

Estimating Benthic Secondary Production from Aquatic Insect Emergence in Streams Affected by Mountaintop Removal Coal Mining, West Virginia, USA

Brent Johnson¹, Ken Fritz¹, & Rachel Price²

¹U.S. Environmental Protection Agency, Cincinnati, OH
Ecological Exposure Research Division

²Federal Energy Regulatory Commission, Washington, D.C.

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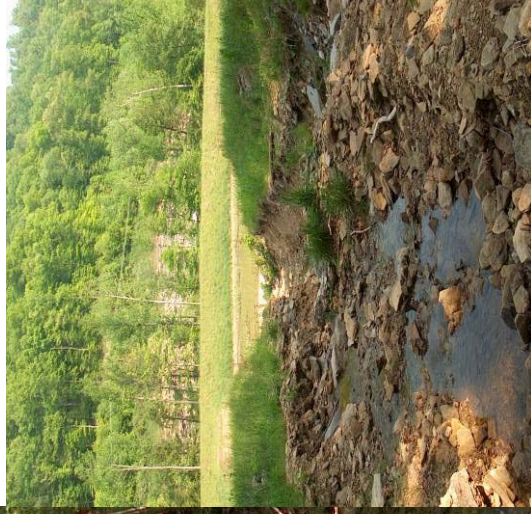
Why Functional Measures?

- Measures of ecological processes or rates rather than individual “snapshots” of stream sites
- May provide more complete ecological assessments (human analogy: height, weight vs. blood pressure, heart rate)
- More easily linked to Ecosystem Services (EPA-ORD Research Initiative)
- Component of EPA’s Tiered Aquatic Life Use (TALU) Guidance
- USACOE – CWA §404 language and guidance
- *Ohio Valley Environmental Coalition v. Army Corps of Engineers 2007* - “Functional Assessment Approach for High Gradient Streams” (Charleston, WV May 2007)



Rapid Assessment of Headwater Stream Functions

- Functional measures are often more time-intensive and costly
- Need for rapid methods for functional assessment to aid monitoring and regulatory agencies



Insect Emergence Biomass as a Rapid Measure of Secondary Production



From Statzner and Resh (1993):

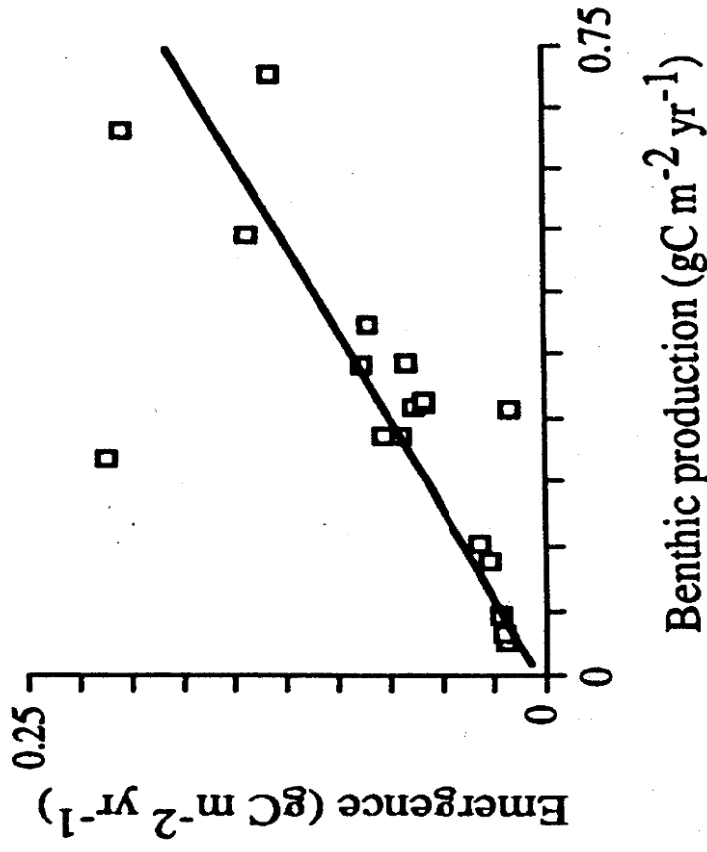


Fig. 3. Emergence (as annual biomass) and annual benthic secondary production estimates for 18 populations of lotic insects. Data from Neveu (1973), Speir and Anderson (1974), Benedetto Castro (1975), Weichselbaumer (1984), and Ritter (1985)

Objectives

- Estimate annual benthic community production from aquatic insect emergence
- Compare production in streams draining hollow fills and forest
- Assess relationships between production and conventional structural assessment measures



Surface Coal Mining in the Central Appalachians

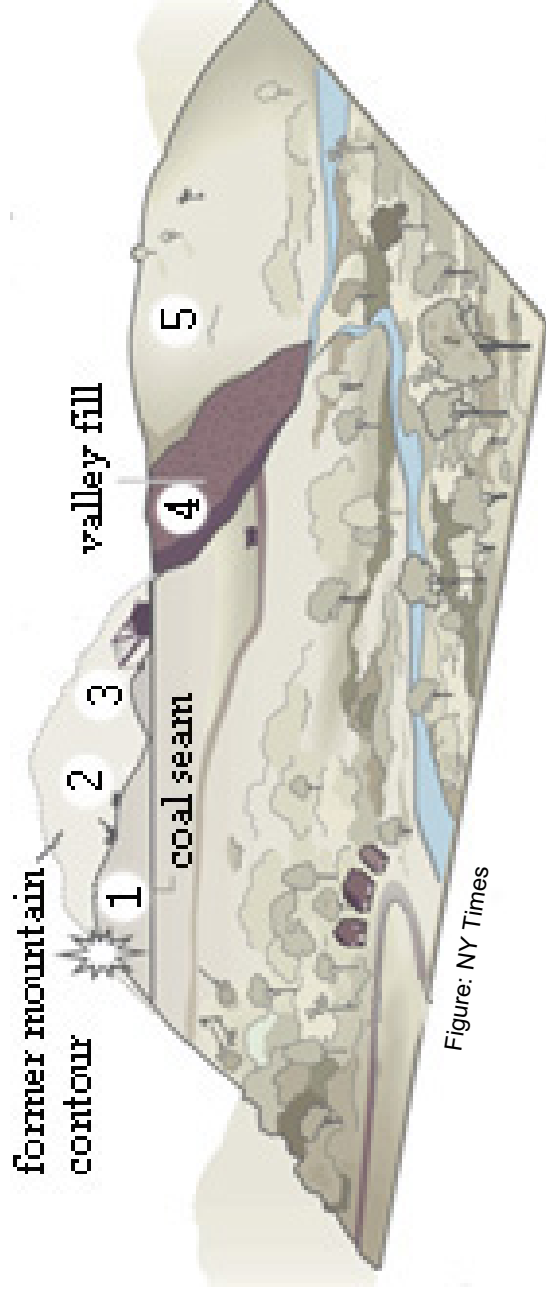


Figure: NY Times



Photo: WVGES



Photo: WV Mine Safety

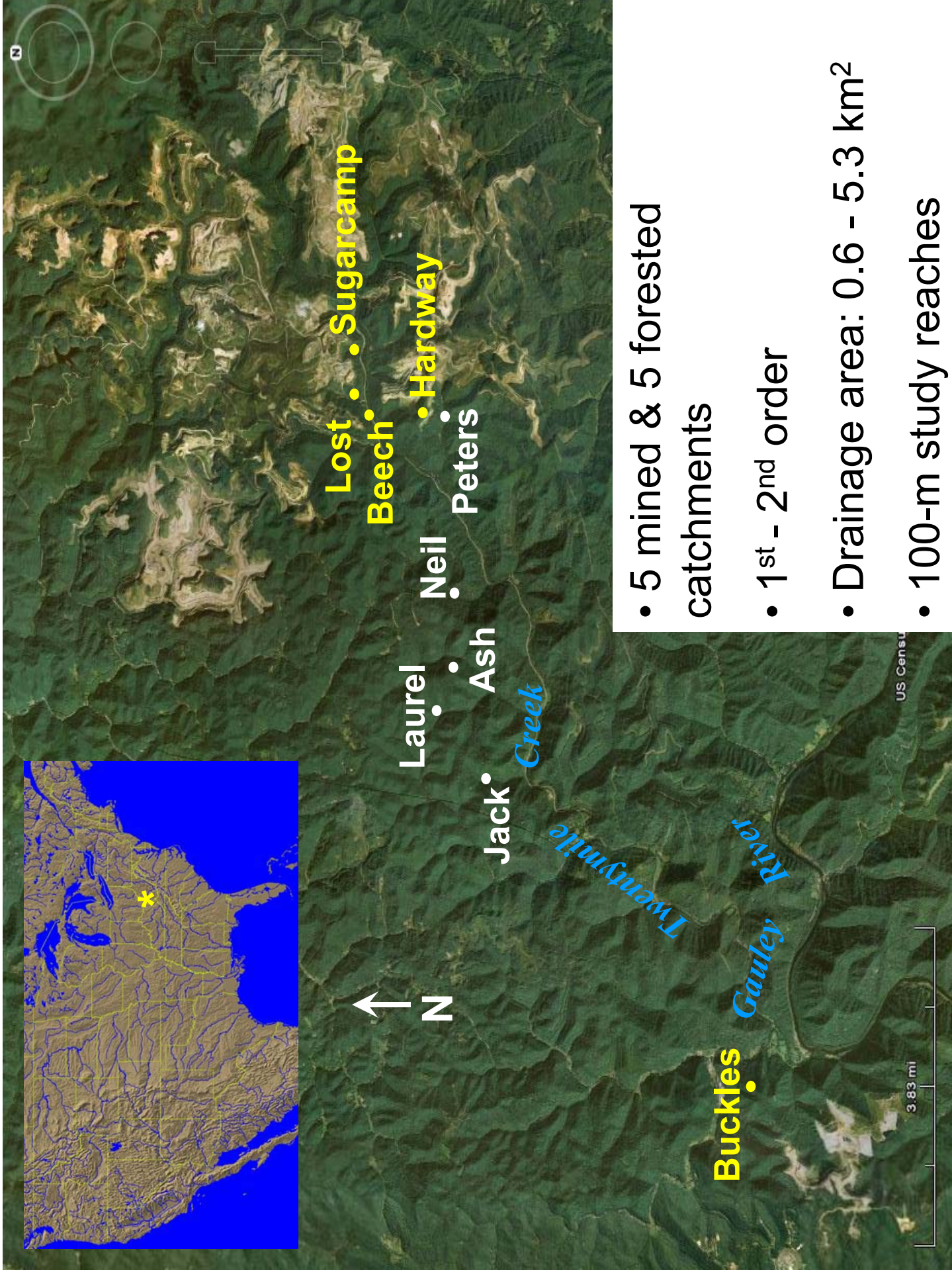


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- 5 mined & 5 forested catchments
- 1st - 2nd order
- Drainage area: 0.6 - 5.3 km²
- 100-m study reaches

Field Methods

- 3 Emergence traps (0.28 m², 250- μ m mesh) deployed in each stream for 14-31 days each season from Autumn 2007-Summer 2008 (Oct, Feb, April, July)
- Nets anchored on stream bottom
- Preservative – 2/3 glycerol, 1/3 10% formalin with soapy water
- Contents sieved and preserved in 80% ethanol

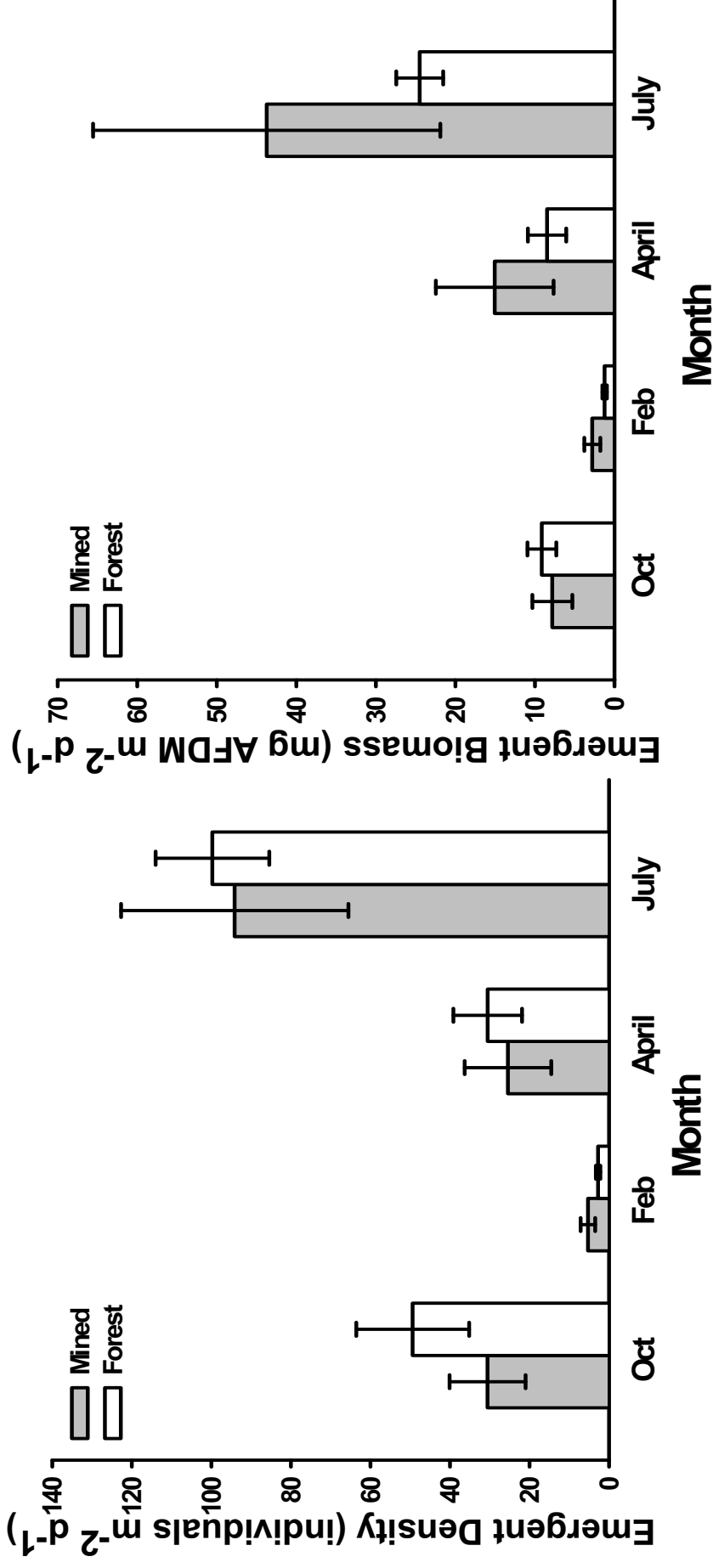


Laboratory Methods & Data Analysis

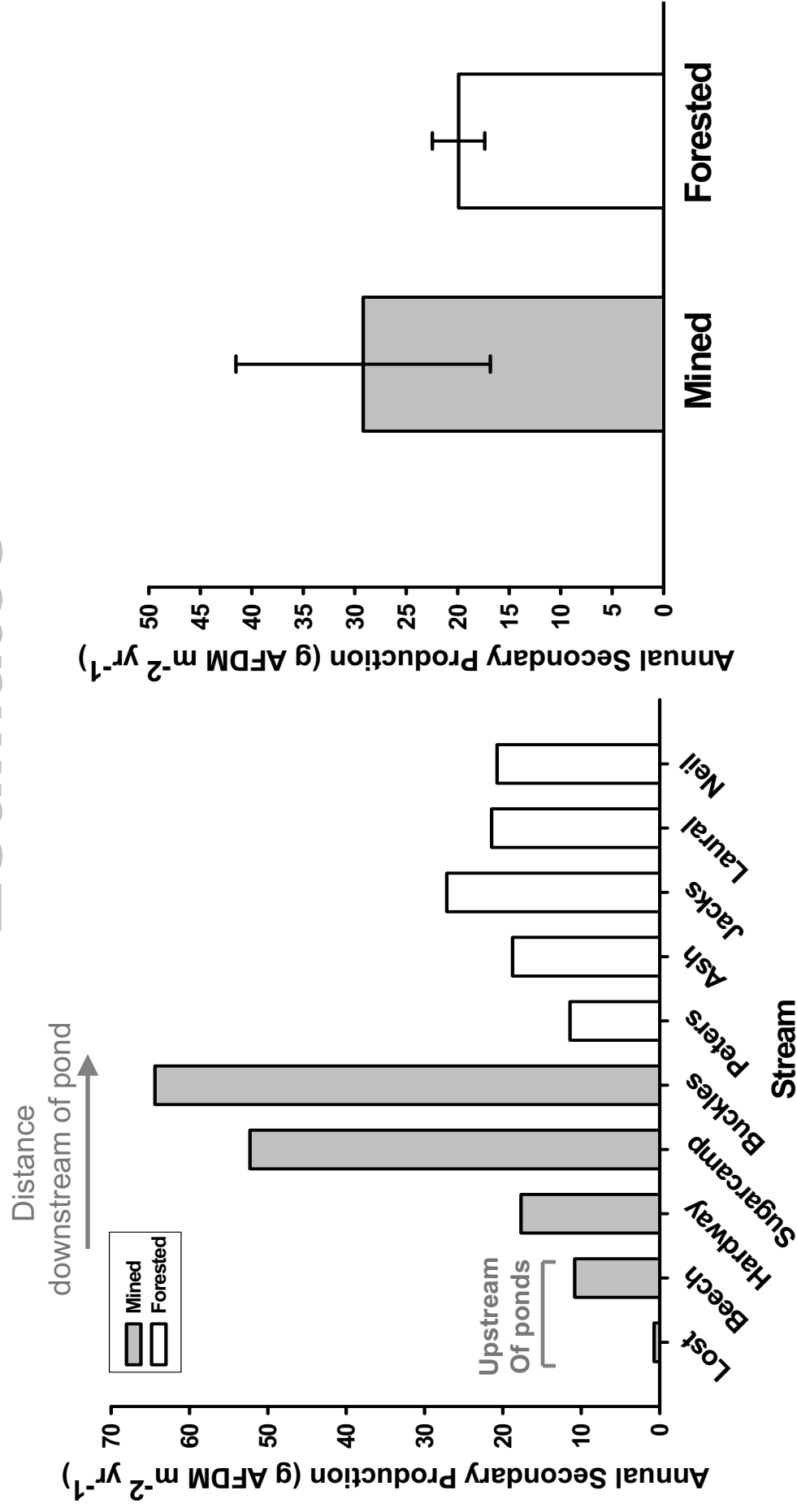
- Identification to Order or Suborder
- Excluded terrestrial taxa
- Individuals measured to nearest mm
- Ash-free dry mass (AFDM) estimated using DM length-weight regressions for adults (Sabo et al. 2002) with 0.85 conversion factor
- Benthic production estimated using an average E/P ratio of 18.3% (Poepperl 2000)
- Daily production multiplied by number of days in each season. Seasonal production then summed to obtain annual secondary production estimates



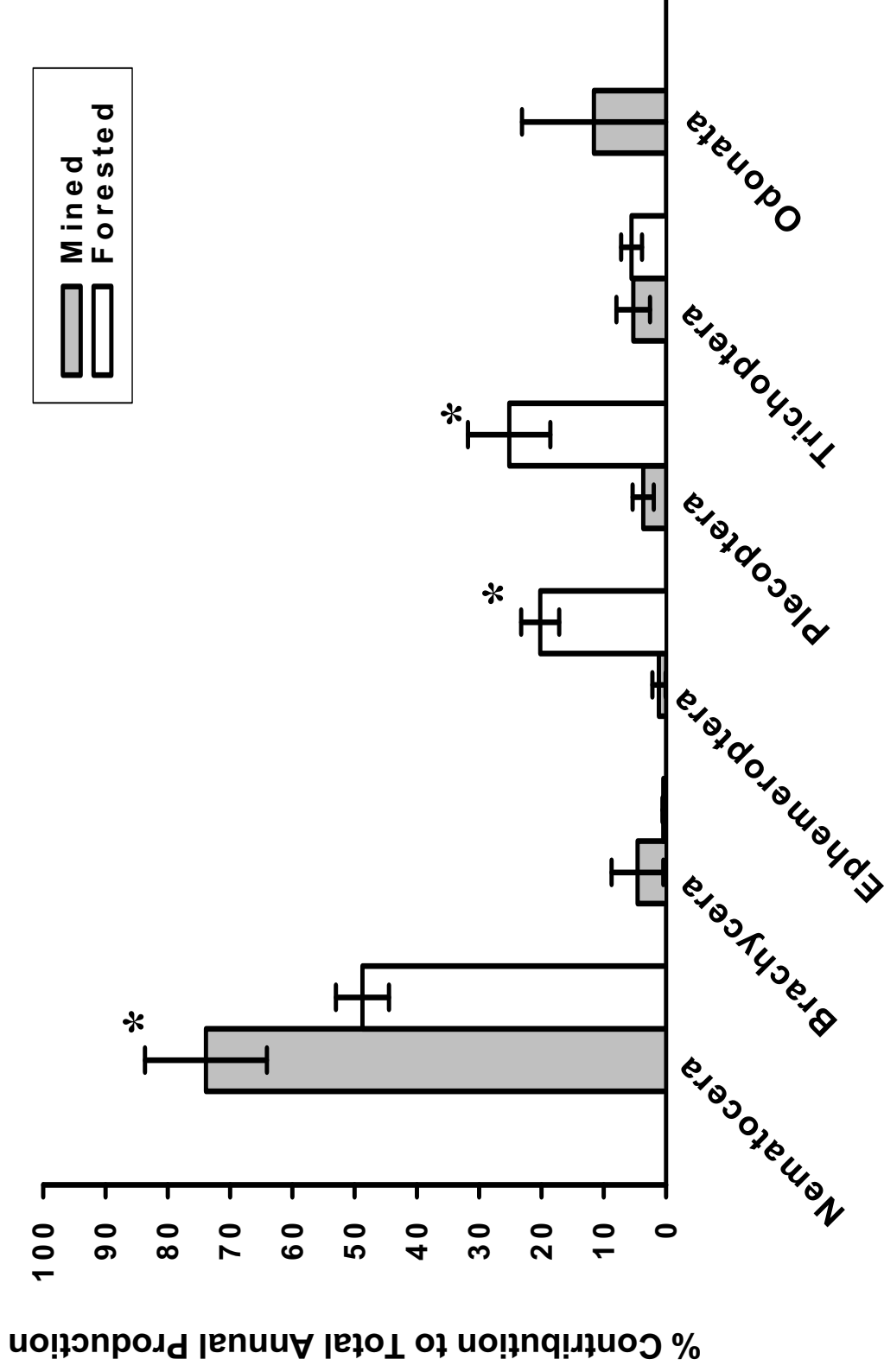
Seasonal Emergent Abundance & Biomass



Annual Benthic Production Estimates



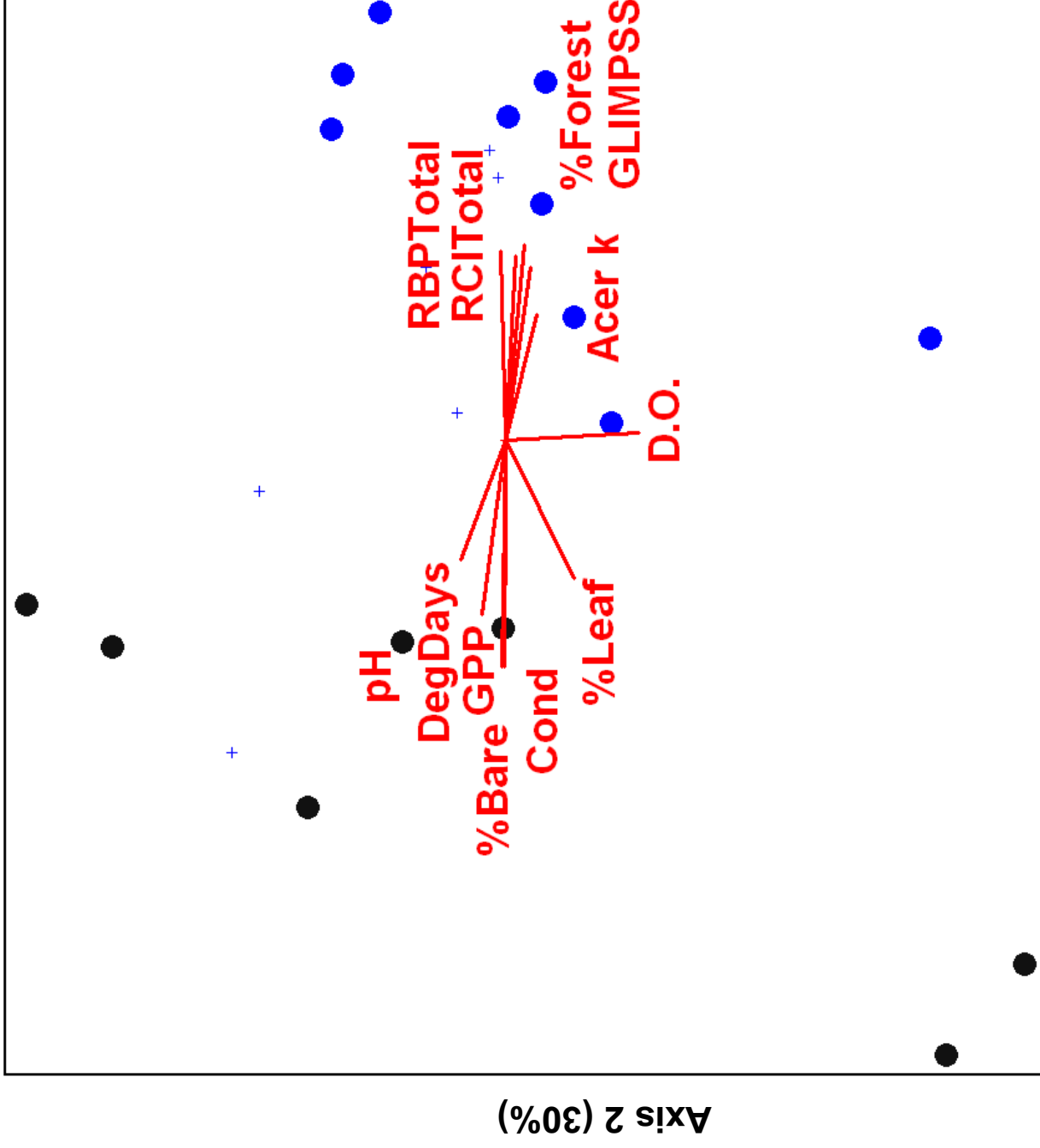
Relative Contribution to Total Annual Production



July Emergent Density

- Six taxa
- NMS
- 2-D Solution
- Stress = 0.072

● Forested
● Mined



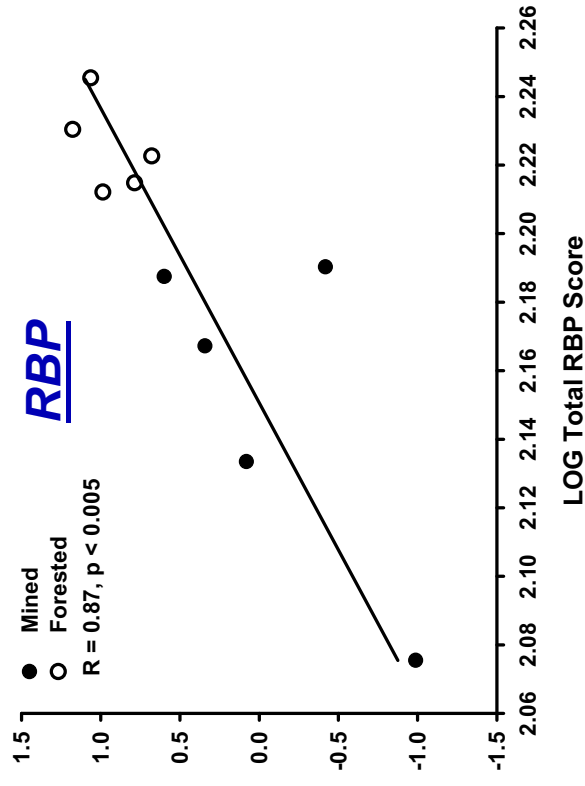
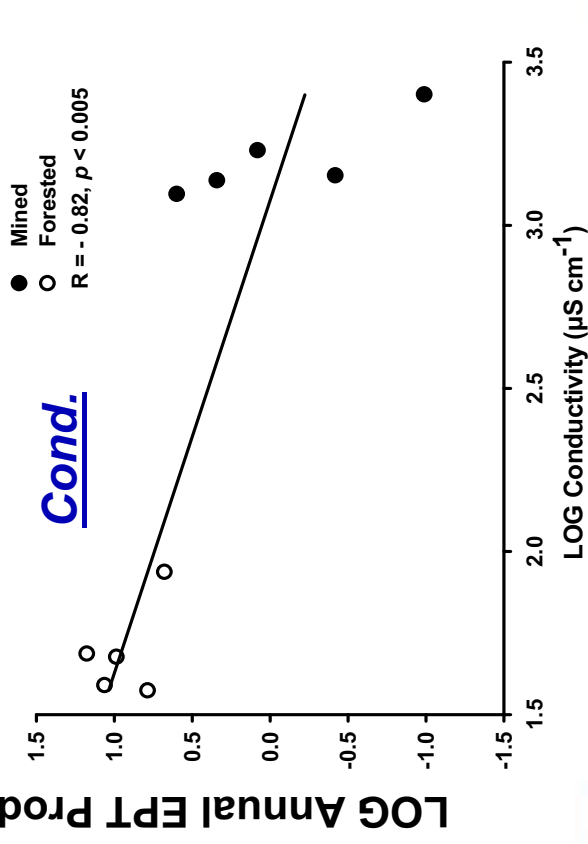
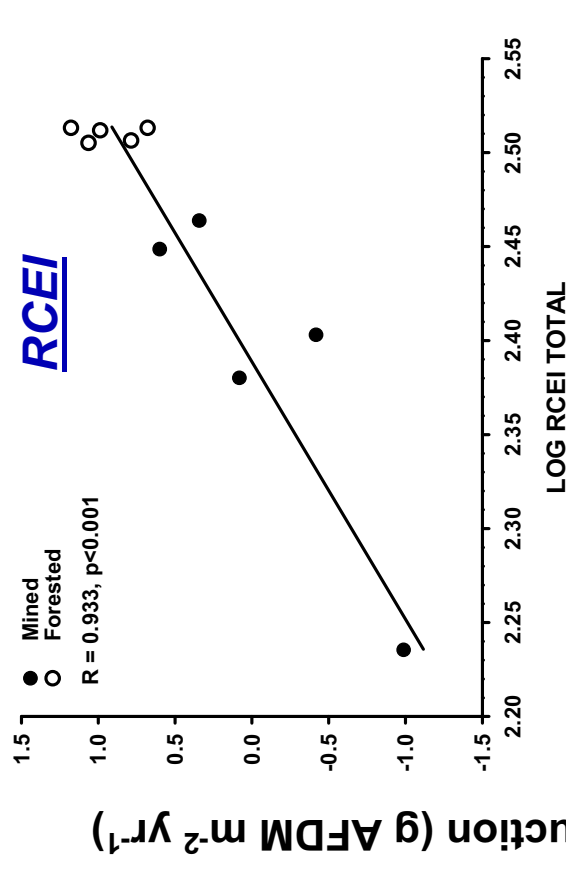
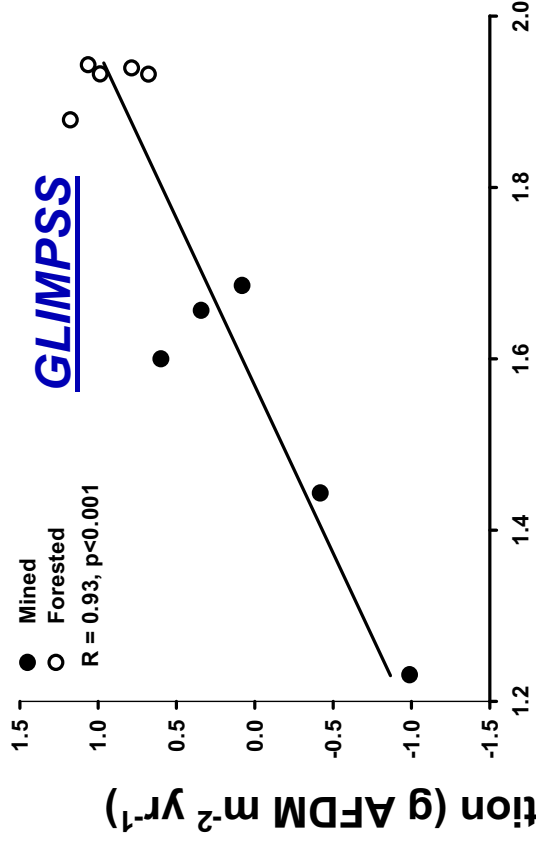
Axis 1 (65%)



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Annual EPT Production vs. Structural Assessment Measures



Summary

- No significant differences in total abundance, biomass, and production between treatments
- Strong differences in community composition with lower EPT production in mined streams
- EPT emergence/production correlated with many structural measures including habitat assessments and benthic index results
- In mined streams, effect of different community composition on other ecosystem attributes and production at higher trophic levels uncertain
- Mechanism responsible for loss of EPT taxa, especially mayflies, below fills still in question



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