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Macroinvertebrate production and trophic structure in a tallgrass prairie headwater stream

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Abstract. Research on North American prairie stream communities has lagged behind other regions. We examined the ecosystem significance of the macroinvertebrate community of riffle/run habitats in Kings Creek, a 2nd-order tallgrass prairie stream at Konza Prairie Biological Station (Kansas, USA), by estimating secondary production, benthic organic matter standing stocks, and resource consumption and egestion by functional groups. Annual mean standing stock macroinvertebrate biomass was 2.3 g ash-free dry mass (AFDM)/m^2, annual production was 19.7 g AFDM m^{-2} y^{-1}, and the annual community production/biomass (P/B) ratio was 8.6. Macroinvertebrate production was higher than published estimates for forested streams of similar size, but much lower than that of a Sonoran desert stream. Distribution of production among functional groups was 30% for collector-gatherers, 9% for collector-filterers, 20% for scrapers, 23% for shredders, and 18% for predators, resembling estimates from some forested streams with the exception of higher scraper production. Although detritivorous groups were productive in this prairie stream, they appeared food limited. Consumption estimates indicated shredders and collector-gatherers annually ingested ~80% and ~240% of coarse particulate organic matter (CPOM) and fine particulate organic matter (FPOM) standing stocks, respectively. Thus, re-ingestion and/or diet shifts may be common, particularly among collector-gatherers, and the FPOM pool must turn over rapidly. Invertebrate predators also consumed a sizeable portion (~52%) of prey, whereas scrapers (~21%) and filterers (<1%) consumed relatively small portions of their respective resources, suggesting top-down influences on these groups. This study indicates that, during a period of relatively stable flow in this prairie stream, macroinvertebrate production and functional structure were roughly intermediate between North American forested and desert systems. Our results underscore the value of secondary production estimates for examining invertebrate communities in an ecosystem context.

Key words: aquatic macroinvertebrates, secondary production, organic matter, energy flow, trophic structure, food web, prairie stream, Konza Prairie Biological Station.

Benthic invertebrate communities in North American prairie streams are poorly studied compared to those of other regions (e.g., forested streams, Matthews 1988). Studies have described prairie stream macroinvertebrate community composition and functional structure (e.g., Gray and Johnson 1988), and examined the influence of hydrologic disturbance (e.g., Miller and Golladay 1996, Hax and Golladay 1998) and even bison crossings (Fritz et al. 1999) on macroinvertebrate communities. More recently, N cycling was quantified through the biotic and abiotic compartments of a prairie stream, including macroinvertebrates (Dodds et al. 2000). However, no studies have examined the flow of energy through or within macroinvertebrate communities in North American prairie streams. Energy flow through trophic levels is one measurable property that all ecosystems share, and on which meaningful comparisons can be based (Odum 1983). To quantify the role of a population in energy flow, an estimate of production is essential.

Secondary production is the ultimate measure of the success of a population because it integrates abundance, biomass, growth, reproduction, and survivorship (Benke 1993). Studies examining macroinvertebrate community production in streams have increased since Benke's (1993) review, and some studies have examined streams in regions that were previously poorly studied (e.g., Ramirez and Pringle 1998). An advantage of using production to examine macroinvertebrate communities is that production estimates allow for better characterization of community structure and function than either

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