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Foodbase monitoring and research: response to PEP

U.S. Department of the Interior
U.S. Geological Survey

Outline

- Core Monitoring Information Needs (CMINs)
- Research findings in relation to CMINS
- Proposed foodbase monitoring and research in FY12-14

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Core Monitoring Information Needs

- **1.1.1 Determine and track the composition and biomass of primary producers below Glen Canyon Dam in conjunction with measurements of flow, nutrients, water temperature, and light regime.**

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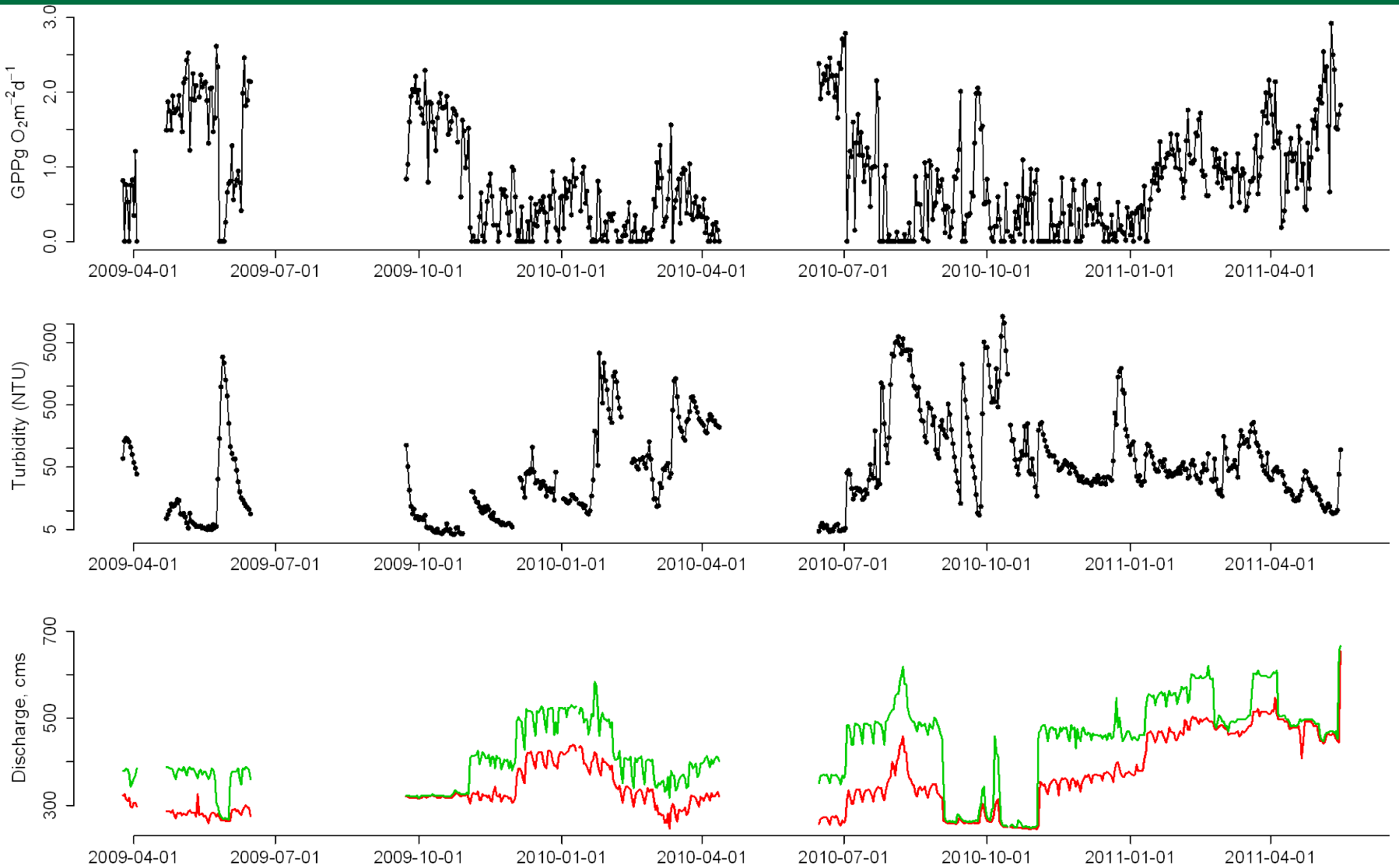
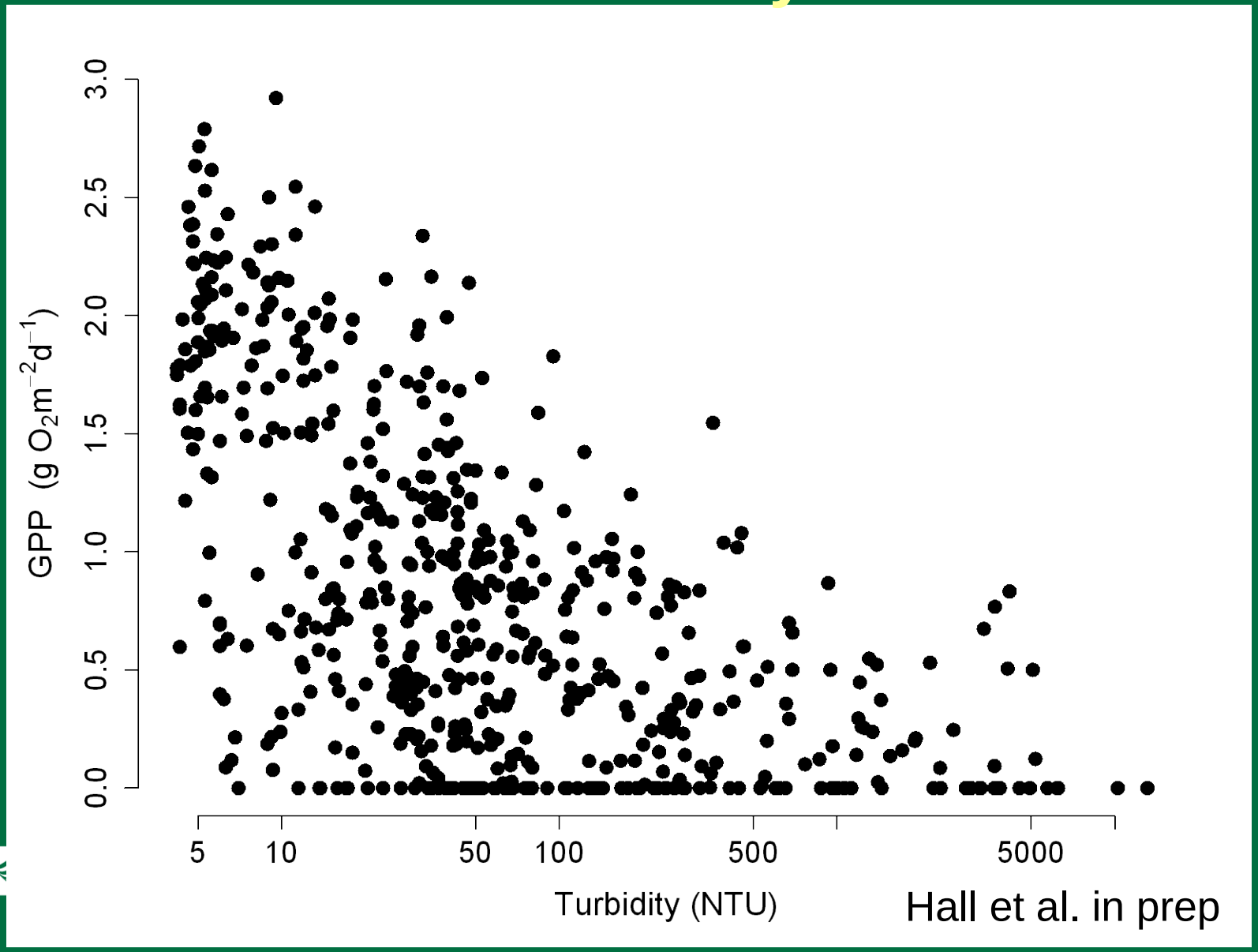
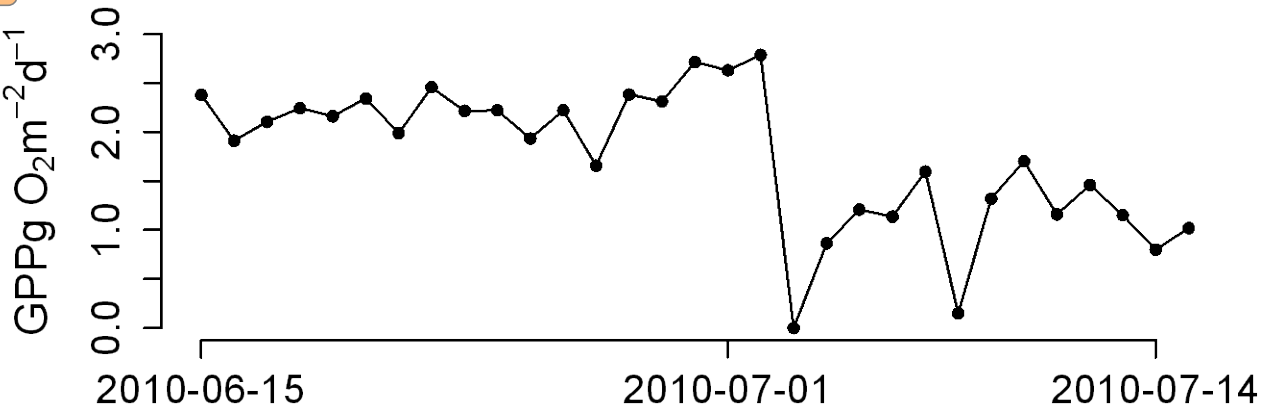
Flow operations and turbidity control algae production in Grand Canyon

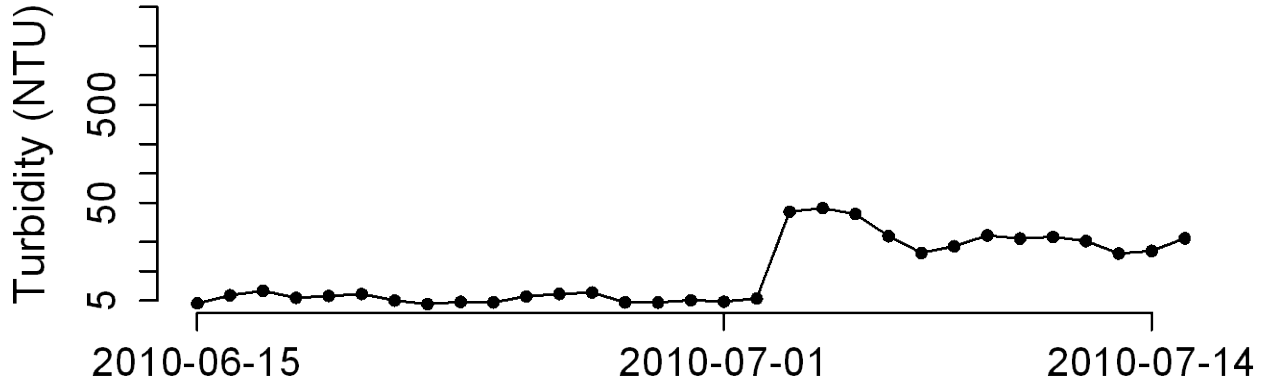


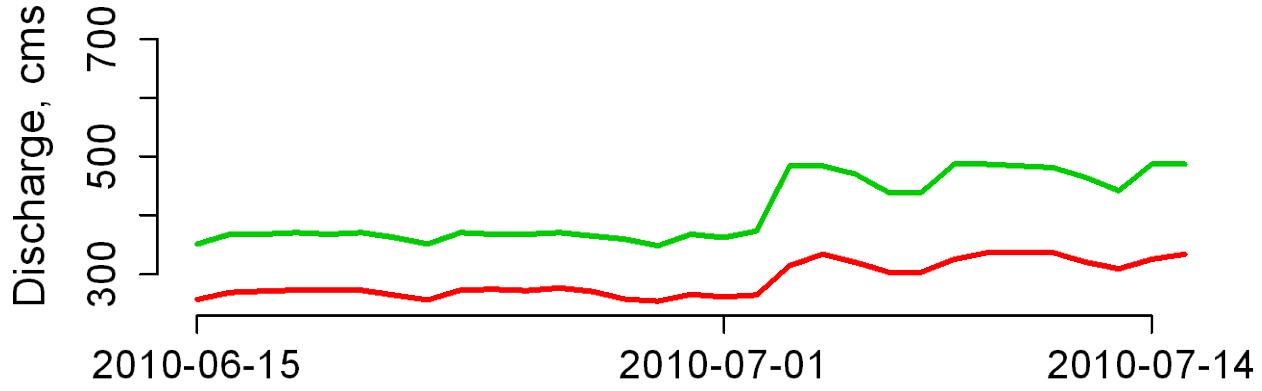
Hall et al. in prep

Turbidity strongly controls algae production in Grand Canyon









Increase in summer flow lowers GPP, likely by burying algae underwater

Hall et al. in prep

Monitoring Strategy

- Continuous metabolism at water quality monitoring sites (RM 0, RM 30, RM 61, RM 87, RM 165, RM 225, and in LCR)

- Changes in response to PEP
  - Organic matter budgeting scaled back relative to original proposal

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Core Monitoring Information Needs

- 1.2.1 Determine and track the composition and biomass of benthic invertebrates below Glen Canyon Dam in conjunction with measurements of flow, nutrients, water temperature, and light regime.

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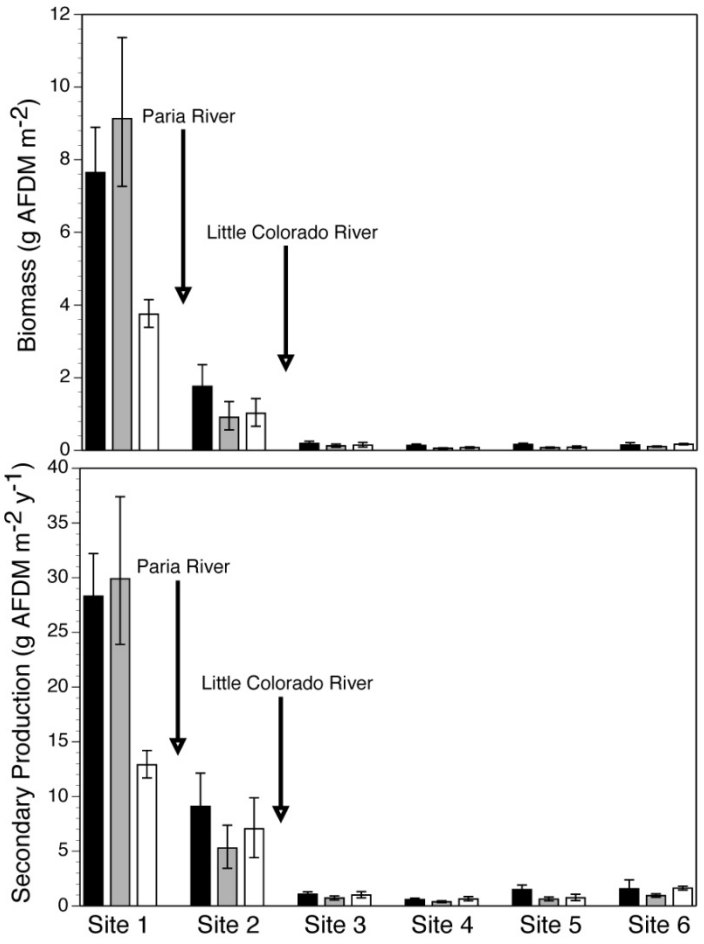
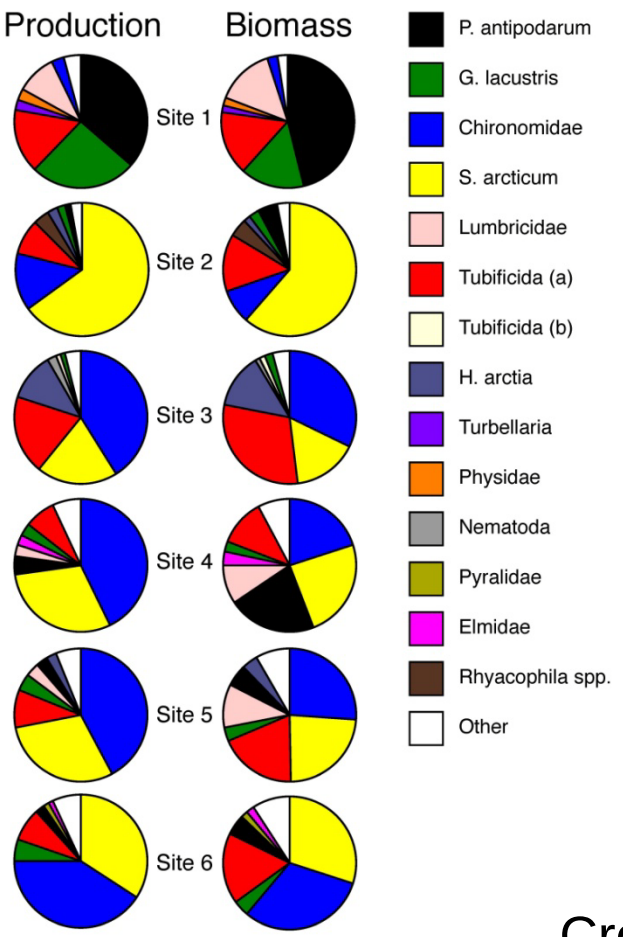
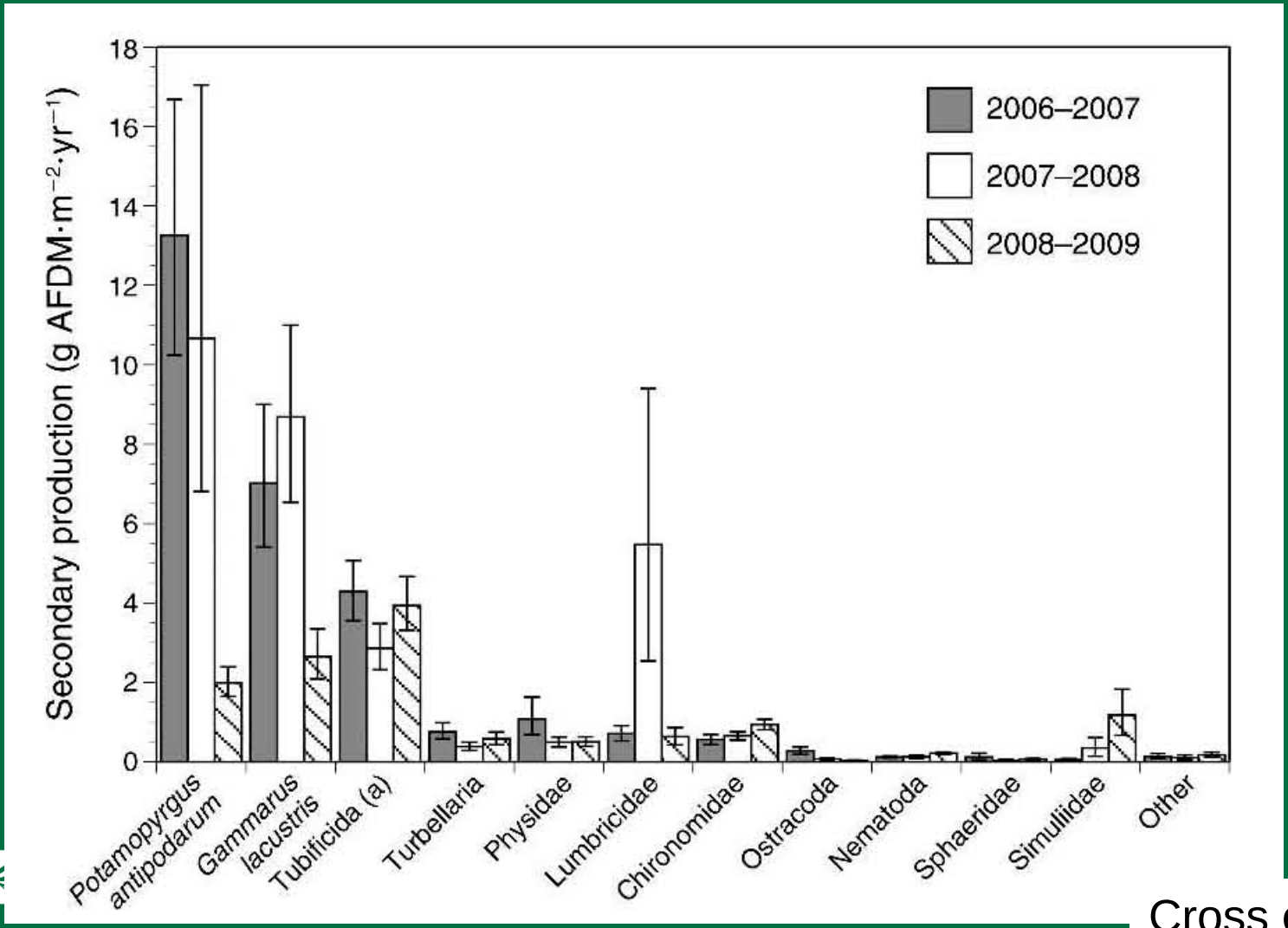
Invertebrate production exhibits stepped declines below the Paria and LCR, and production below the LCR is extremely low relative to other streams and rivers





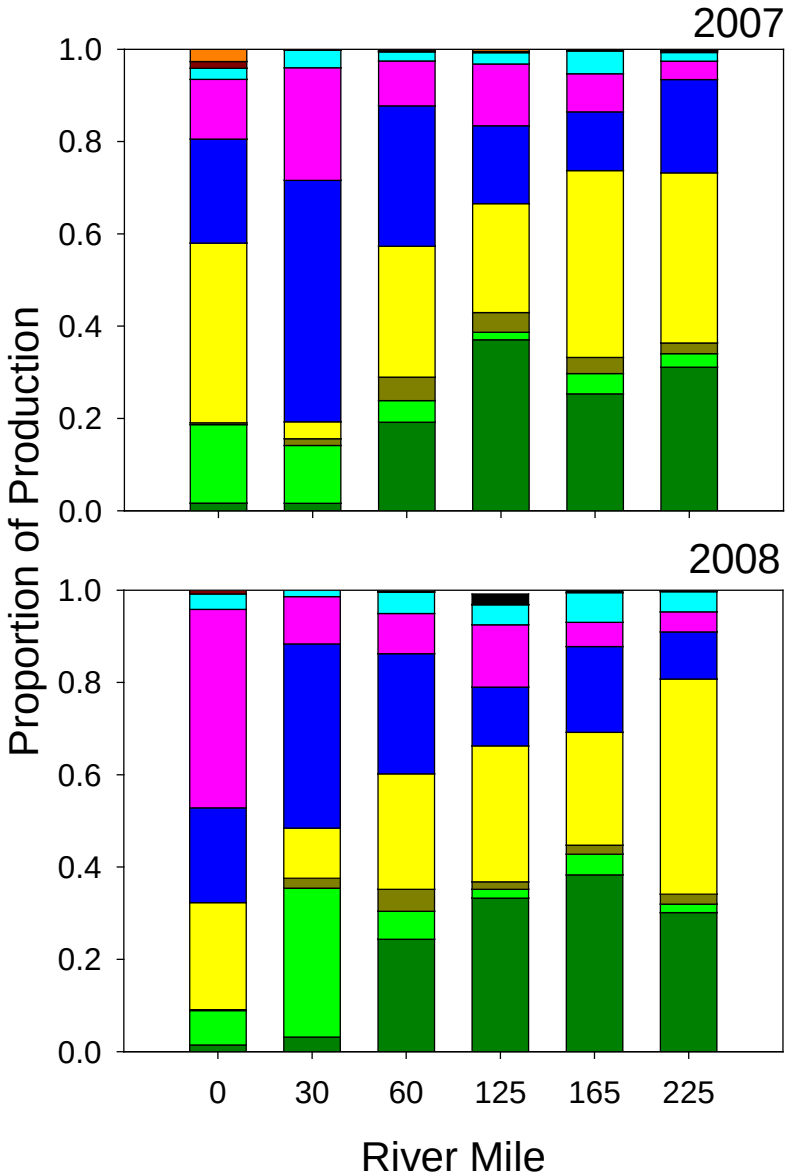
Cross et al. in prep

High flow events can exert a strong control on invertebrate assemblages and secondary production in the tailwater reach



Cross et al. (2011)

The production of native and non-native fishes through the river is fueled principally by two aquatic insect taxa—midges and blackflies



-Midges and black flies

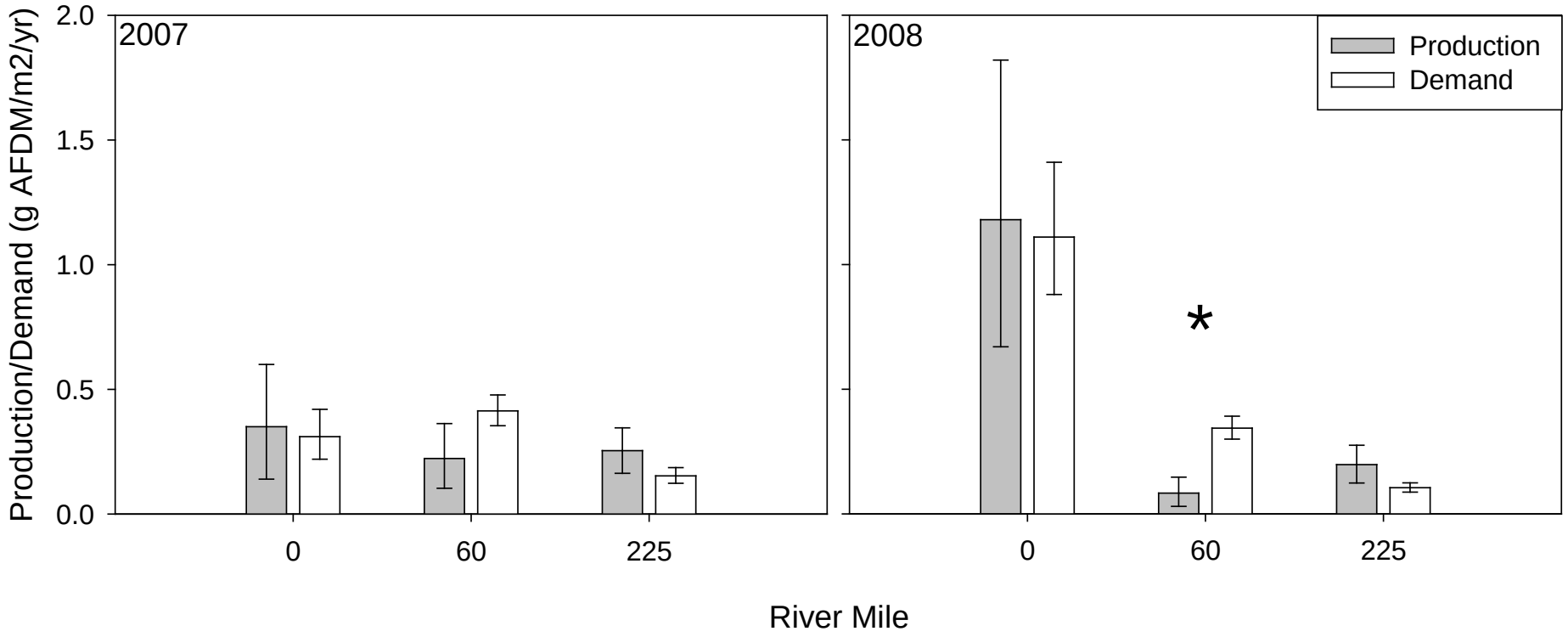
- 45-61% of production

-Diatoms

Additional 20-40% of production at ‘native fish sites’

Donner and others, *in prep*

Fish production throughout the river appears limited by the availability of high quality prey and fish may exert top-down control on these prey



- Black fly (and midge, not show) production ≈ or < demand by fish

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Monitoring Strategy

- Benthic sampling throughout Glen and Grand Canyon
  - Comprehensive survey once per year (starting in FY13)
  - To occur when hydropeaking is relatively low and benthic biomass is high (May?)
  - Cobble habitats in Glen, Marble Canyon, and LCR confluence will be sampled quarterly in cooperation with natal origins & NSE project. Will yield benthic production estimates
- Changes in response to PEP:
  - Benthic production monitoring in key reaches was added.

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Monitoring Strategy

- Monitoring emergent insects throughout Grand Canyon using citizen scientists
  - 9 commercial river guides equipped with light trap sampling kits that will be deployed from April through October
  - Anticipate ~1500 samples from throughout Grand Canyon
- Changes in response to PEP:
  - Strategy completely changed. Original proposal called for month long sticky trap deployments at 6 fixed sites.

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Core Monitoring Information Needs

- 1.3.1 Determine and track the composition and biomass of drift in the Colorado River in conjunction with measurements of flow, nutrients, water temperature, and light regime.

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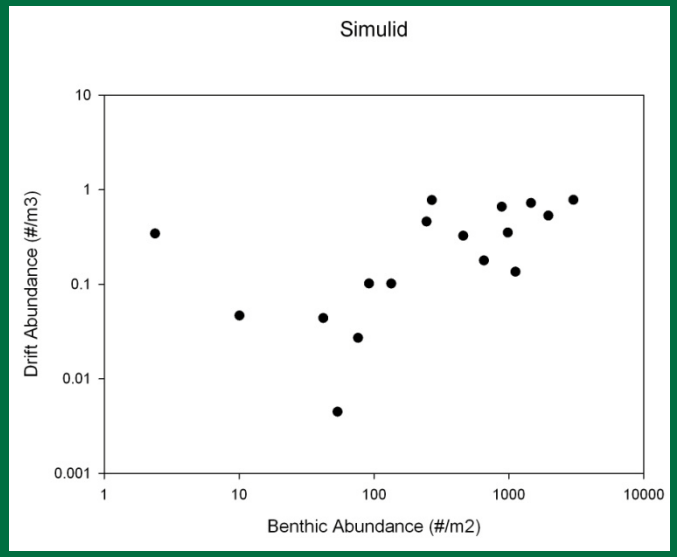
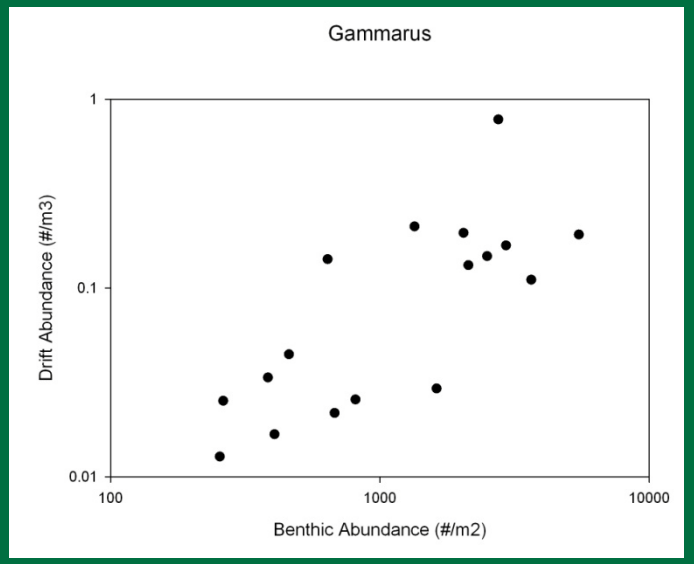
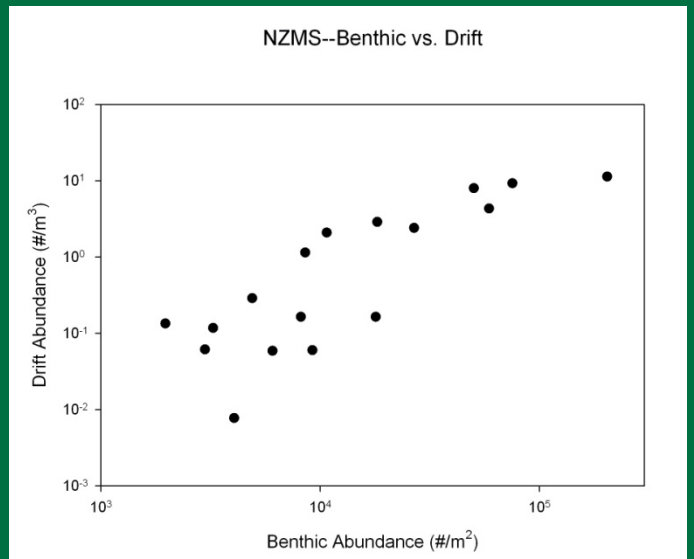
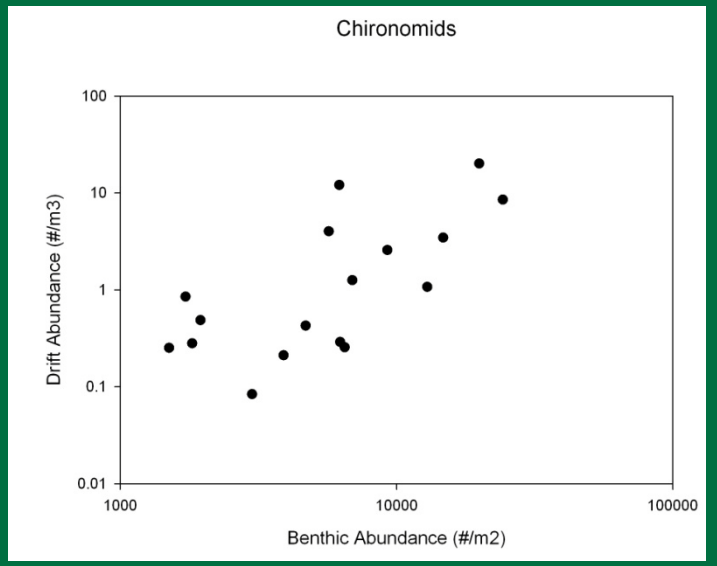
Drift abundance strongly related to benthic abundance

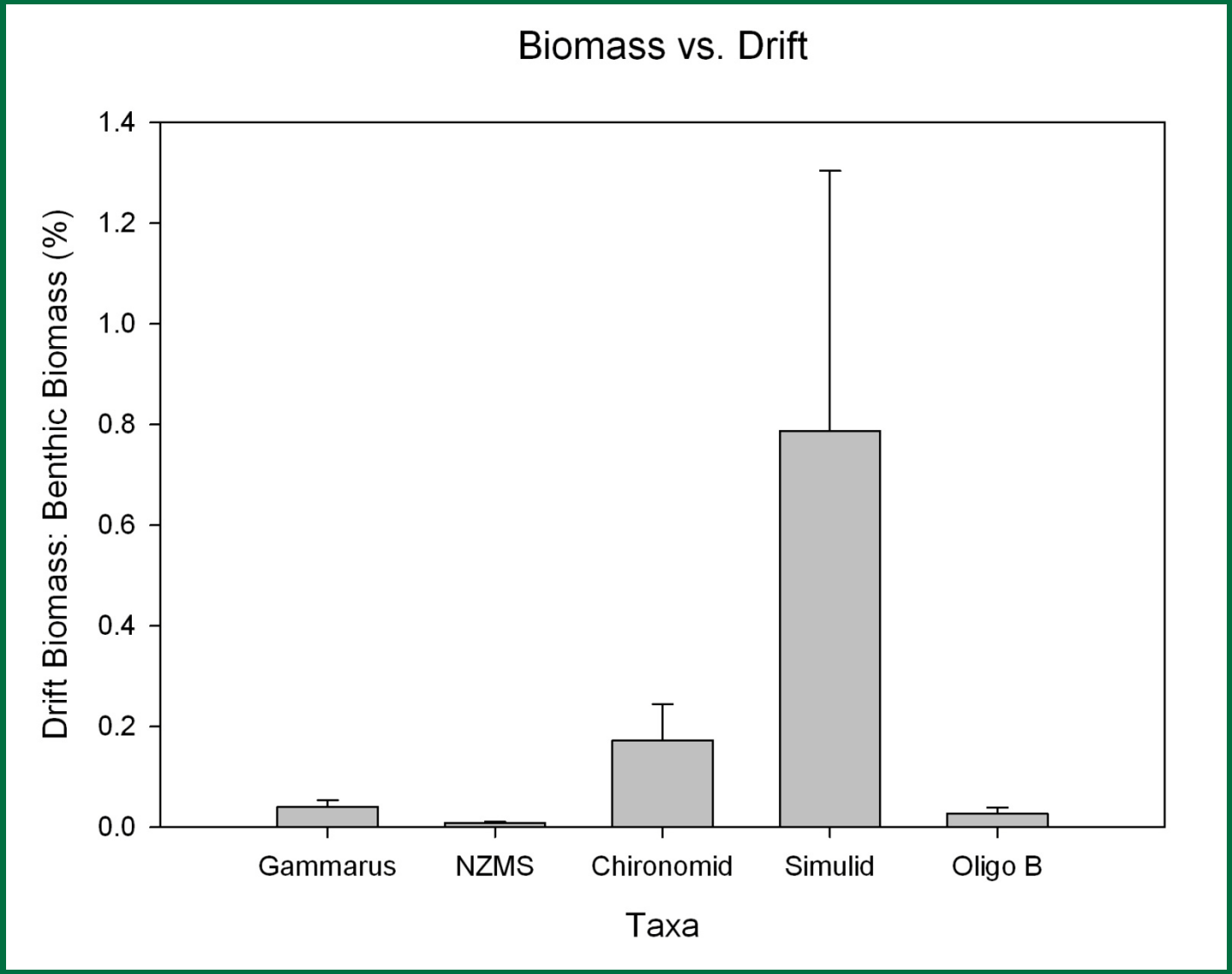








Some Taxa More Prone to Drifting Than Others



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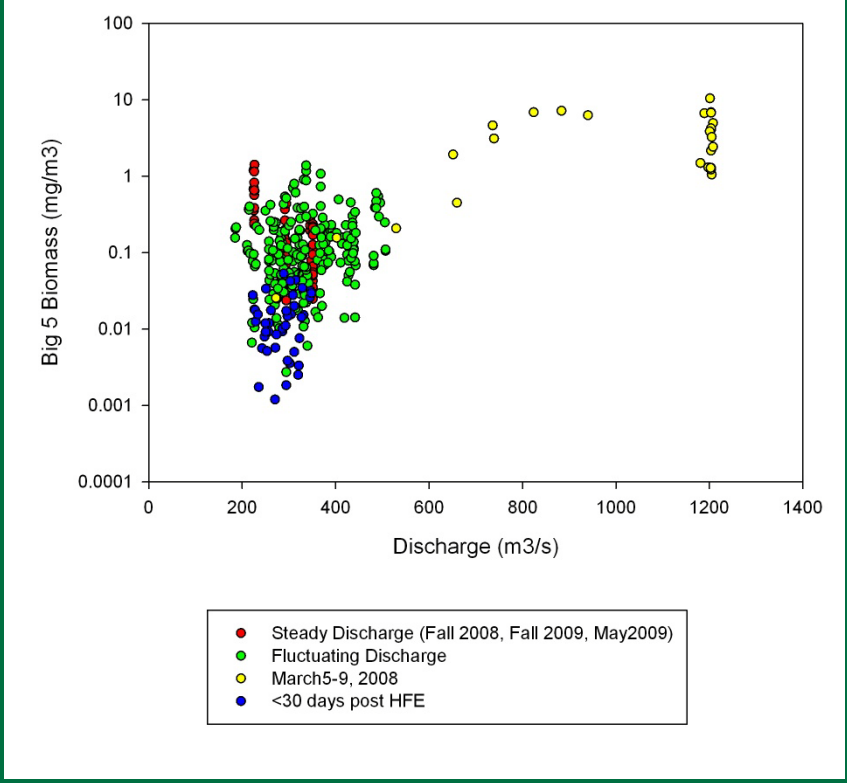
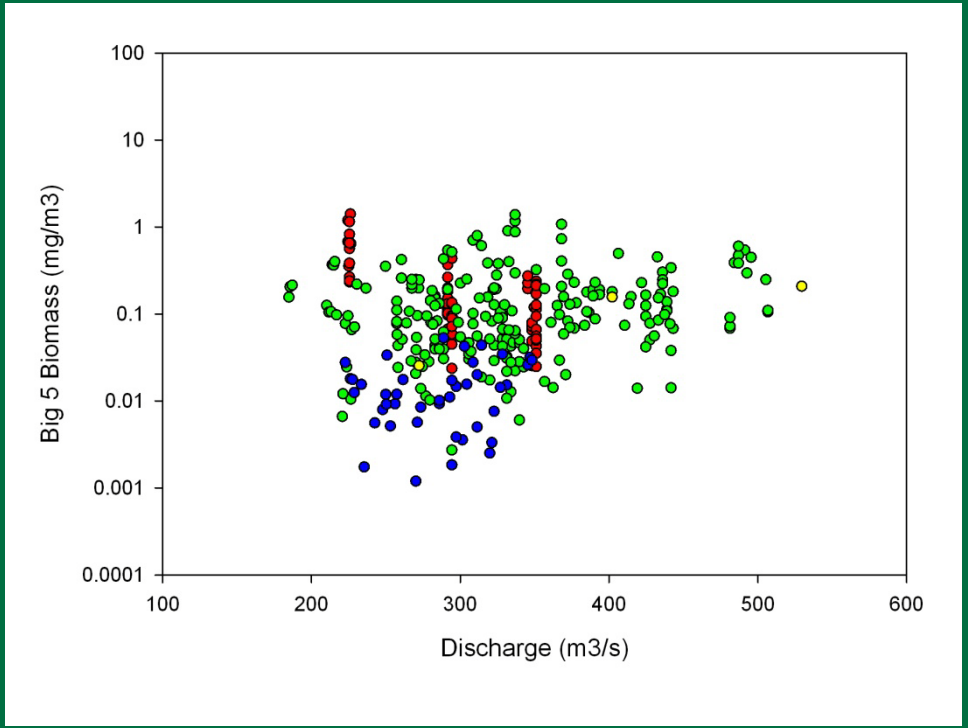
Discharge Regime Does Not Appear to Have Strong Affect on Drift Biomass





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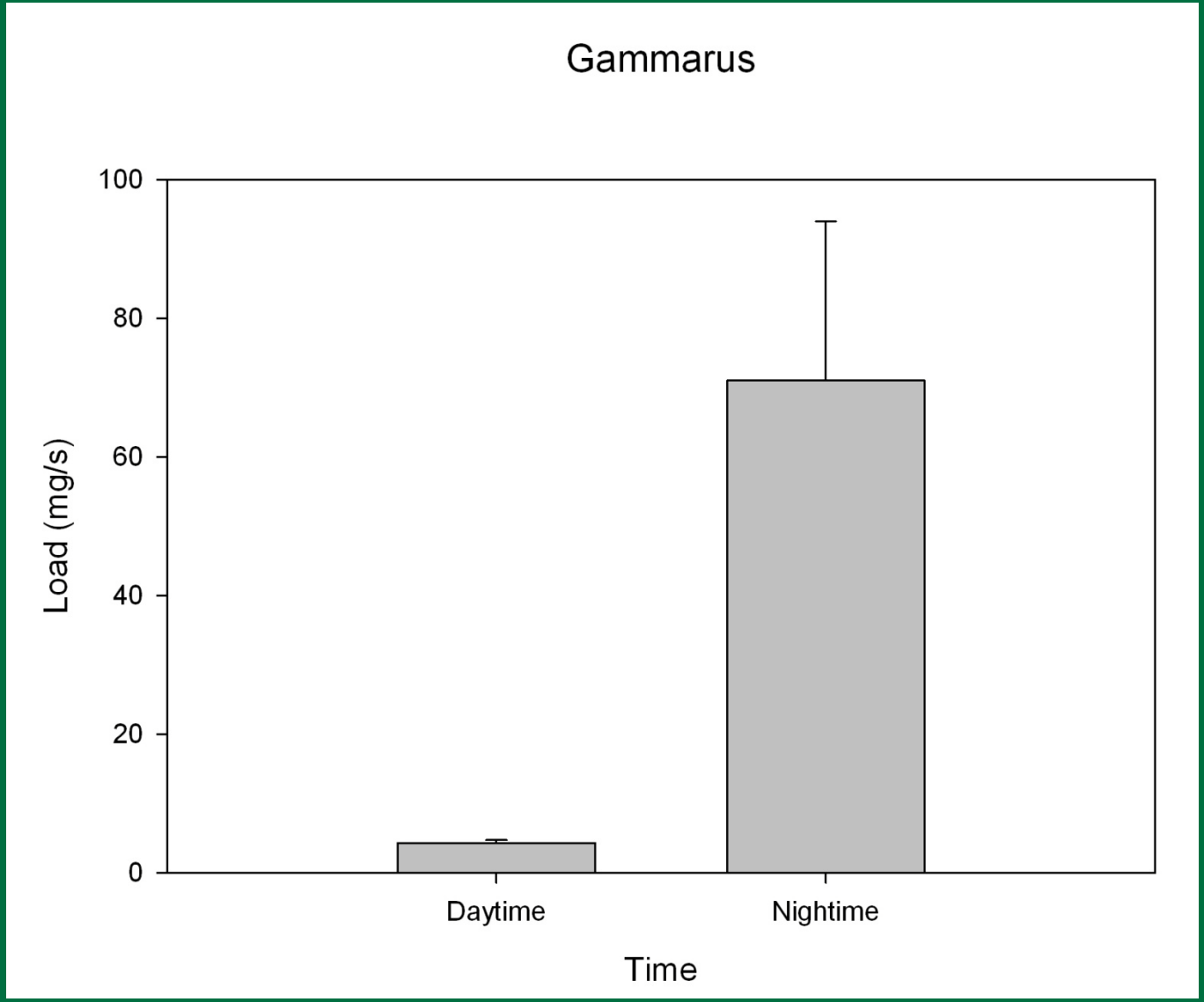
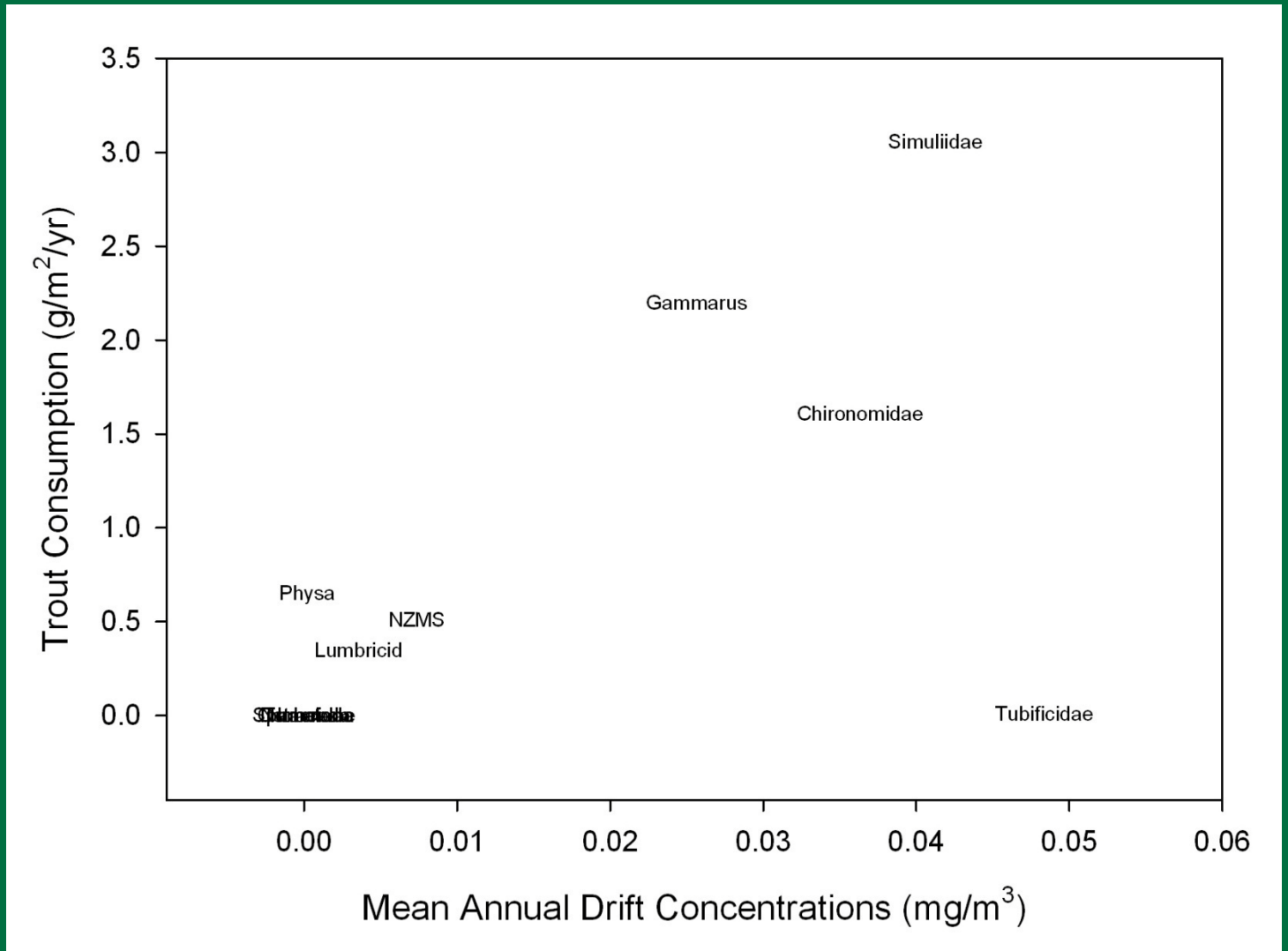
Time of Day is a Big Lever for Some Taxa



Drift is direct measure of food available to drift feeding fishes



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Monitoring Strategy

- Invertebrate drift measurements in Glen Canyon, Marble Canyon, and Diamond Creek
  - Collected from thalweg using boats
  - Midday and nighttime
  - Every 6 weeks
  - Quarterly in Marble Canyon and near LCR in cooperation with natal origins & NSE

- Changes in response to PEP: drift sampling will be done from boats only

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Research

- LCR food web study
  - In cooperation with FWS
  - Will assess potential for food limitation and explore role of LCR hydrology in driving juvenile humpback chub dynamics

- Changes in response to PEP: need to study tributaries to understand relative importance of mainstem

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Summary of key points

- FY12-14 monitoring and research is integrated into other ongoing projects (natal origins, NSE, aggregation monitoring)
  - Allows for more rigorous sampling (boat-based instead of hike-in)
- Makes use of citizen scientists to monitor emergence
- Builds onto GCMRCs water quality monitoring program
- Benthic invertebrate production will be monitored in key reaches

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Update

- Drift rates in Glen Canyon are very low (similar to days immediately after 2008 HFE when system had been scoured)
- Predation rates on the available drift are very high, on order 2-10/day or higher, particularly in 2012
- Drift entry rates are likely high (2%+) enough to allow depletion of the benthic biomass for at least some invertebrate species (chironomids, simulids, gammarus)

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Update

- Factors that stimulate trout recruitment (steady flows, HFEs) likely lead to trout densities high enough to cause sustained periods (2+ yr) of depletion for those invertebrate species
  - This implies high probability of trout collapse, preceded by increased downstream dispersal of juvenile trout (a predator-prey cycle effect)

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Update

- It is unlikely that there is an endogenous predator-prey cycle between trout and the main invertebrates; that cycle would have a period of less than 10 yrs, but observed trout peaks are about 13-14 yrs apart.

- Low drift densities, lack of large emergence hatches, and low swallow abundance all indicate that the LF insect foodbase is perilously low in 2012.

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