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Growth and Production of Juvenile Trout in Michigan Streams: Influence of Potential Ration and Temperature

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Abstract.–Twelve streams in northern lower Michigan were studied over a 3-year period to determine the influence of temperature and macroinvertebrate standing crop on growth and production of juvenile trout (*Salvelinus fontinalis* and *Salmo trutta*). Thermal conditions were typical for small streams in the glacial outwash regions of Michigan, which are heavily influenced by ground water. Macroinvertebrate community compositions were found to differ between sites although dominant taxa were similar. Total macroinvertebrate standing stock was correlated with several different measures of temperature including mean daily summer temperature, suggesting greater macroinvertebrate densities at higher temperatures. Observed young-of-the-year (YOY) brook trout growth rates varied from 0.0084 to 0.0266 g/day (a factor of >3x). Brown trout growth rates ranged from 0.0158 to 0.0218, but YOY brown trout were absent from 7 of 12 sites. Results indicated that overall benthic prey availability was more variable over time than was temperature or YOY growth performance. YOY brook trout growth was significantly correlated with total abundance of adult trout (kg/ha; all species combined). We developed several multiple regression models for predicting growth of juvenile brook trout in small ground water streams. The best-fit model included thermal, biological and nutrient (total phosphorus) variables as predictors (R^2 adj. = 0.86).

We also developed a causal path model with temperature and macroinvertebrate components to examine the underlying causes of juvenile brook trout growth rate and to estimate the direct and indirect effects of temperature on growth. In this model temperature was the strongest factor affecting variation in juvenile brook trout growth rate, having about a 50% greater effect on growth than all ration variables combined. However, indirect effects of temperature acting on growth rate through the ration variables accounted for approximately half of the total temperature effect. Ration effects on trout growth rate were also statistically significant, with the predator taxa being slightly more important than filter-feeding primary consumers. Biomass of both groups increased with increasing temperature and together provided the basis for temperature's indirect effect on trout. Management applications to small ground water fed trout streams are discussed in relation to the results of this study.

Temperature and ration are two major factors influencing the growth of fish (Brett 1979, Diana 1996). In both laboratory studies and in natural trout streams, higher growth rates