Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Reynolds number effects on gill pumping mechanics in mayfly nymphs ANDREW SENSENIG, JEFFREY SHULTZ, Dept. of Entomology, KEN KIGER, Dept. of Mechanical Engineering, University of Maryland — Mayfly nymphs have an entirely aquatic life stage in which they frequently inhabit stagnant water. Nymphs have the capability to generate a ventilation current to compensate for the low oxygen level of the water by beating two linear arrays of plate-like gills that typically line the lateral edge of the abdomen. The characteristic Reynolds number associated with the gill motion changes with animal size, varying over a span of Re = 5 to 100 depending on age and species. The assumption that the system maintains optimal energetic efficiency leads to the prediction that animals transition from rowing to flapping mechanisms with increasing Re, while possibly utilizing a squeeze mechanism to a greater extent at lower Re. To investigate this hypothesis, we capture the motion of the gills through 3D imaging to investigate the effect of Reynolds number on the stroke patterns. PIV is utilized to assess flow rates and viscous dissipation. The effectiveness of the ventilation mechanism at each size has important consequences for the range of oxygen levels, and hence the habitat range, that can be tolerated by that size.

Ken Kiger
University of Maryland

Date submitted: 04 Aug 2006 Electronic form version 1.4