

**EFFECTS OF THE VARIABLE FLOW  
REGIME ON THE  
ECOLOGY OF THE  
BLACK CANYON OF THE BEAR  
RIVER, IDAHO**

**John Gangemi  
River Science Institute, Inc.**

**Part I: Experimental Design**

**Part II: Study Reaches**

**Part III: Methods**

**Part IV: Results**

**Part V: Conclusion**

# Part I

## *Experimental Design*

# Study Objectives

Examine the effects of a variable flow regime (scheduled whitewater releases) on the river channel shape, substrate and aquatic biota.

## Specifically investigate

- 1) **Macroinvertebrates**—population trends, diversity and community indices;
- 2) **Organic Matter**—Ash-Free Dry Weight (AFDW);
- 3) **Periphyton**—chlorophyll concentration and biomass;
- 4) **Fisheries**—population trends, community composition, fish condition;
- 5) **Filamentous Algae**—density; and
- 6) **Channel Morphology**—shape and substrate composition.

# Study Design & Schedule

- **Years 2005-2007—Baseline monitoring**
  - Comparisons between reaches to identify similarities and differences
  - Comparisons within reaches over time to evaluate variability
- **Years 2008-2010—Experimental / Treatment Phase**
  - Monitor physical and biological response to variable flow regime (scheduled whitewater releases ranging from 800 to 1500 cfs) below Grace Dam
  - Comparisons within reaches between baseline and experimental data set

# Part II

## *Study Reaches*

# Part II—Study Reaches

**Reach 1** — reference reach partially regulated by Bear Lake

**Reach 2** — treatment reach regulated by Grace Dam

**Reach 3** — treatment reach regulated by Grace Dam

**Reach 4** — treatment reach regulated by Grace Dam

# Reach 1: Bailey Creek Road



Upstream view from LB



Downstream view



Transect A



# Reach 2: Below Grace Dam

Transect E (ID DEQ T5)



Transect D (ID DEQ T2)



# Reach 2

Downstream view, Transect B



Upstream view, Transect C





# Reach 3: Black Canyon



View from South Canyon Rim, Transects C, D and E.

# Reach 3: Black Canyon



Upstream view, Transects B, C & D.



View from RB between Transect E.



# Reach 4: Upstream of Grace Power Plant



Upstream view from Transect E



Downstream view from Transect E

# Part III

# Methods

# Channel Morphology and Substrate



Figure 9:  
Reach 2, Transect 5  
Left Bank Pin

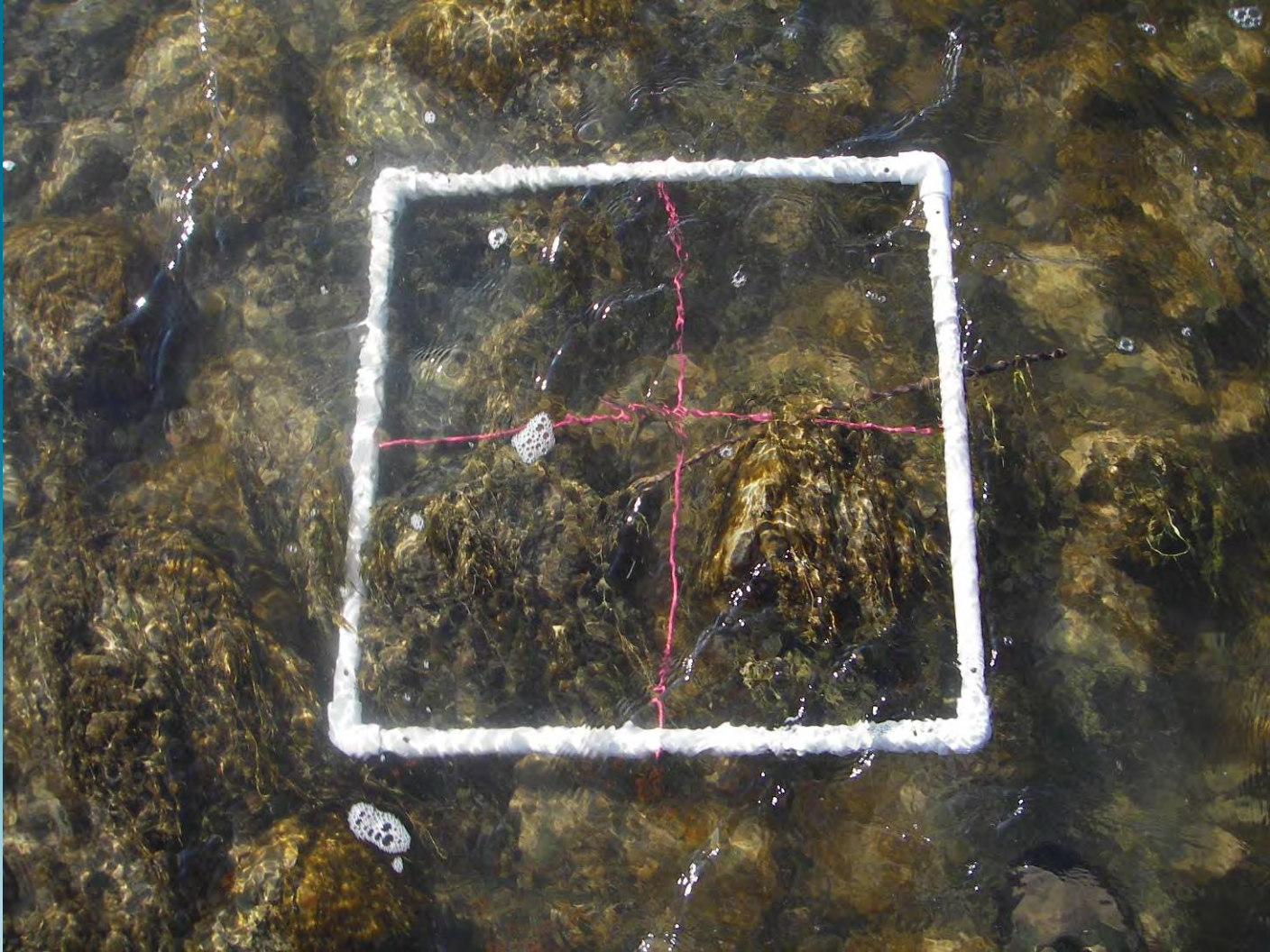


# Periphyton





# Filamentous Algae



# Fisheries





# Benthic Macroinvertebrates



# Statistical Analysis

**Between Reach Comparisons** —Single Factor ANOVA (alpha = 0.1), non-parametric Kruskal Wallis H-test

**Between Year Comparisons Within Individual Reaches** —Single Factor ANOVA (alpha = 0.1), non-parametric Kruskal Wallis H-test

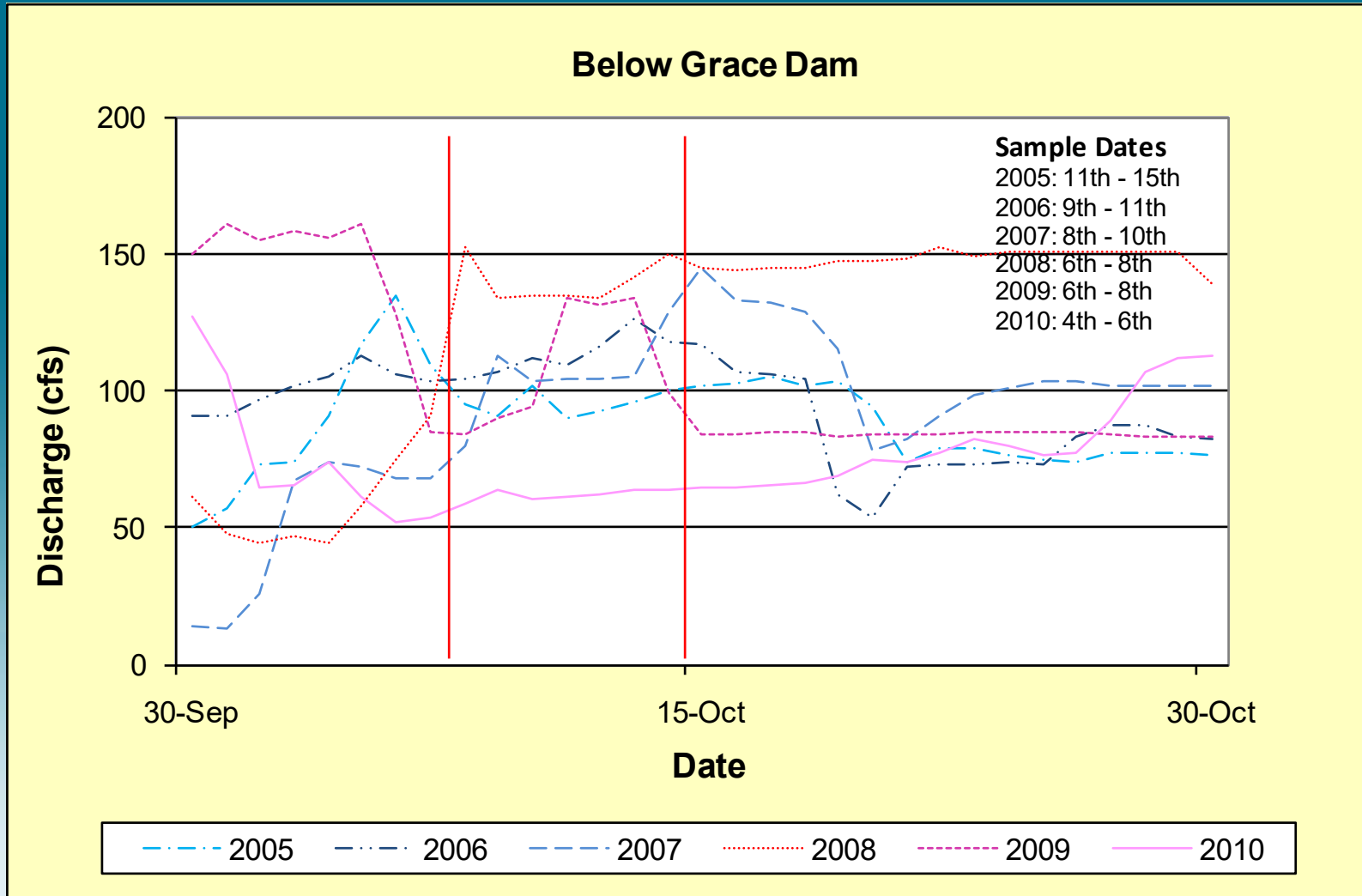
**BMI Sample Variability** —Power Analysis of Taxa Richness (alpha=beta=0.1)

# Part IV

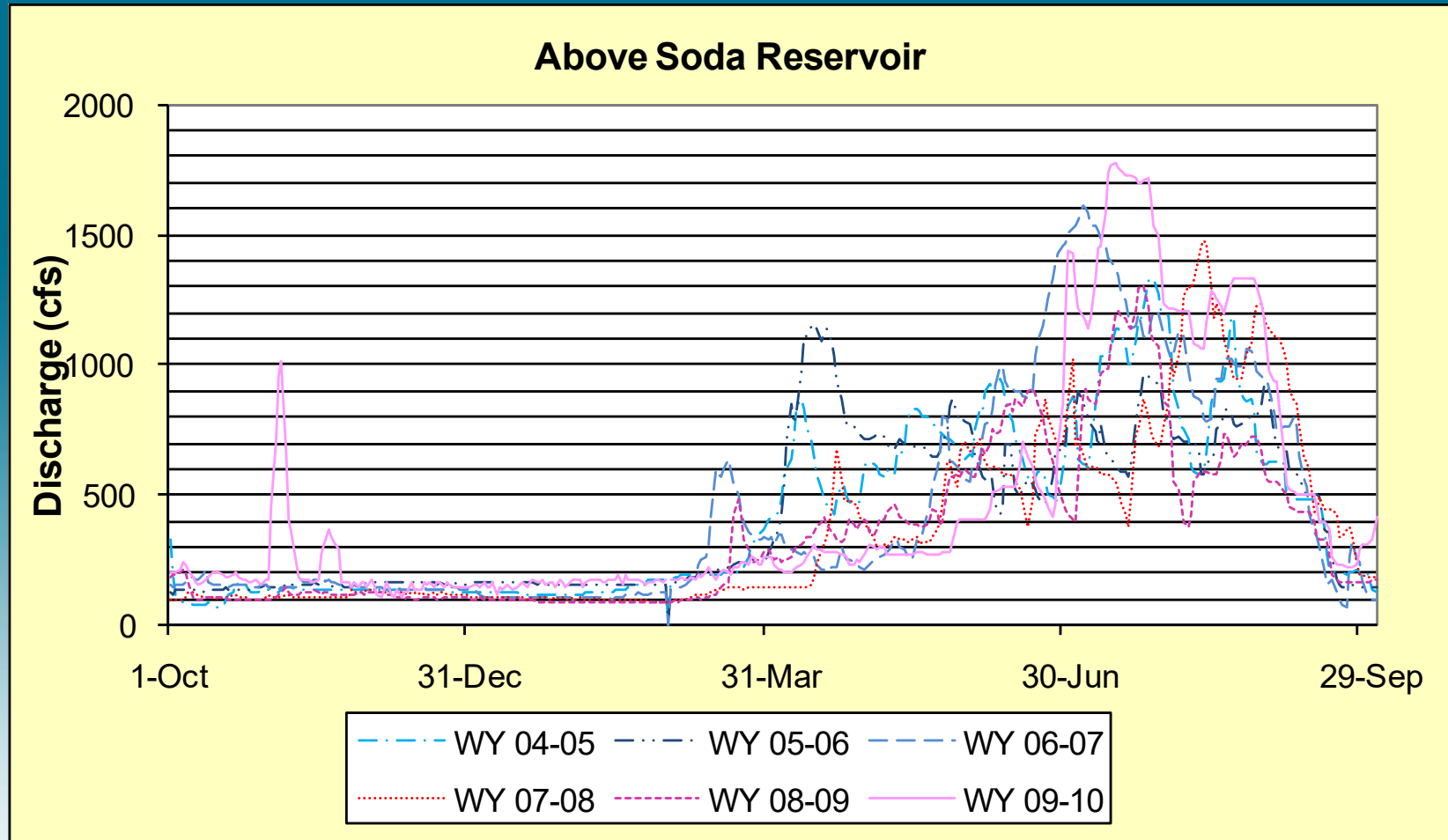
# Results



# Bear River Discharge, October 2005 through 2010

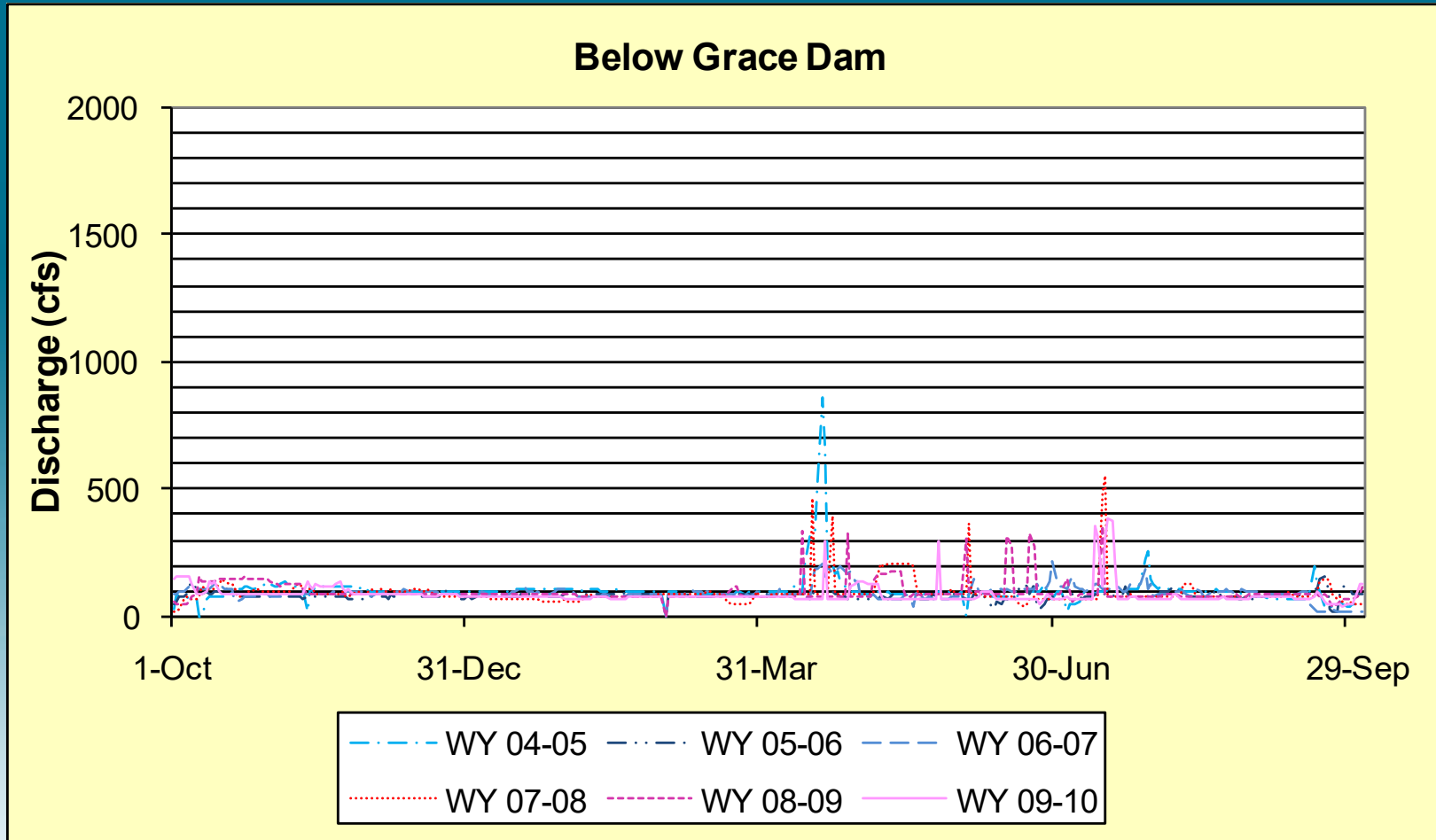


# Bear River Annual Discharge, 2005 - 2010 WYs

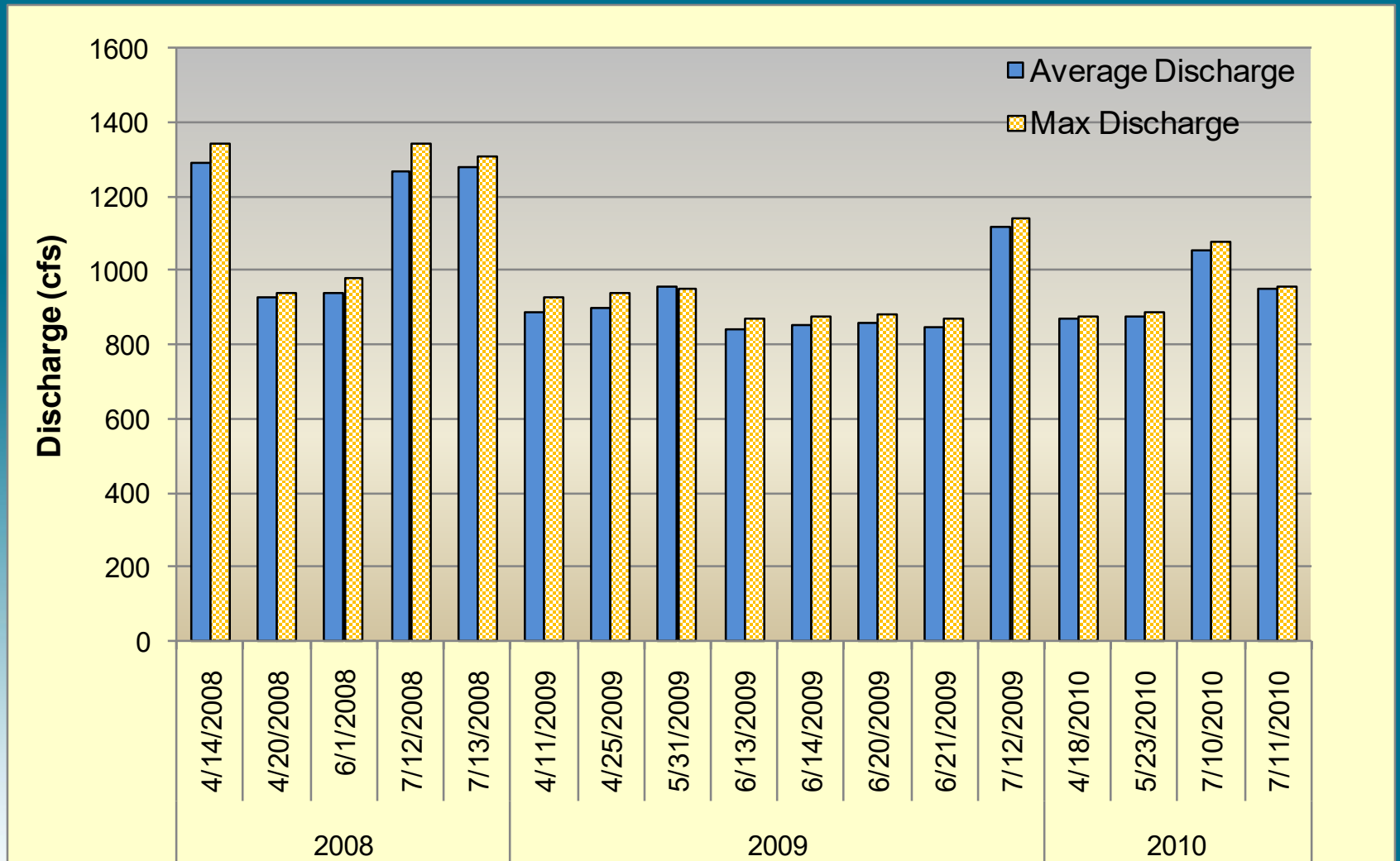




# Bear River Annual Discharge, 2005 - 2010 WYs

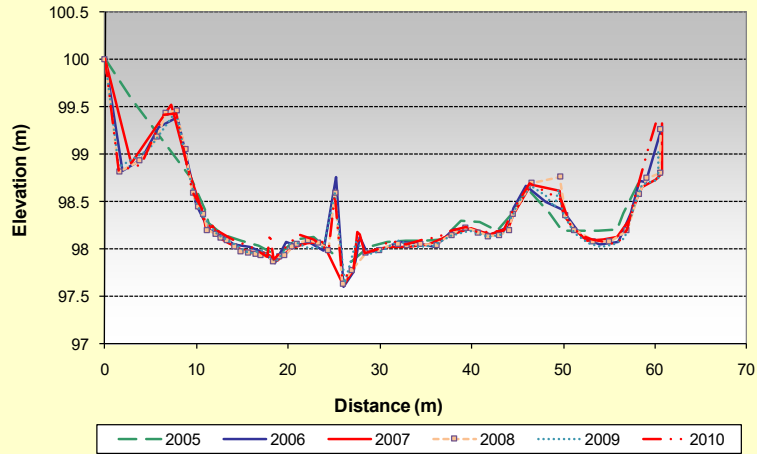


# Variable Flow Releases, 2008 - 2010

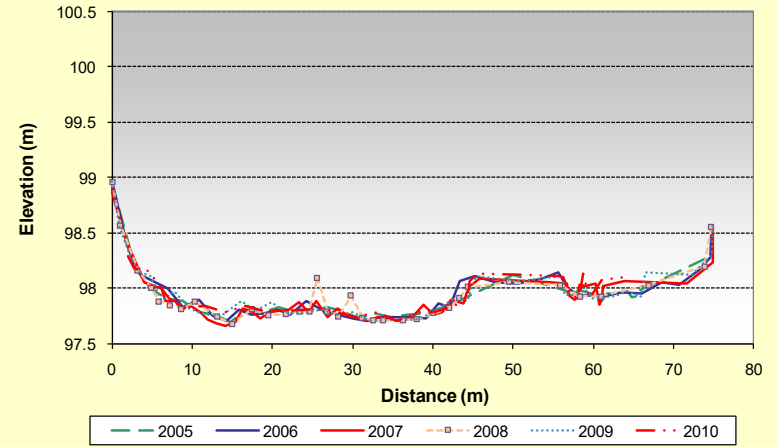


# Channel Cross Sections—Reach 2

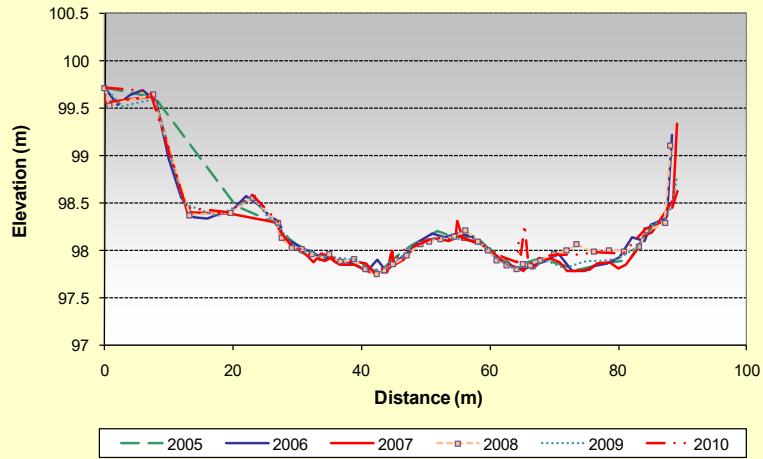
Reach 2, Transect A



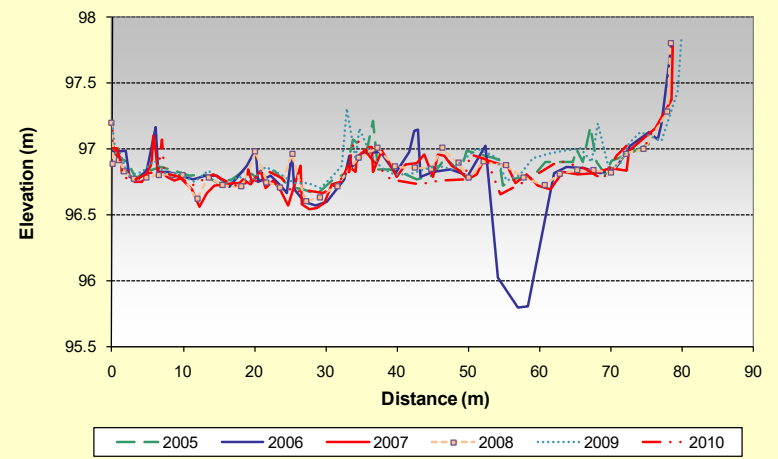
Reach 2, Transect C



Reach 2, Transect B

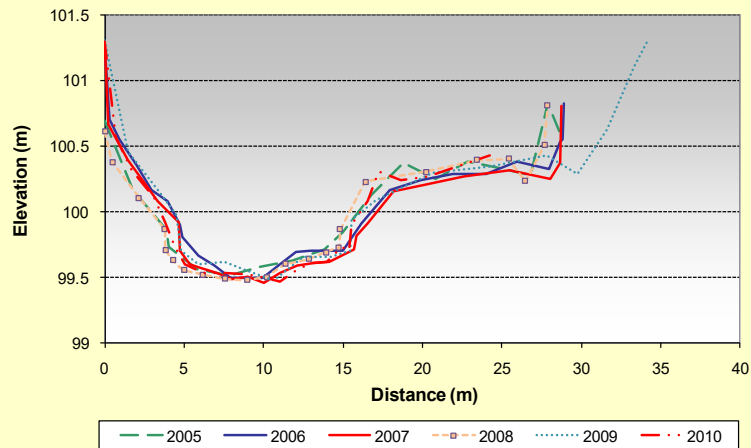


Reach 2, Transect D

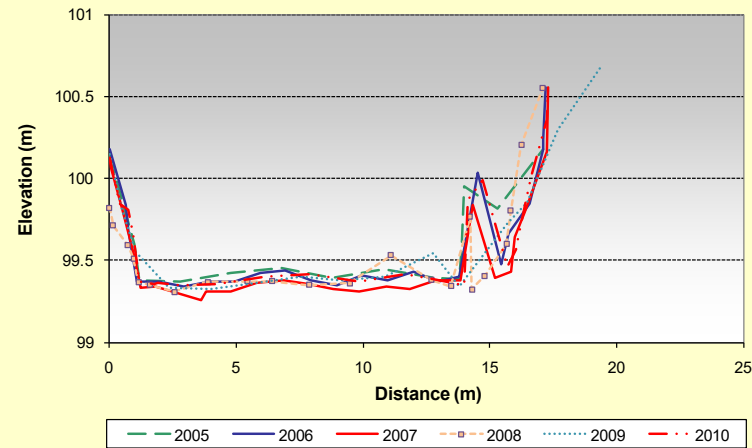


# Channel Depths—Reach 3

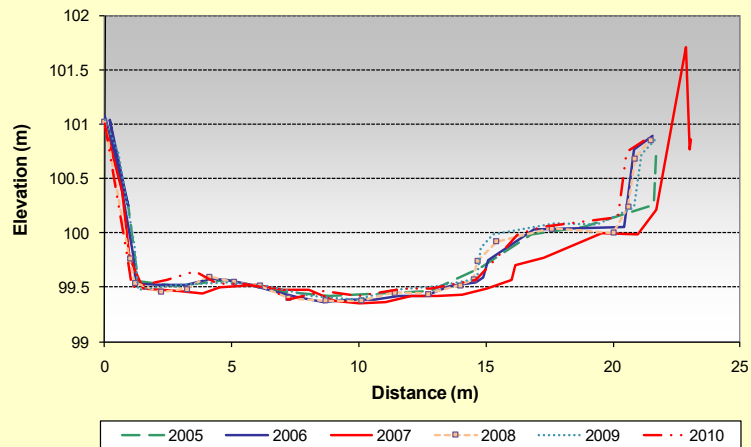
### Reach 3, Transect A



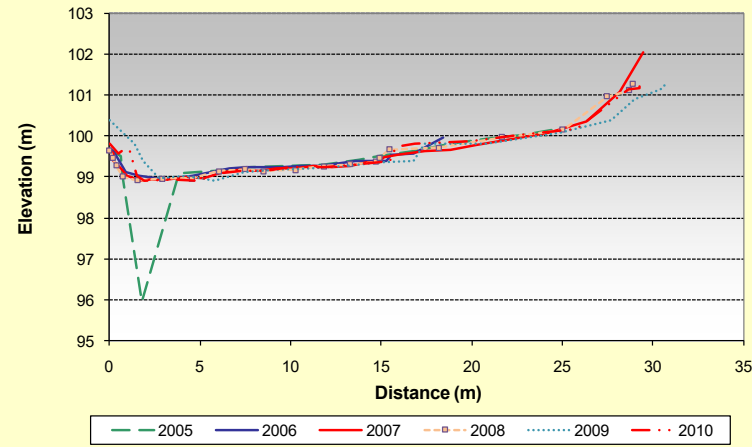
### Reach 3, Transect C



### Reach 3, Transect B

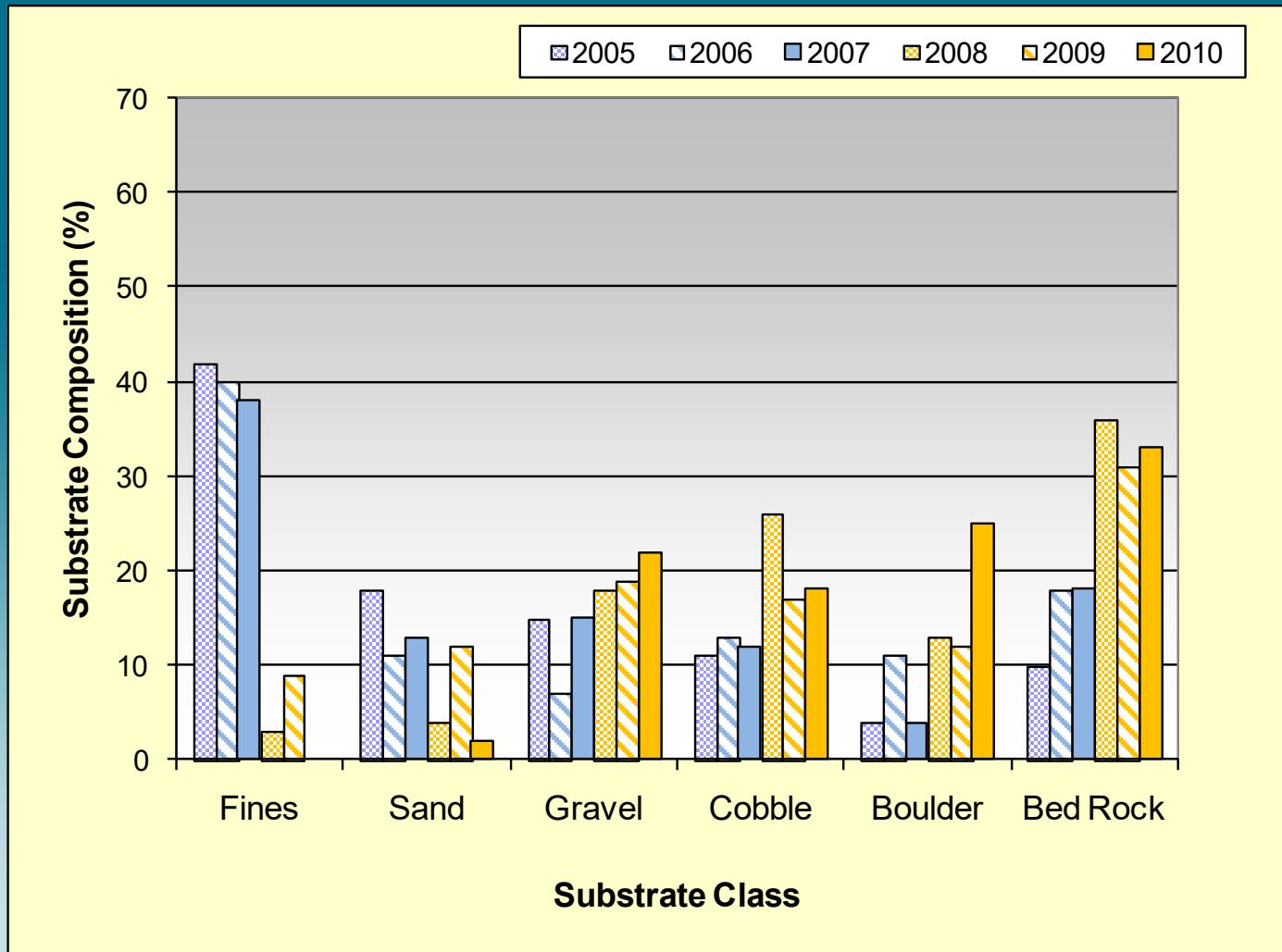


### Reach 3, Transect D



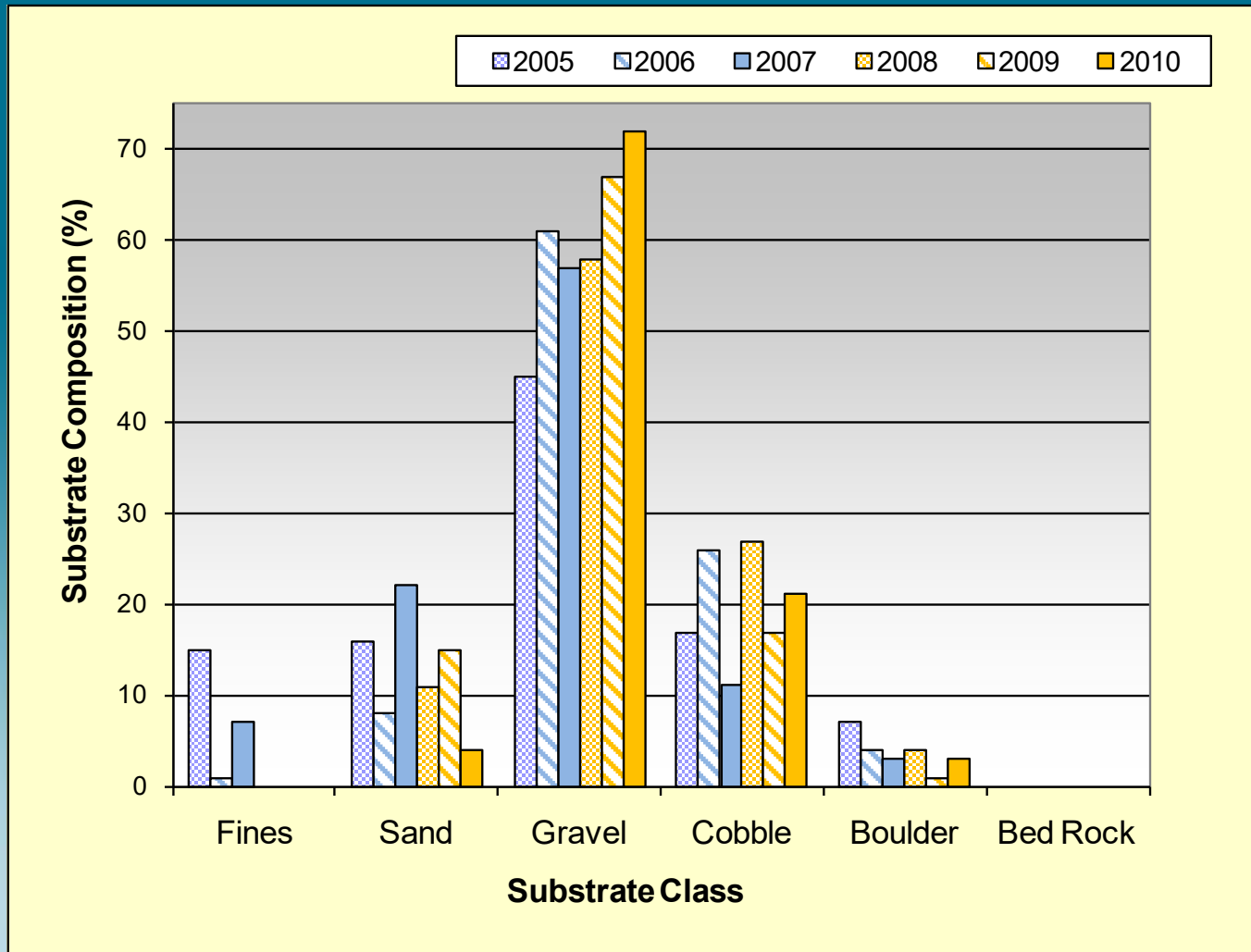
# Reach 2—Substrate composition 2005 - 2010

## Wolman Pebble Count

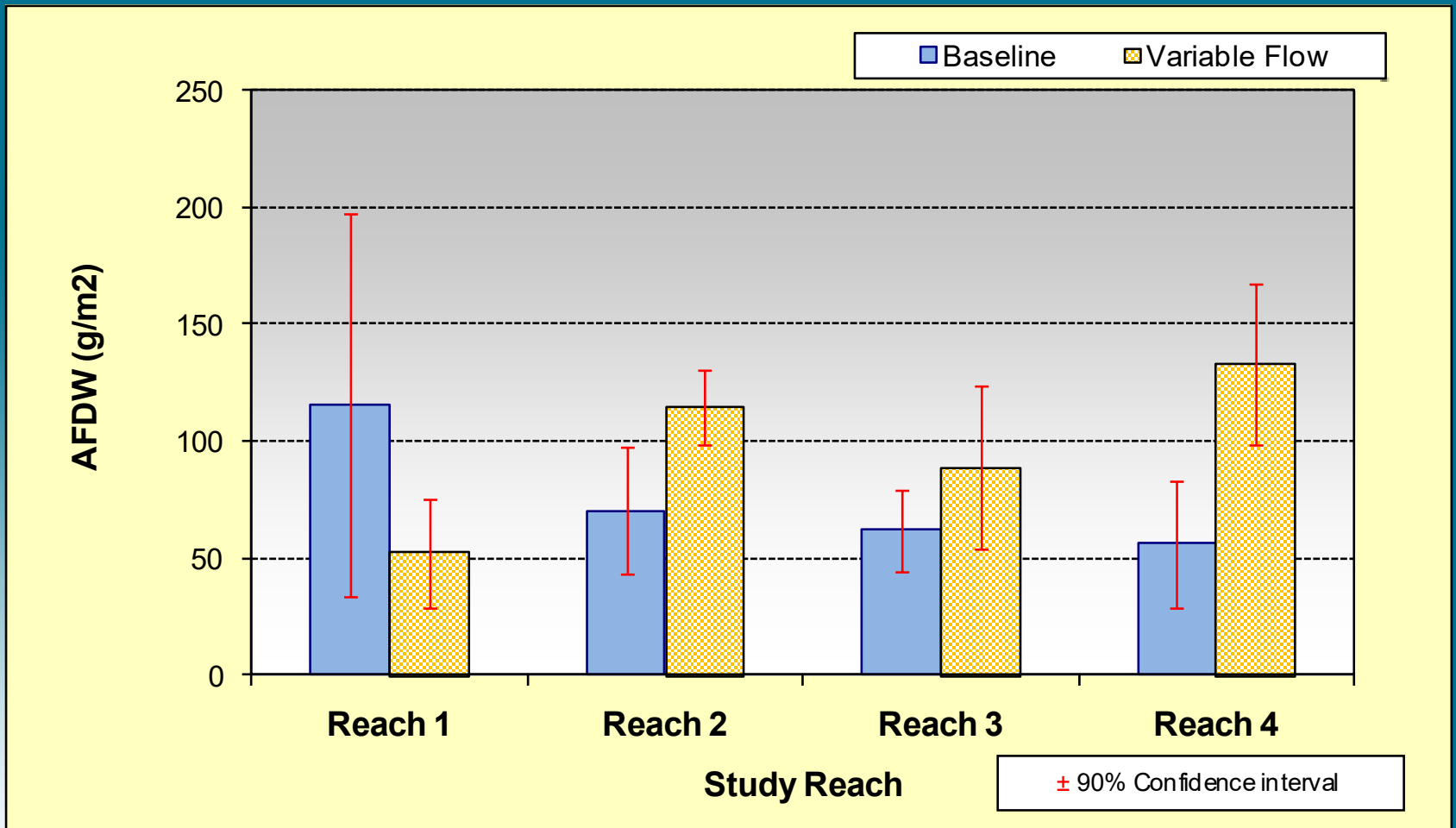


# Reach 3—Substrate composition 2005 - 2010

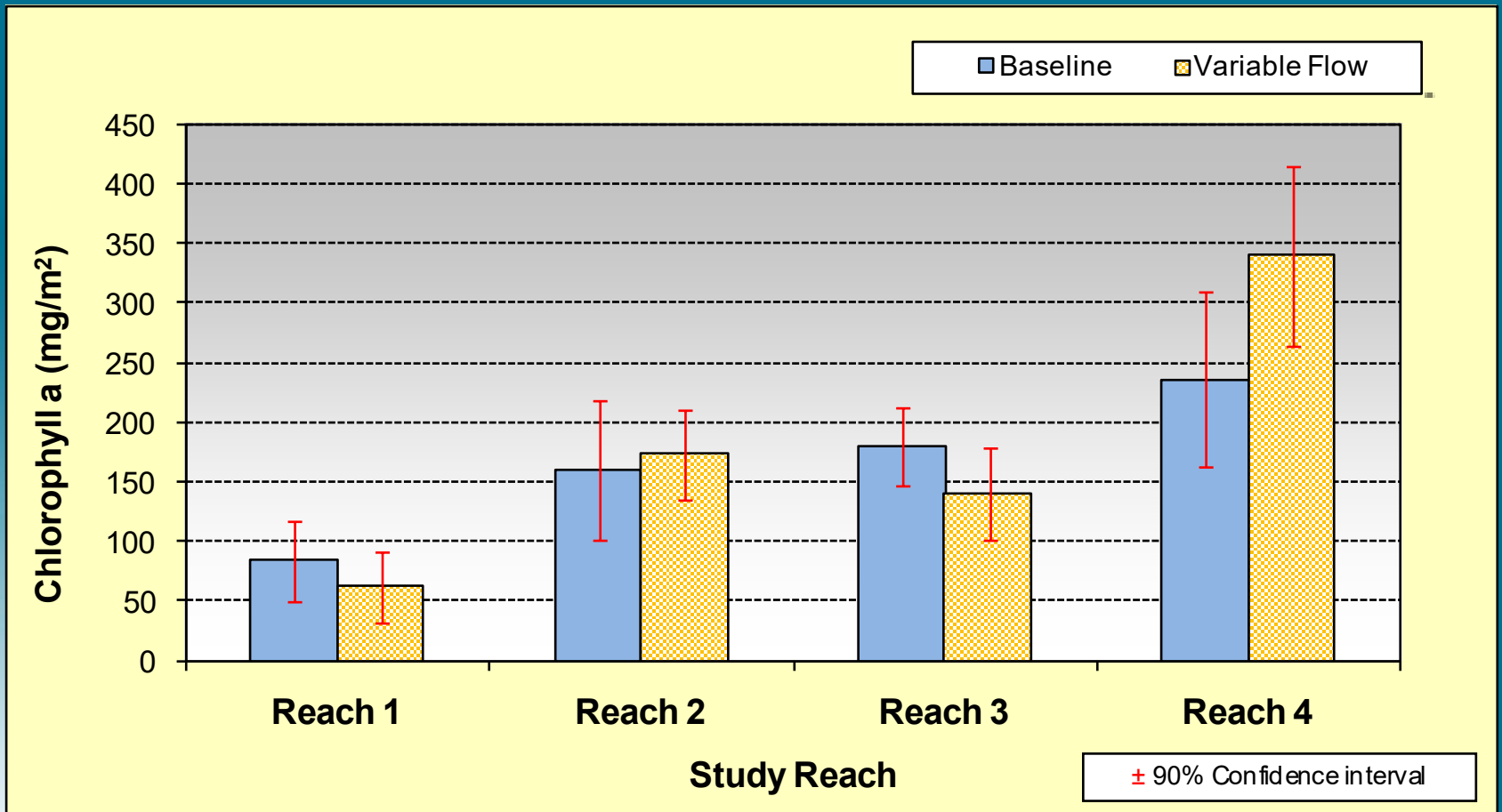
## Wolman Pebble Count



# Periphyton mean AFDW, baseline phase versus variable flow phase

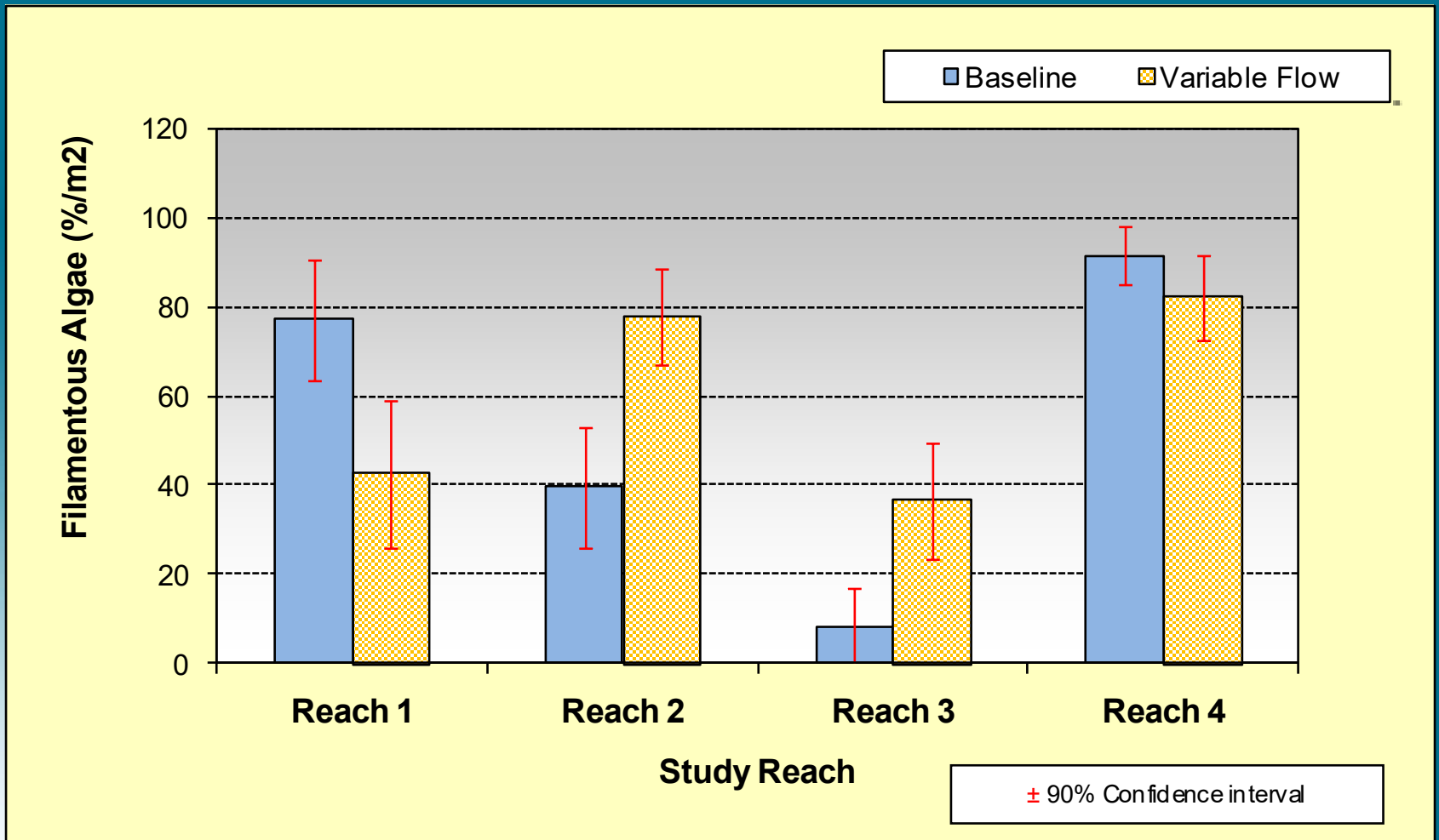


# Periphyton Chlorophyll a, baseline phase versus variable flow phase

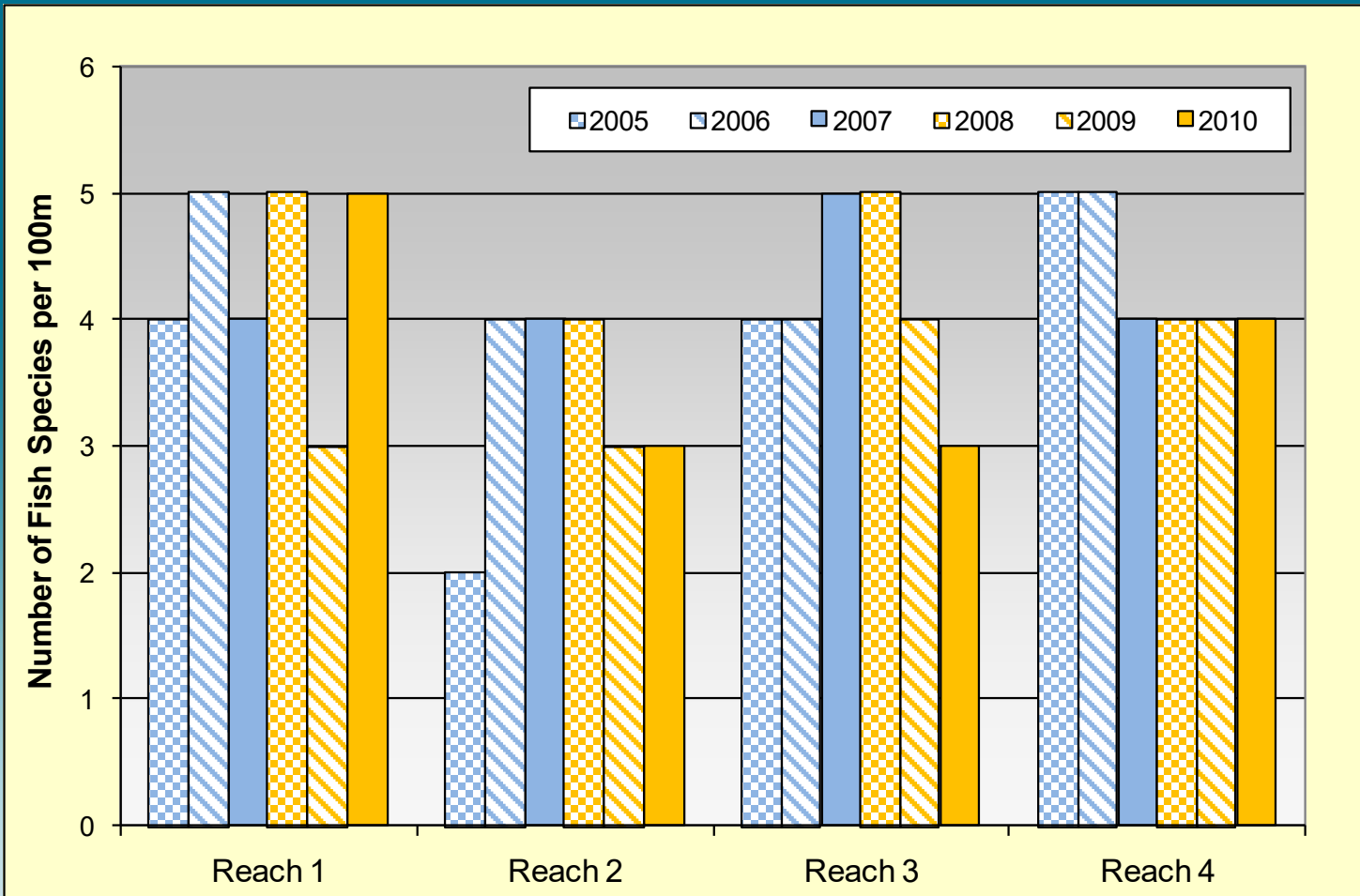




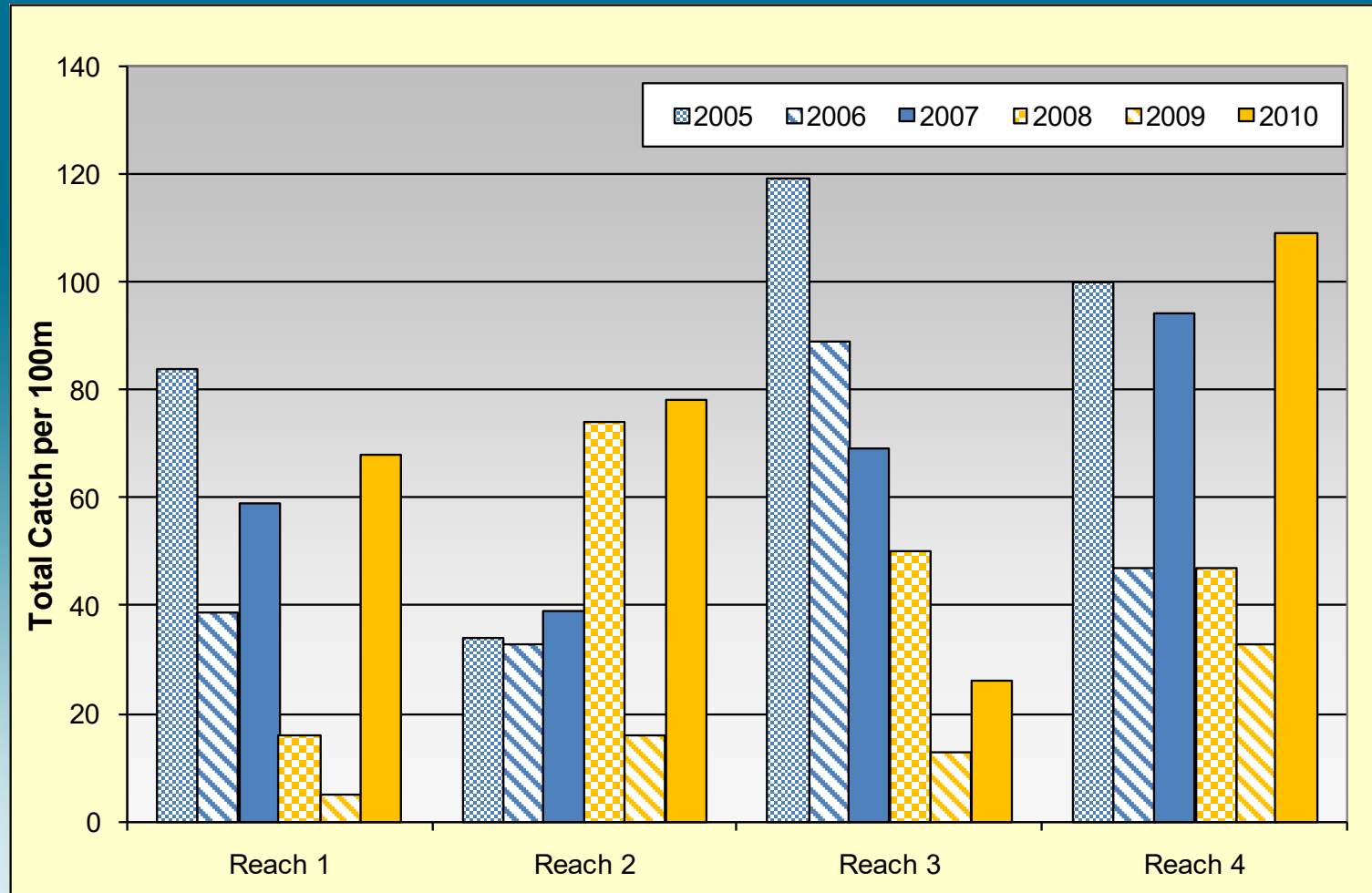
# Filamentous Algae Coverage, baseline phase versus variable flow phase



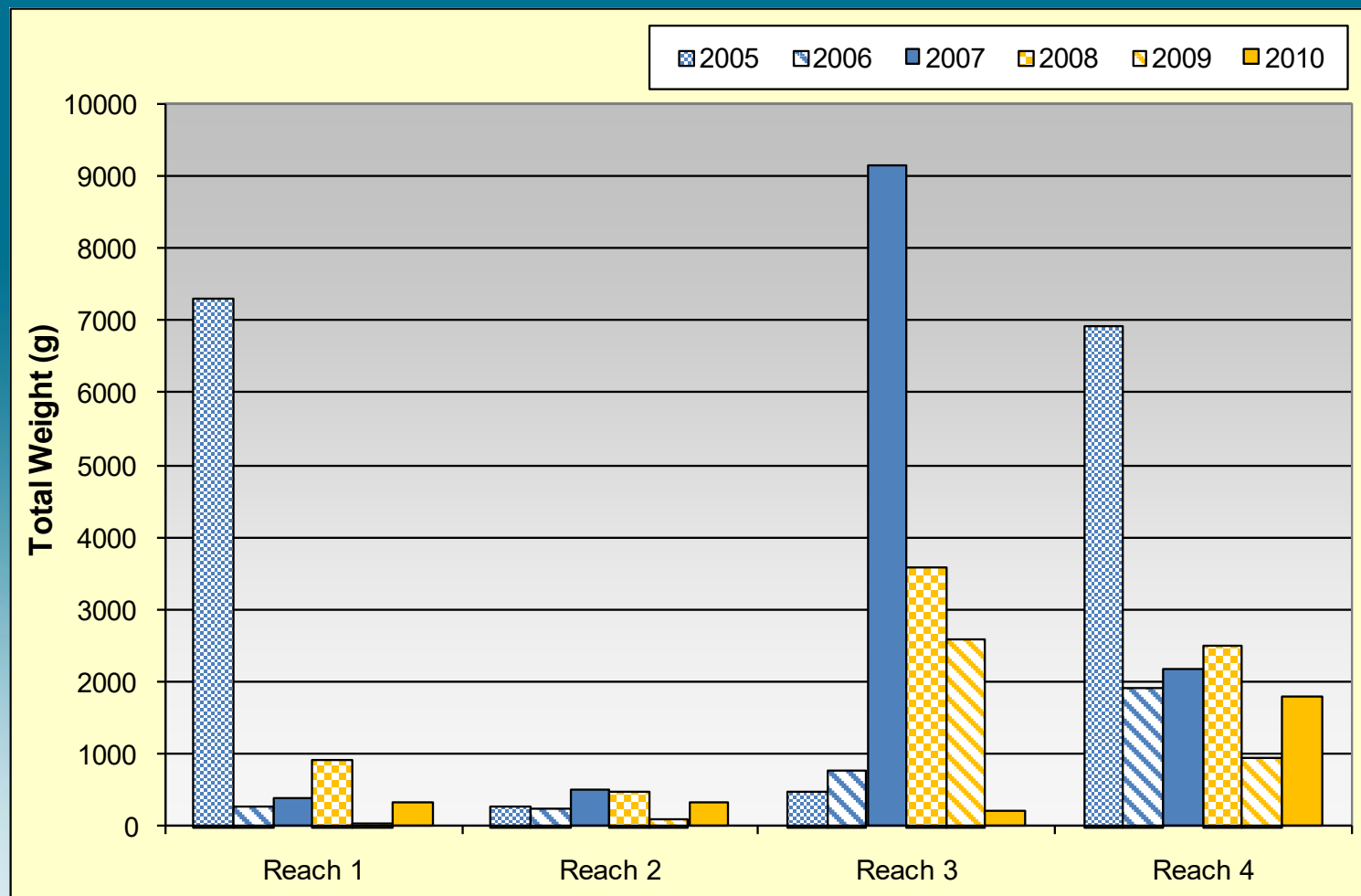
# Fish Species Richness, October 2005 - 2010



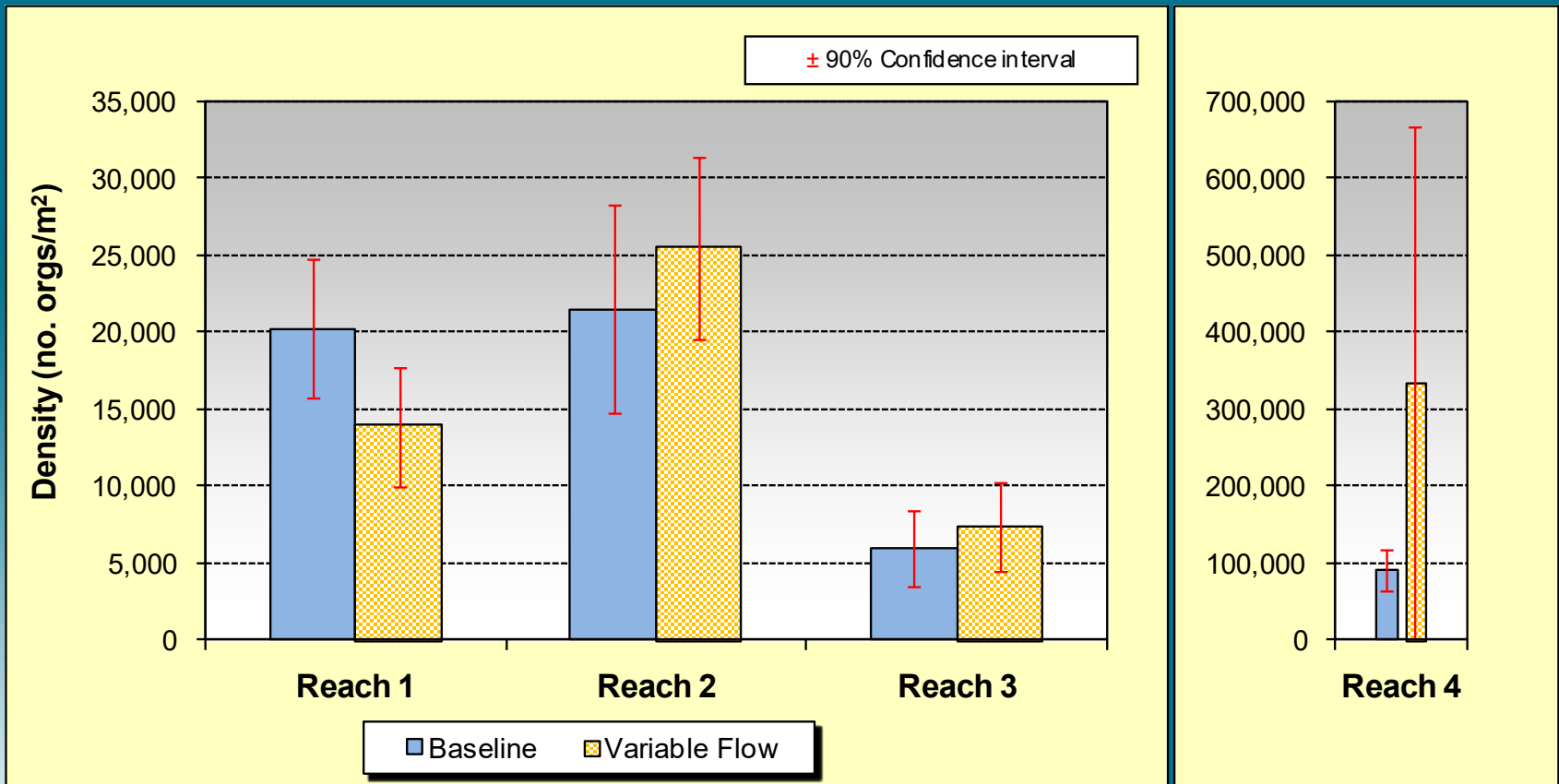
# Total Catch per 100 meters, October 2005 - 2010



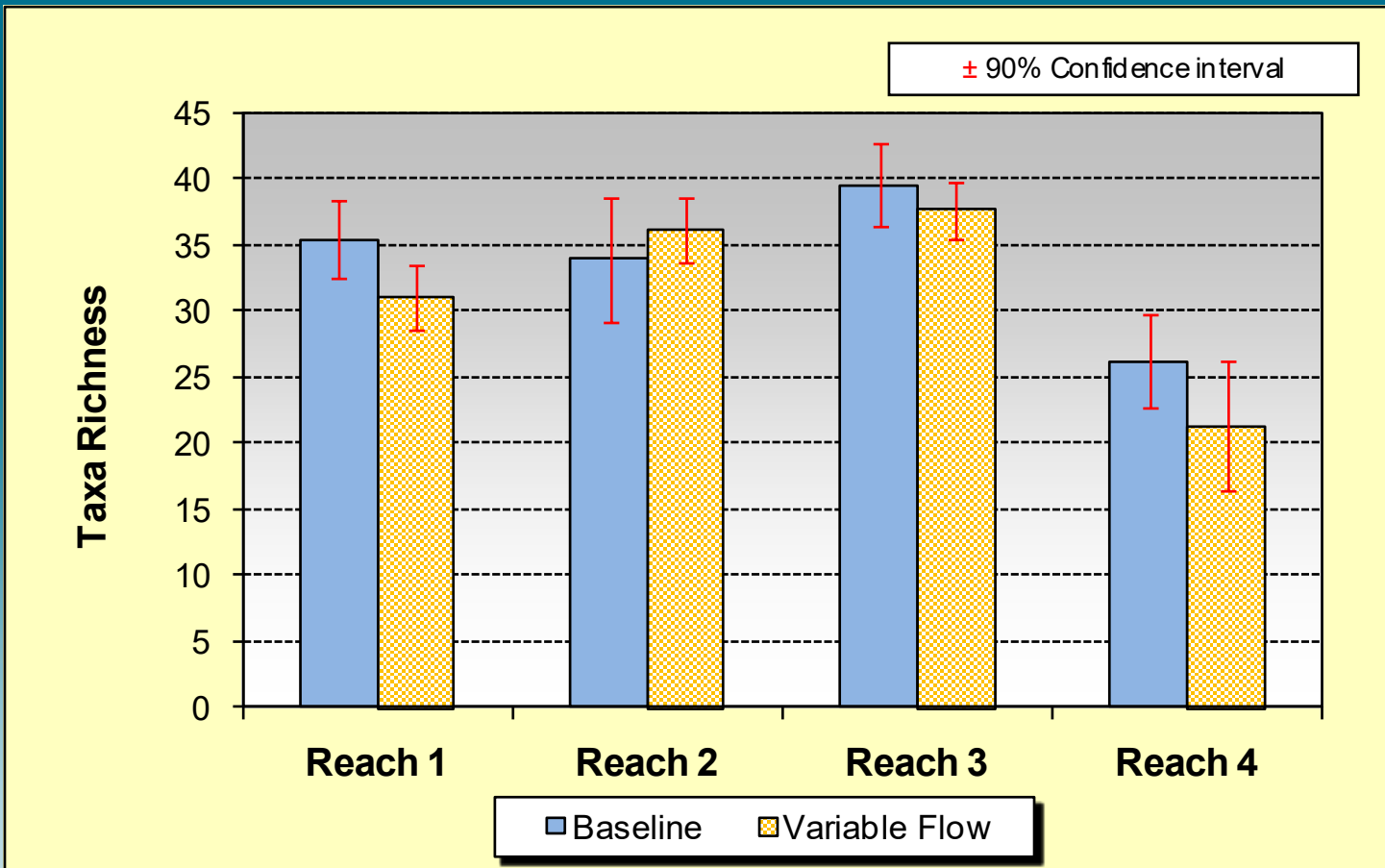
# Fish Biomass per 100 meters, October 2005 - 2010



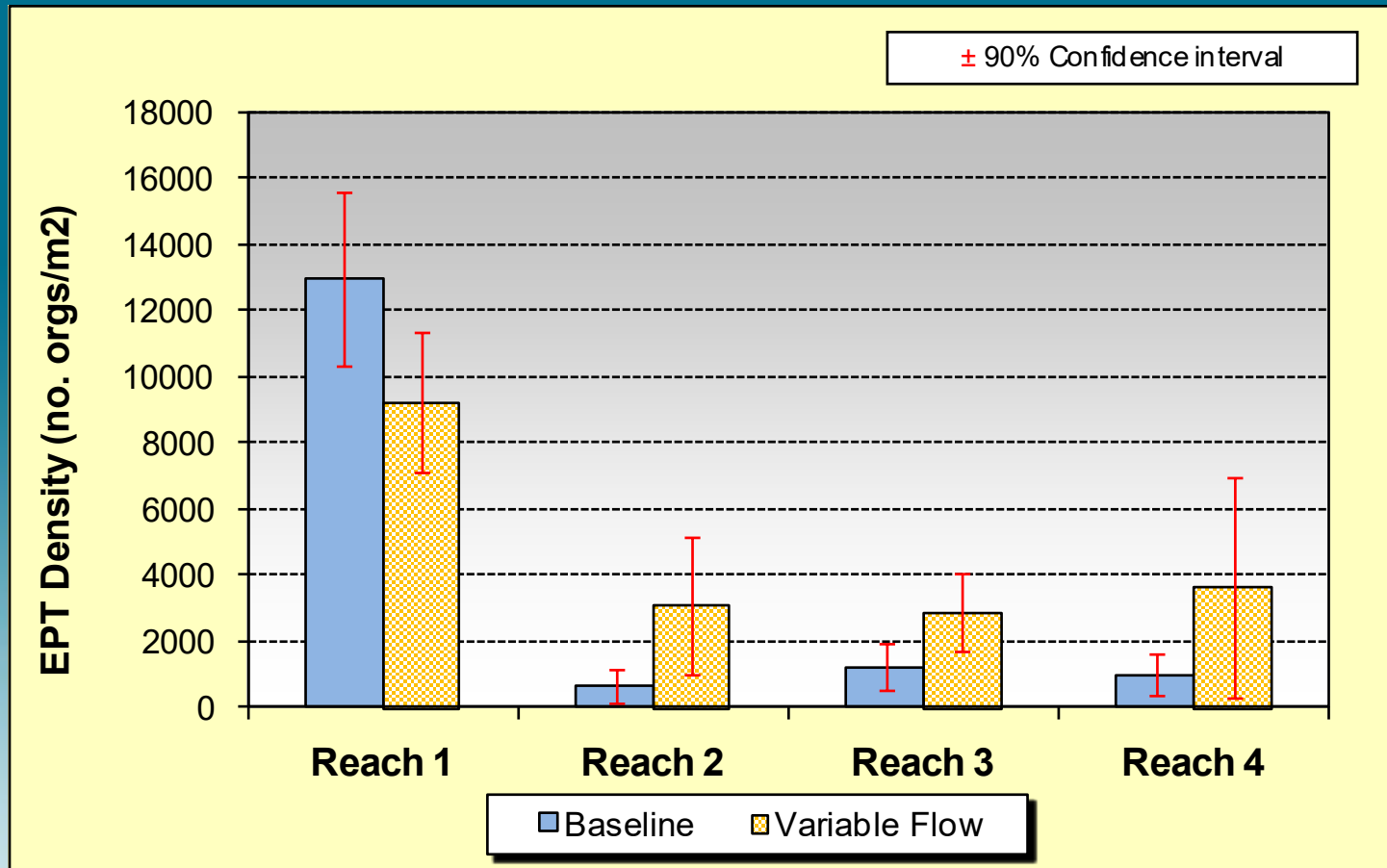
# Average BMI Density, baseline period versus variable flow



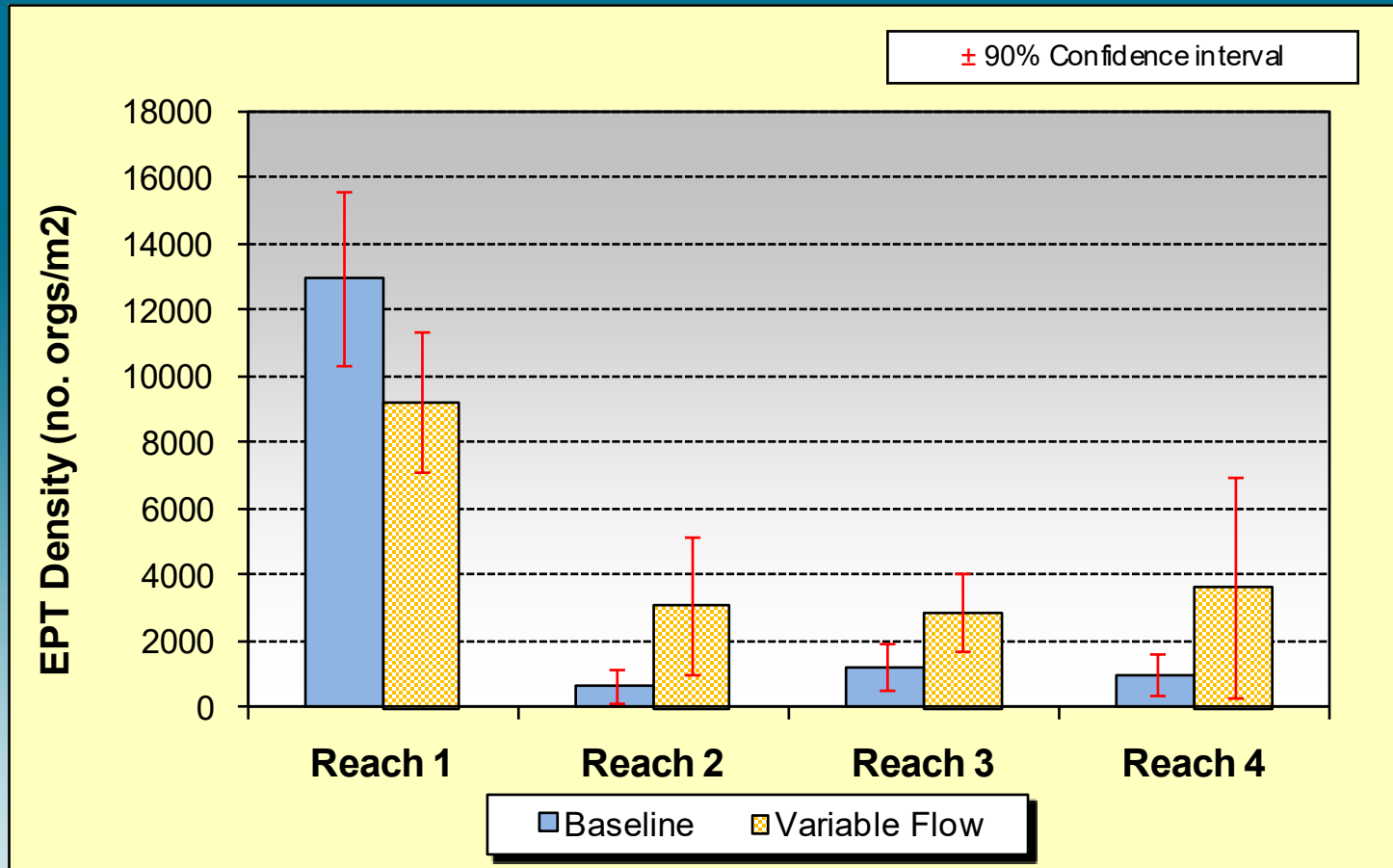
# BMI Taxa Richness, baseline period versus variable flow



# Average EPT Density, baseline period versus variable flow



# EPT Taxa Richness, baseline period versus variable flow





**Part V**

**Conclusions**

# Conclusions

**Study Reach Comparisons—Substantial differences between reaches**

- Hydrologically
- Temperature
- Channel shape and structure
- Biological community

# Channel Shape and Composition

## Channel Shape

- Within study reach similar between sample years

## Substrate Composition

- Reaches 2 and 3: Substantial shift from smaller grained materials in baseline period to coarser materials in variable flow phase

# Periphyton Community

- AFDW substantially higher in reaches 2, 3 and 4 in variable flow phase but significant in reaches 2 and 4 only
- Chlorophyll a more variable across the three treatment reaches.
  - Reach 2, chlorophyll a was similar between the baseline and variable flow periods.
  - Reach 3, chlorophyll a was significantly lower during the variable flow phase.
  - Reach 4, chlorophyll a was significantly higher during the variable flow period.
- Difficult to detect changes in periphyton community using annual sampling event

# BMI Community

- BMI density and taxa richness showed no differences between the baseline period and the variable flow phase for reaches 2, 3 and 4
- EPT density comparisons within respective reaches indicate a significant increase in reaches 2, 3 and 4 during the variable flow phase.
- EPT taxa richness also increased in reach 2 during the variable flow phase.
- NZMS remains dominant taxa in reach 4

# Fish Community

- **Within individual reaches, fish community composition was relatively similar between years**
- **8 species total**
- **Rainbow trout in reaches 3 and 4 only**
- **Variability in fish stocking and angling pressure over 6-year period in reach 4**



