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

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Abstract.–Thermal conditions and trout population characteristics were followed at 17 sites in northern lower Michigan over a 3-year period to determine the influence of temperature on growth and production of juvenile brook trout *Salvelinus fortinalis* and brown trout *Salmo trutta*. Thermal regimes were summarized from 25 separate indicators using principal components analysis. The first two principal axes accounted for 99.8% of the variation in the summarized temperature variables. The first component was strongly and negatively correlated with summer mean temperature (r=-0.98) while the second principal component was most strongly correlated with mean winter temperature (r=0.95). Growth rate of juvenile brook trout was not significantly correlated with density of juvenile brook or brown trout. Growth rate of juvenile brown trout was not significantly correlated with density of juvenile brook trout, but was negatively correlated with density (r=-0.52) and standing stock (r=-0.46) of juvenile brown trout. Temperature principal components explained 29.7% of the variation in the growth rate of juvenile brook trout and 47.6% of the variation in the growth rate of juvenile brown trout. Addition of density of juvenile trout to these models improved the fit to 33.5% for juvenile brook trout growth rate but did not improve the fit of the growth rate model for juvenile brown trout (R^2=0.45). Production, as measured by standing stocks of juvenile brook and brown trout, was not significantly correlated with either principal temperature component. In order to allow for greater use of the data collected for this study, the basic temperature summaries were used to form simple linear regression (SLR) models for growth rate and standing stock of juvenile brook and brown trout. The best simple model for growth rate of juvenile brook trout explained 48.2% of the variance from the mean daily temperature fluctuation in July. The best brown trout growth rate model explained 53.1% of the variance using the mean daily temperature for the month of July. These types of data are easily collected by fisheries managers and will allow for estimation of expected growth rates at sites containing juvenile brook or brown trout.

While lethal thermal limits for trout in laboratory settings have long been established (e.g., Fry et al. 1946) the influences of temperature on trout living within their range of thermal tolerance is poorly understood. Temperature can be considered a master variable with respect to growth and production of fish due to its influence on both rates of metabolism and foraging activity. Brett (1979) lists temperature, ration, and size of fish as the three main factors influencing the growth of fish. Elliott (1994) has examined thermal influences on growth and production of brown trout *Salmo trutta* in a series of laboratory and field studies. By following characteristics of fish populations (e.g., growth rate, density, standing stock) and