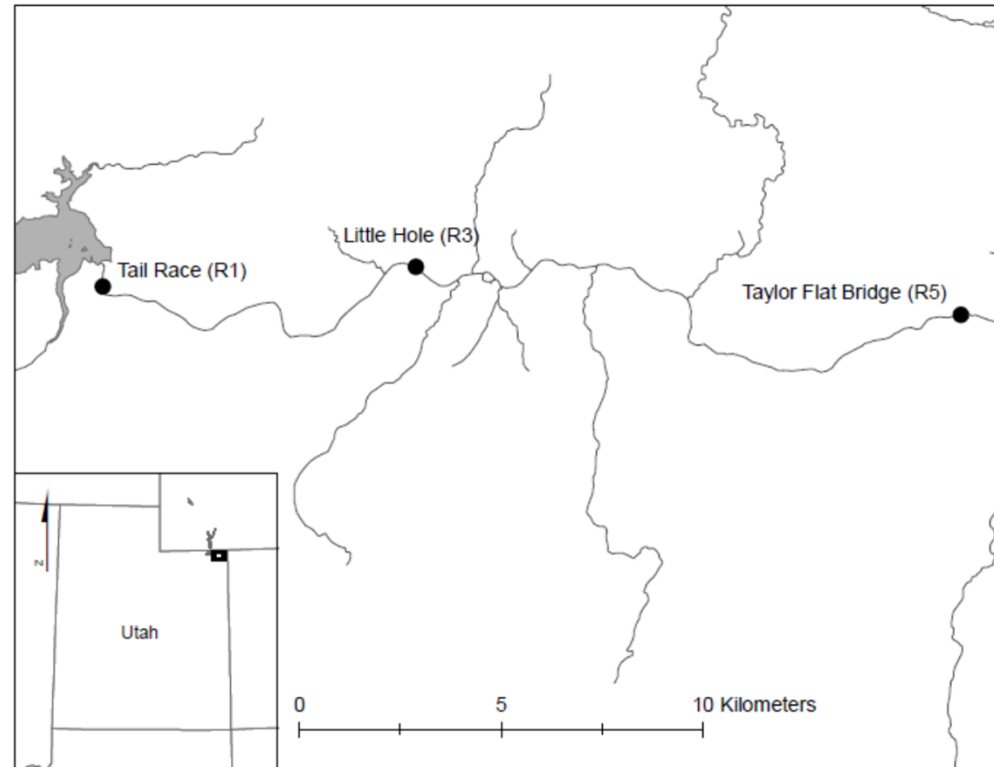
1. Are egg masses randomly distributed or differentially located in habitats impacted by hydropeaking?
2. Does hydropeaking reduce the availability of optimal oviposition habitats?
3. What are the implications of artificially high or low flows for insect recruitment?

Study area



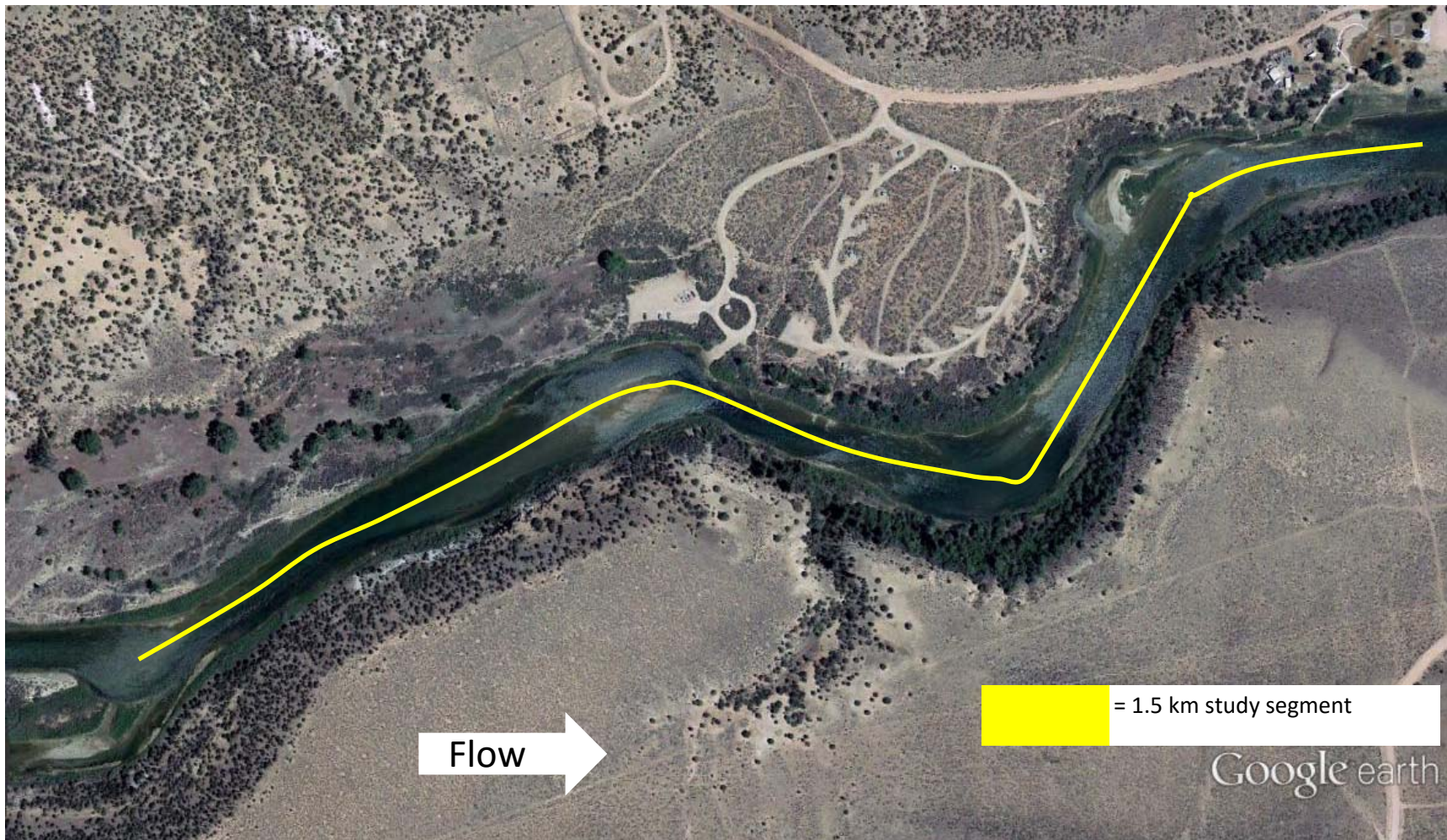
Study area

Selected three segments for study – represent a gradient of hydrogeomorphic conditions



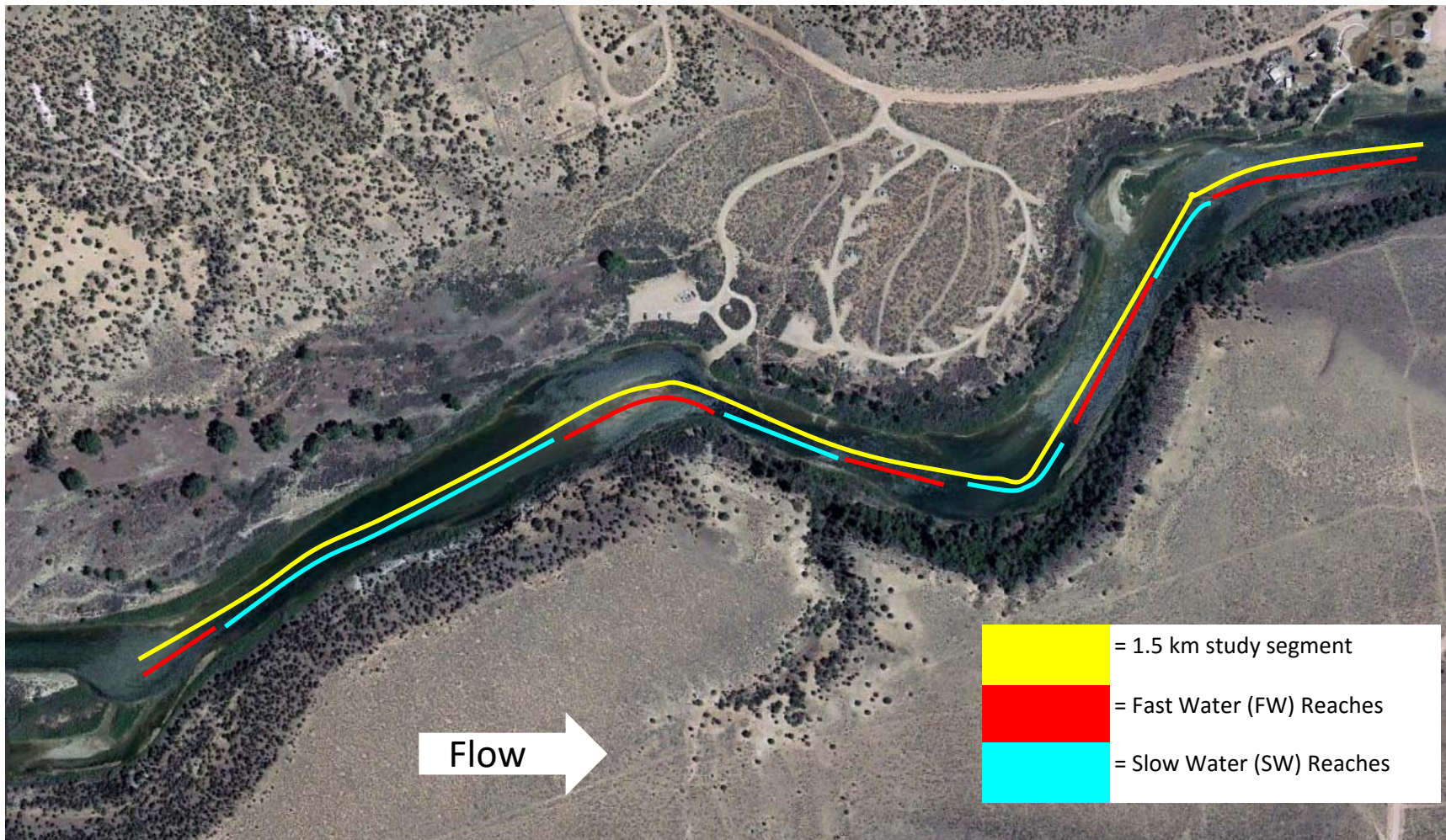
Oviposition habitat availability and utilization

1.5 km river segments



Oviposition habitat availability and utilization

1.5 km river segments: delineated fast- and slow-water habitats – randomly select 2 of each



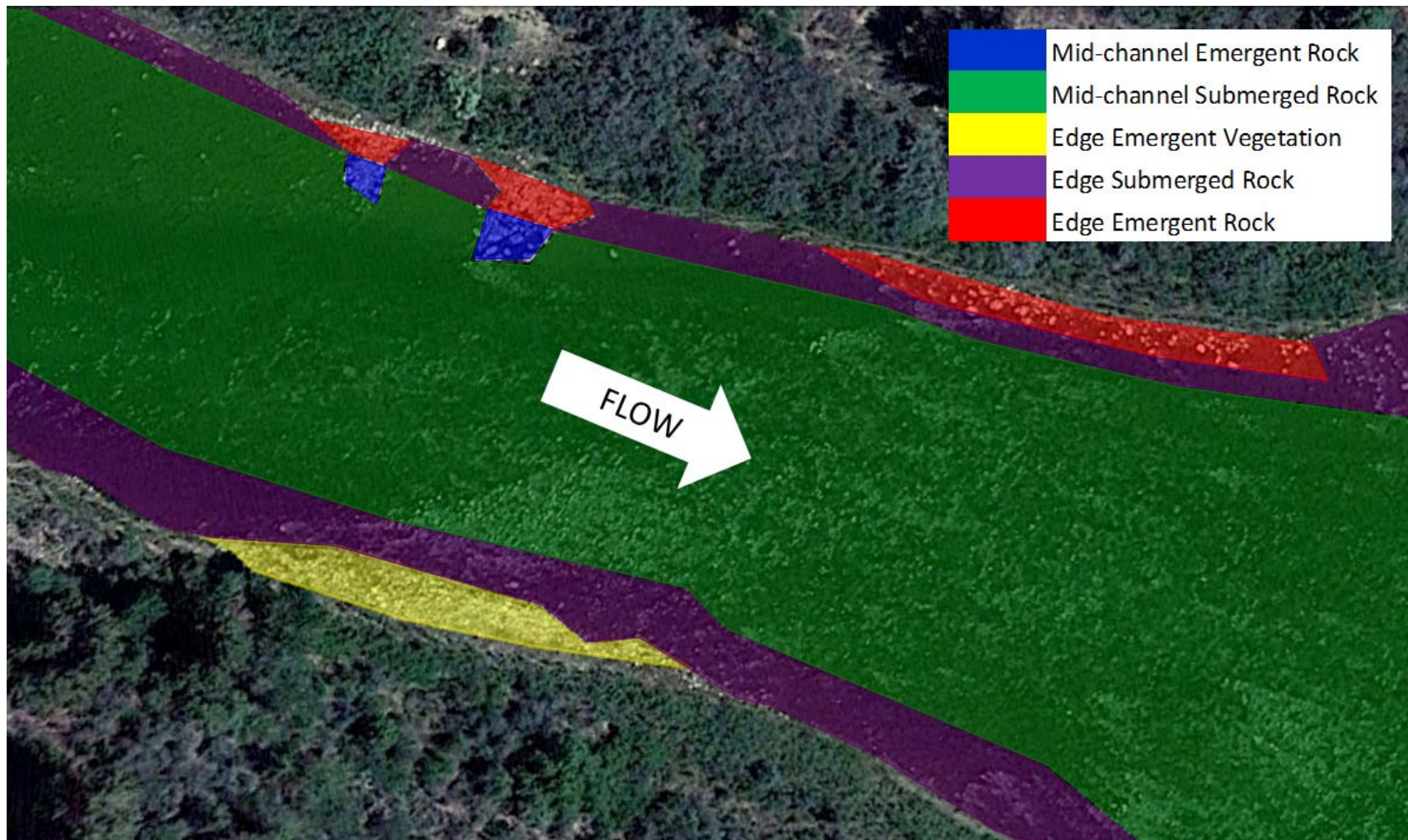
Oviposition habitat availability and utilization

2 stage sampling – 1st stage (availability): 5 transects with 10 sample pts. per transect



Oviposition habitat availability and utilization

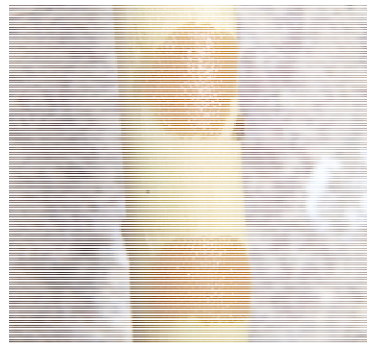
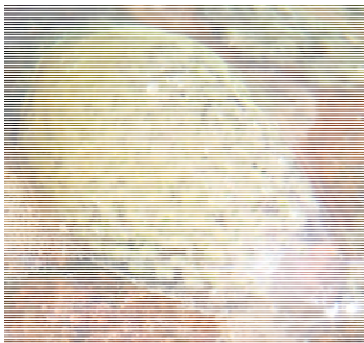
2 stage sampling – 2nd stage (use): stratification to sample rare habitats
(min. of 15 pts. per stratum)
Total points per reach: 75 - 100



Oviposition target taxa

Surveys conducted for:

- Trichoptera: *Hydropsyche occidentalis* and *Brachycentrus occidentalis*
- Ephemeroptera: *Baetis* spp.
- Diptera: Orthocnadiinae (likely *Eukiefferiella* spp.)



Oviposition habitat utilization – RF model results

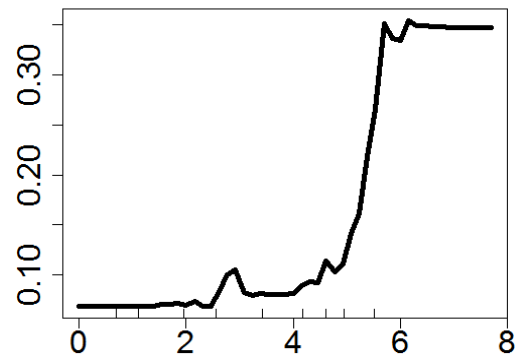
Consistent predictors among taxa:
distance from bankfull, water depth, substrate size, and emergent
substrate area

Predictor	<i>B. occidentalis</i>	<i>H. occidentalis</i>	Orthoclaadiinae
Distance from bank	X	X	X
Substrate size	X	X	X
Emergent area	X	X	X
Water depth	X	X	X
Embeddedness		X	
Velocity	X		
Segment		X	X
Habitat unit			X
R^2	51%	25%	67%

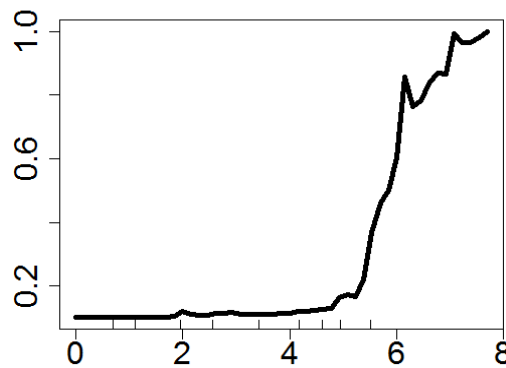
Oviposition habitat utilization – RF model results

Preference for large, emergent substrates

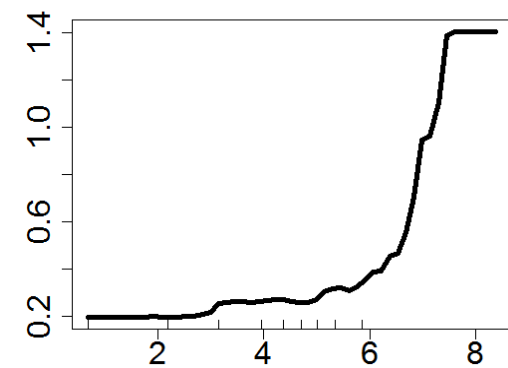
H. occidentalis



B. occidentalis

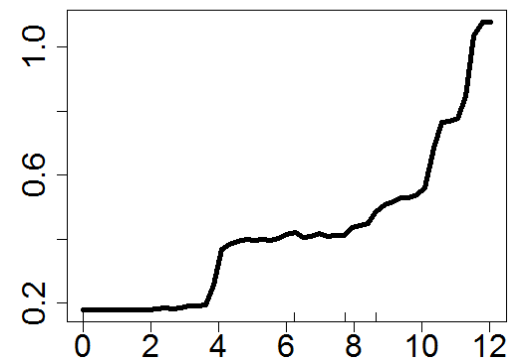
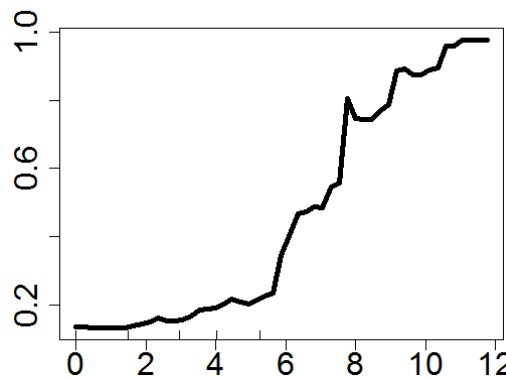
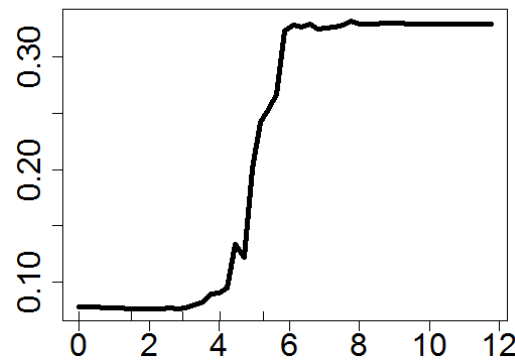


Orthoclaadiinae



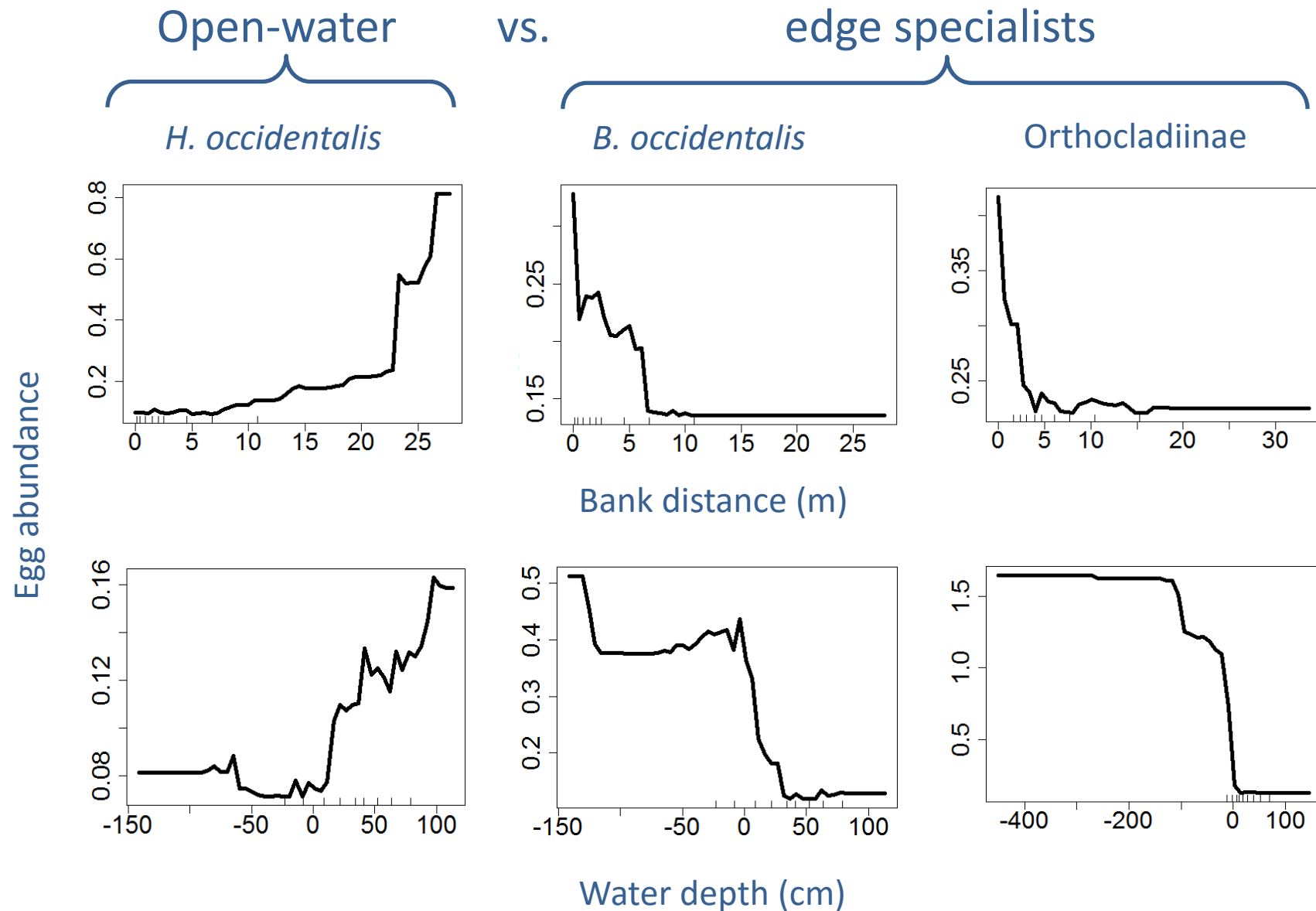
Egg abundance

log substrate size (mm)

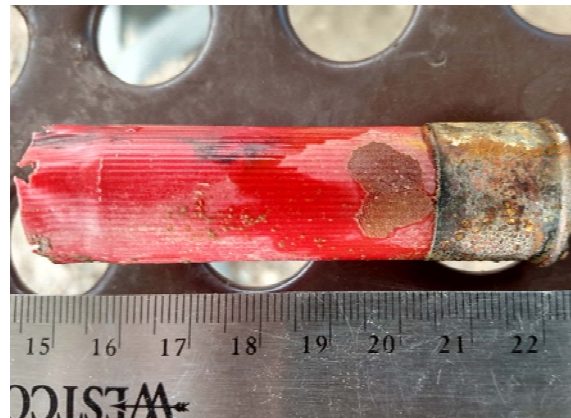


Emergent area (cm²)

Oviposition habitat utilization – RF model results

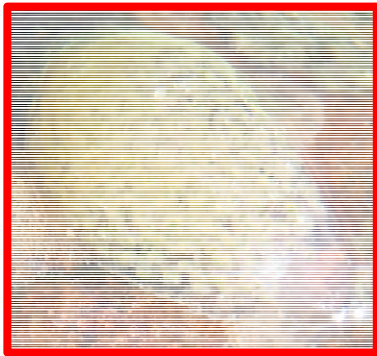


Oviposition habitat utilization



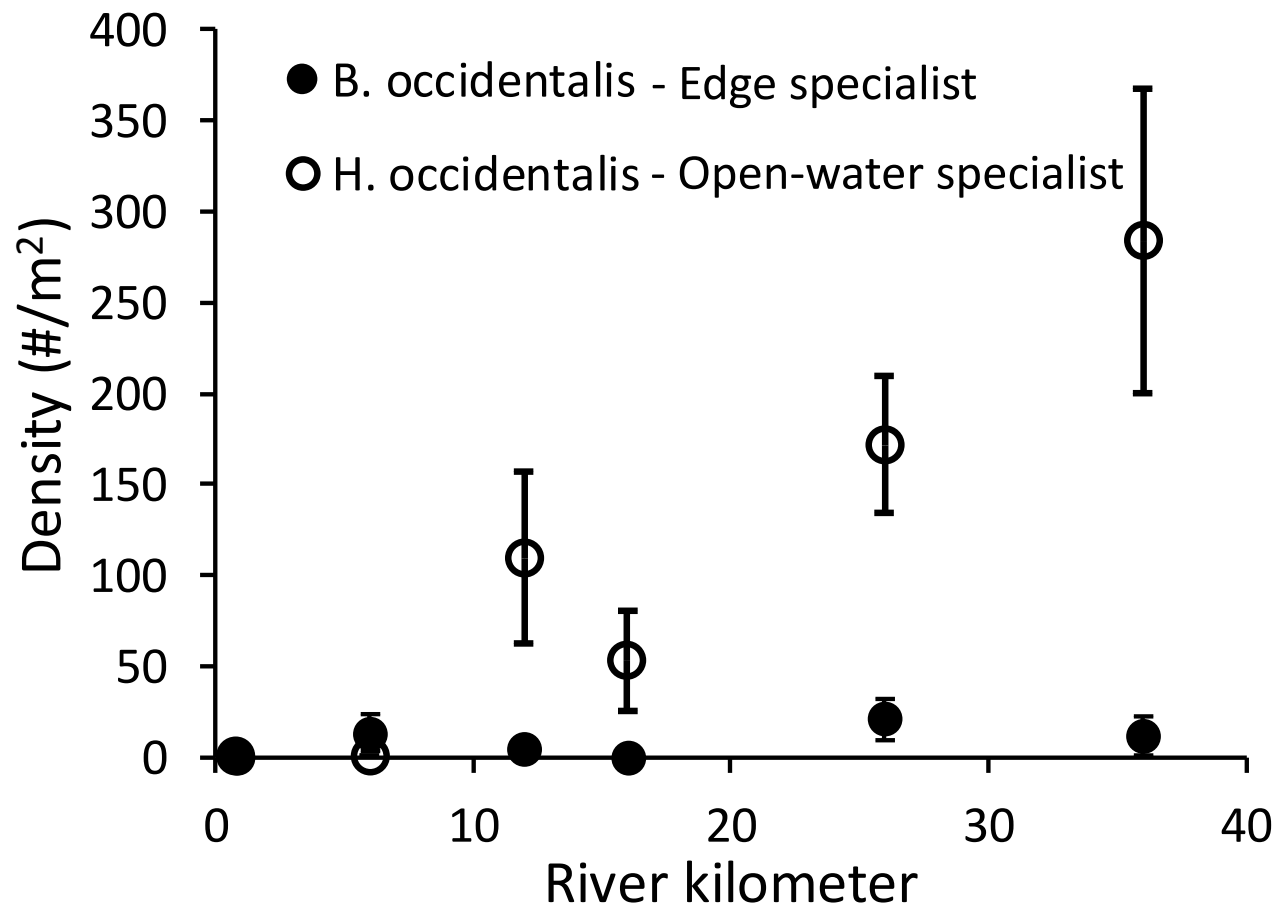
Oviposition habitat utilization results summary

Egg masses for 3 of 4 taxa located in habitats affected by hydropeaking: emergent rocks in the varial zone



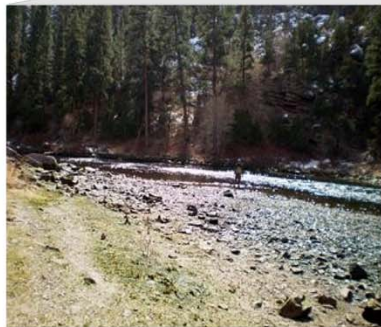
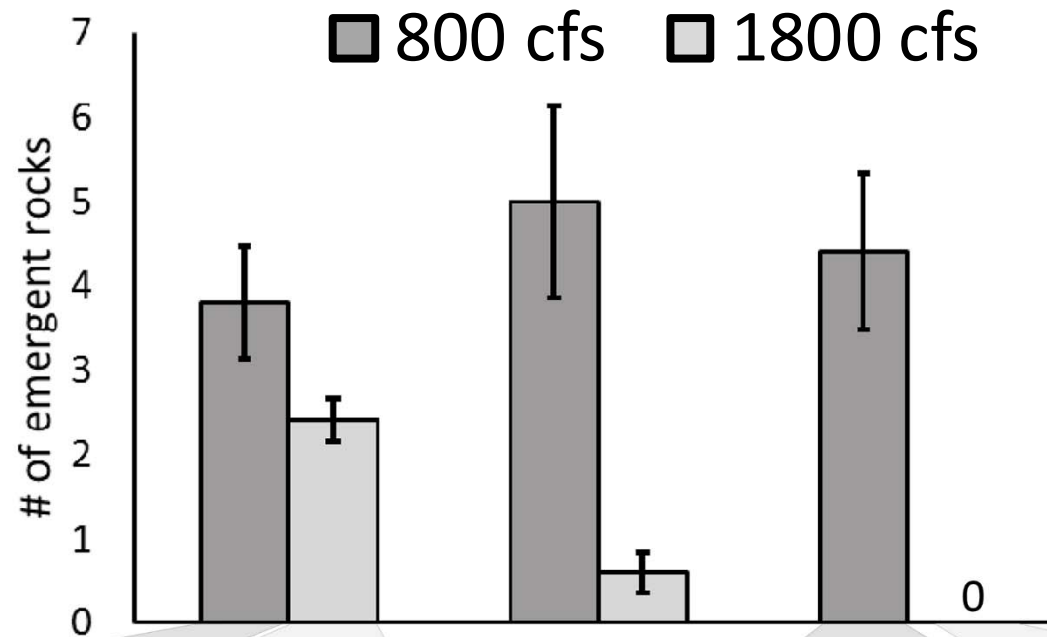
Consequences of hydropeaking and recruitment limitation

To what extent is hydropeaking induced recruitment limitation structuring assemblage composition?



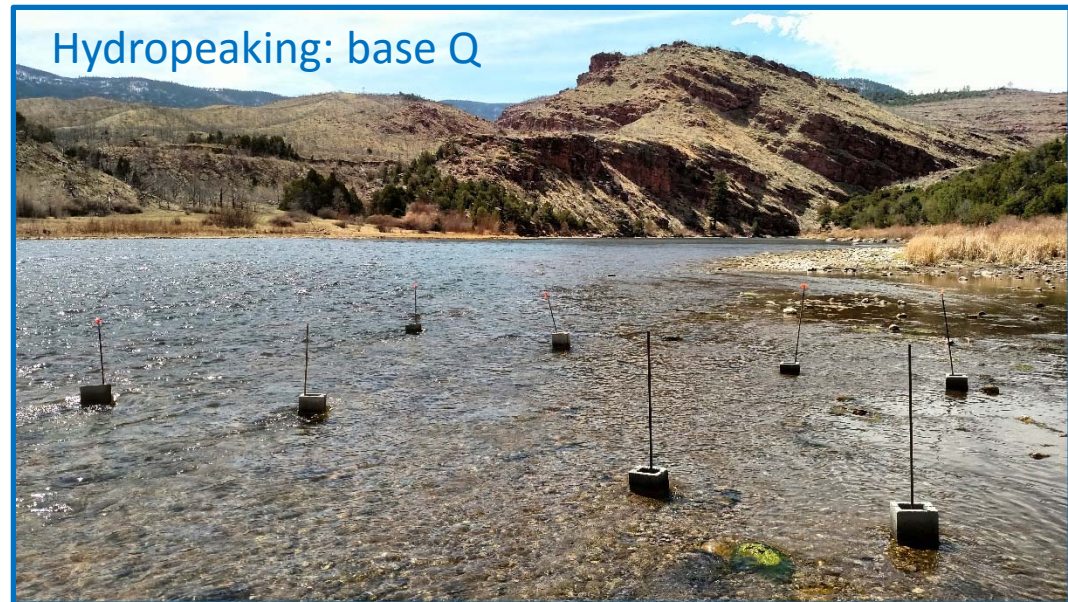
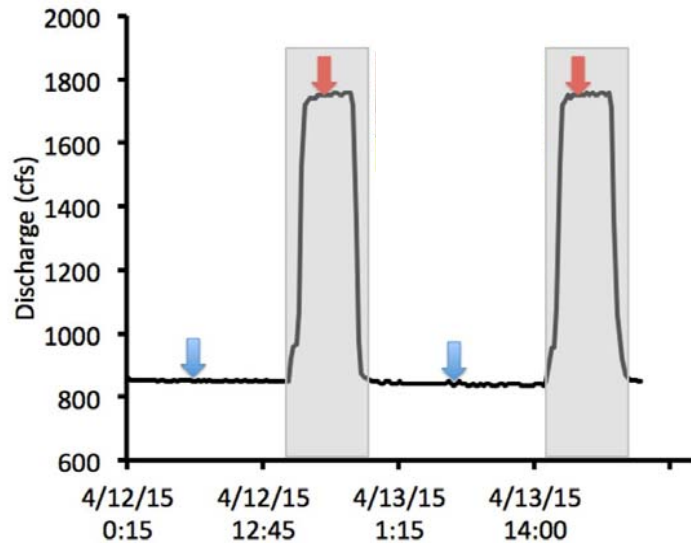
Hydropeaking effects on habitat availability

Hydropeaking significantly reduced the availability of optimal oviposition habitats – emergent rocks



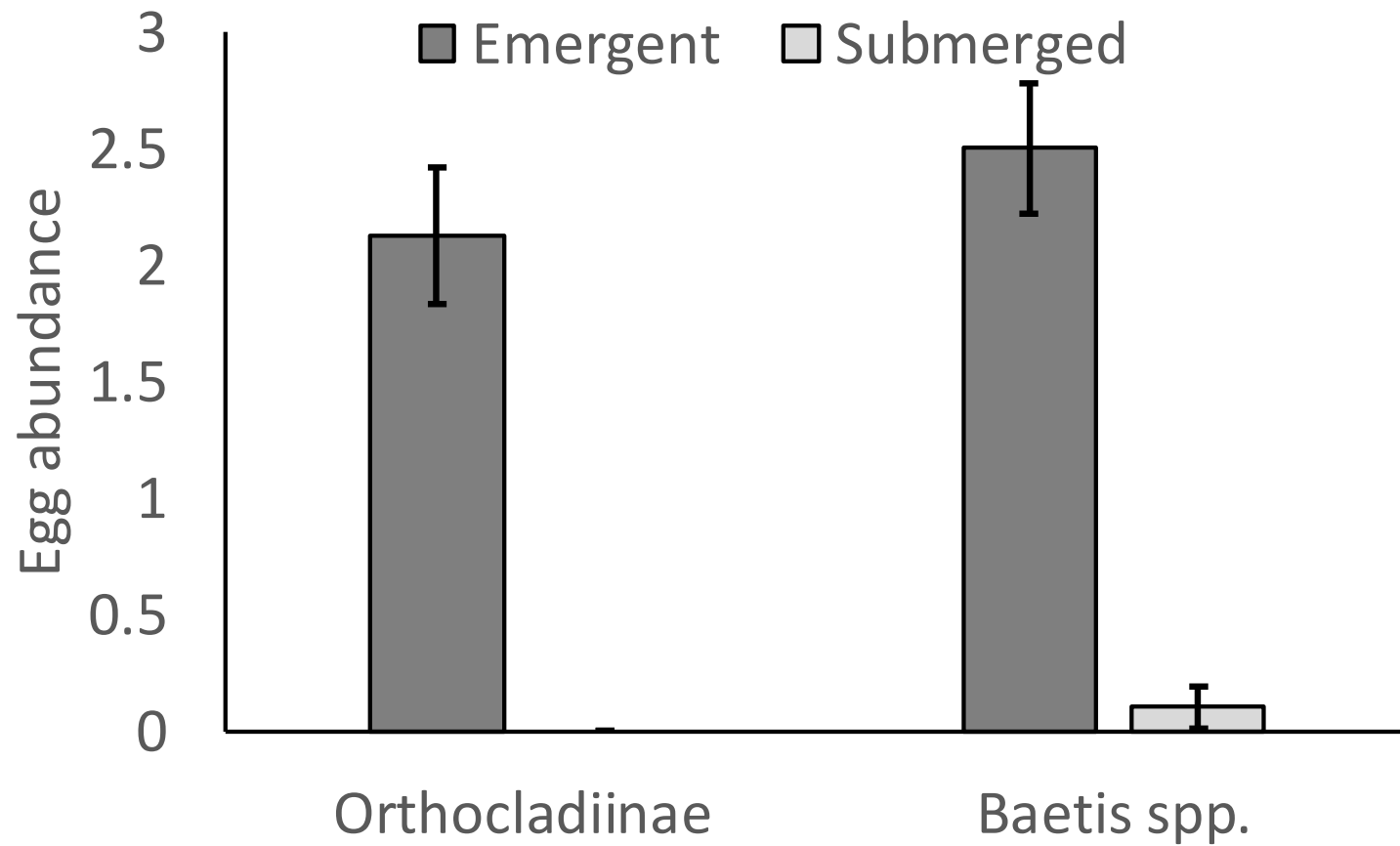
Hydropeaking effects on oviposition

Experimental substrate manipulations:
egg density f (submerged and emergent substrates)



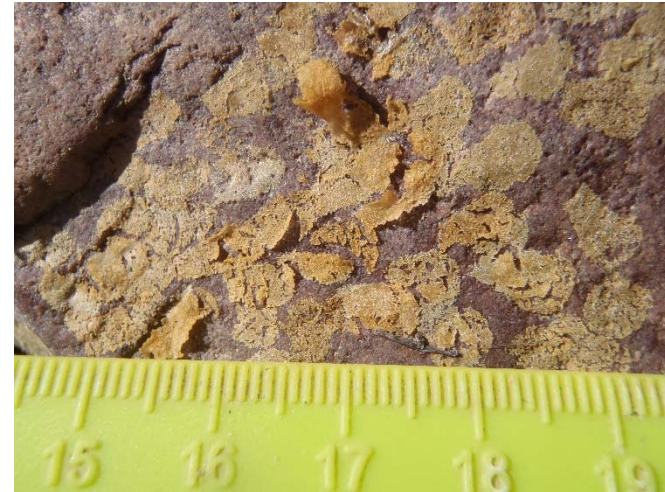
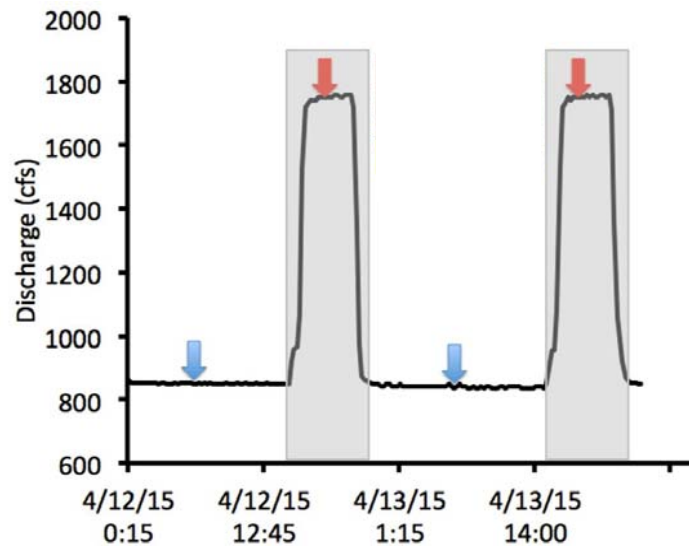
Hydropeaking effects on oviposition

Hydropeaking high flows have the potential to significantly reduced egg densities



Hydropeaking effects on egg viability

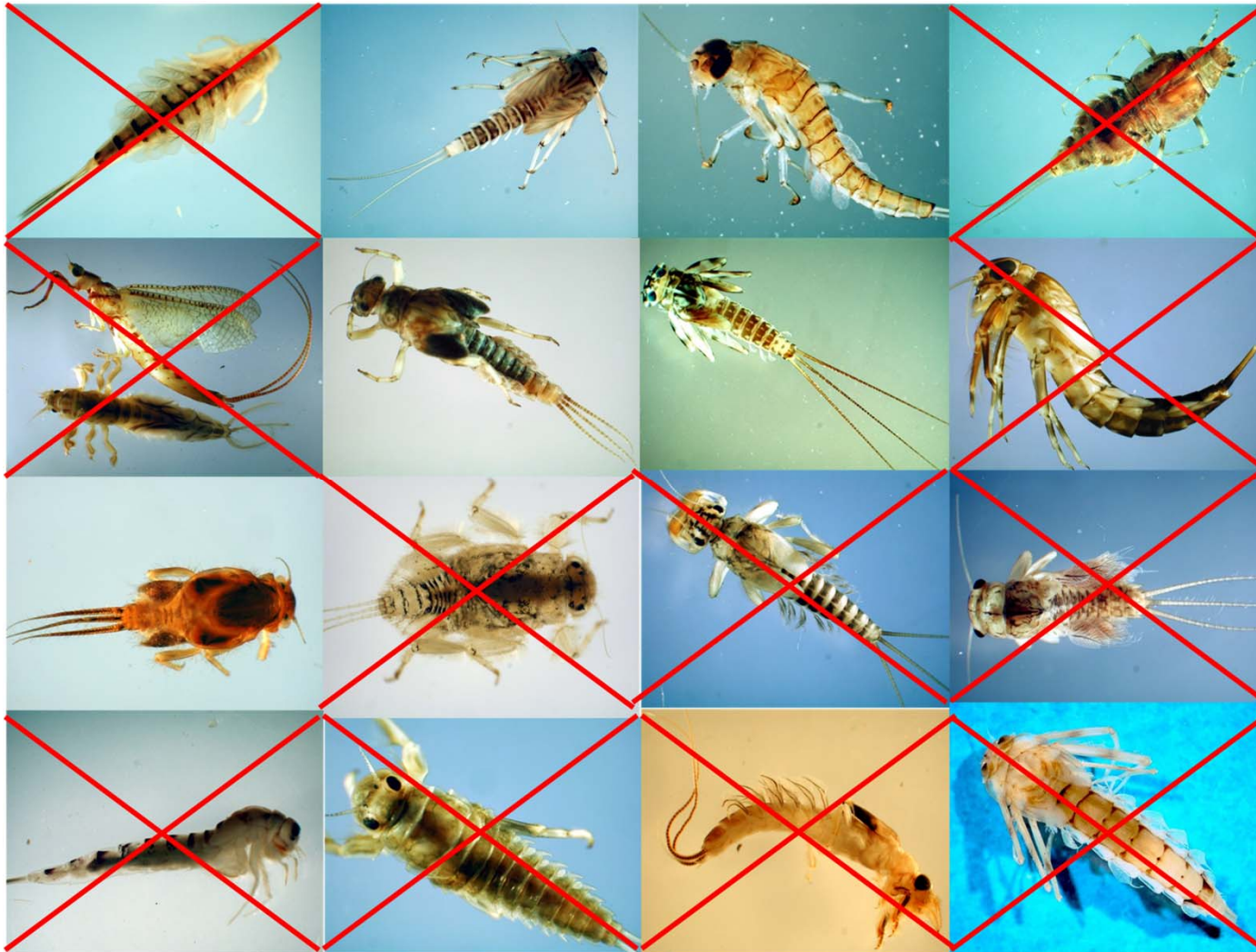
What is the desiccation tolerance of tailwater macroinvertebrates?



Jesse Fleri et al. – Poster 118: Desiccation effects

Consequences of hydropeaking for river biodiversity

Ted Kennedy et al. – S10 (Wednesday 13:45)



Conclusions

- Large river macroinvertebrates disproportionately use edge habitat for oviposition
 - Large emergent mineral substrates
- Hydropeaking can reduce the availability of optimal oviposition habitats
- Both hydropeaking high and low flows have the potential to reduce population recruitment, but by differing mechanisms – loss of habitat and desiccation, respectively
- Timing of hydropeaking, both seasonally and within day, could be managed to increase recruitment