# *2013-14 UMR Mayfly Emergence and Development Synopses*

Based on standardized observations of emergent mayflies reported by a network of 30 citizen-scientists who work, reside, commute, or recreate near the Upper Mississippi River (UMR) or some of its major tributaries (Figure 1), there were two major peaks in the widespread synchronous emergence of *Hexagenia bilineata* mayflies here in 2013 (Figure 2).

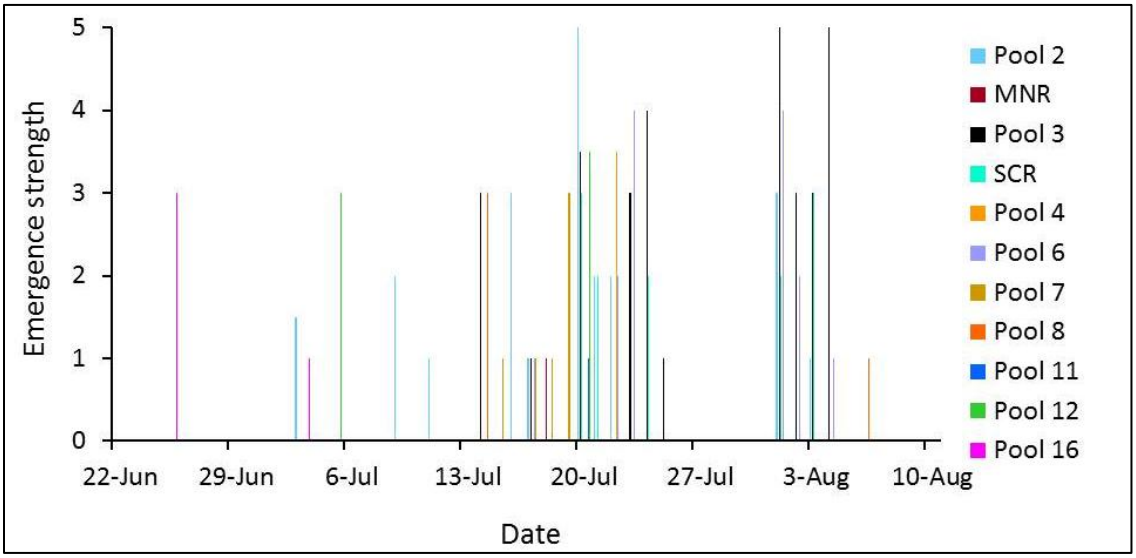


Figure 1. Daily magnitude (mean value) of *H. bilineata* mayfly emergence events reported for UMR pools and tributaries during summer 2013. Note: Minnesota River (MNR); St. Croix River (SCR).

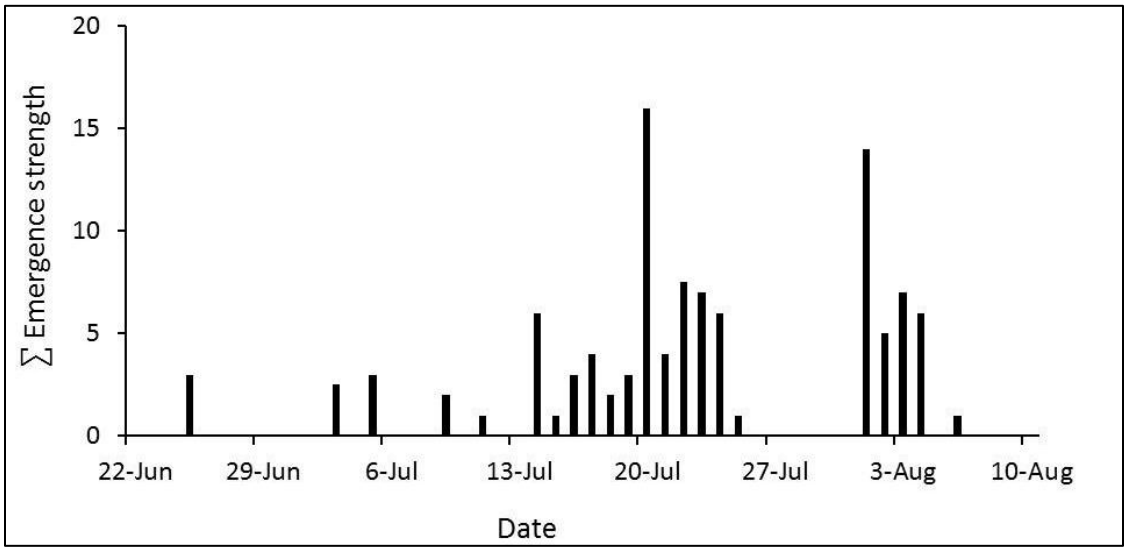


Figure 2. Daily magnitude (cumulative value) of *H. bilineata* mayfly emergence events reported for UMR pools and tributaries during summer 2013.

The primary peak in this activity occurred during the week of 18-24 July when emergent *H. bilineata* were reported from seven UMR navigation pools that span a distance of about 240 river miles from Hastings, Minnesota (Pool 2) to Dubuque, Iowa (Pool 12; Figure 3). Mayfly emergence activity during this period (quantified with the Johnson Scale) peaked on 20 July when this phenomenon was reported from five river reaches and the cumulative emergence strength value for the day (16) was ranked the greatest of the year. Emergent *H. bilineata* were also reported during this period at several sites along the lower St. Croix River (e.g., Prescott, Wisconsin; Stillwater, Minnesota) and the lower Minnesota River (e.g., Minneapolis, Bloomington, and Savage, Minnesota).

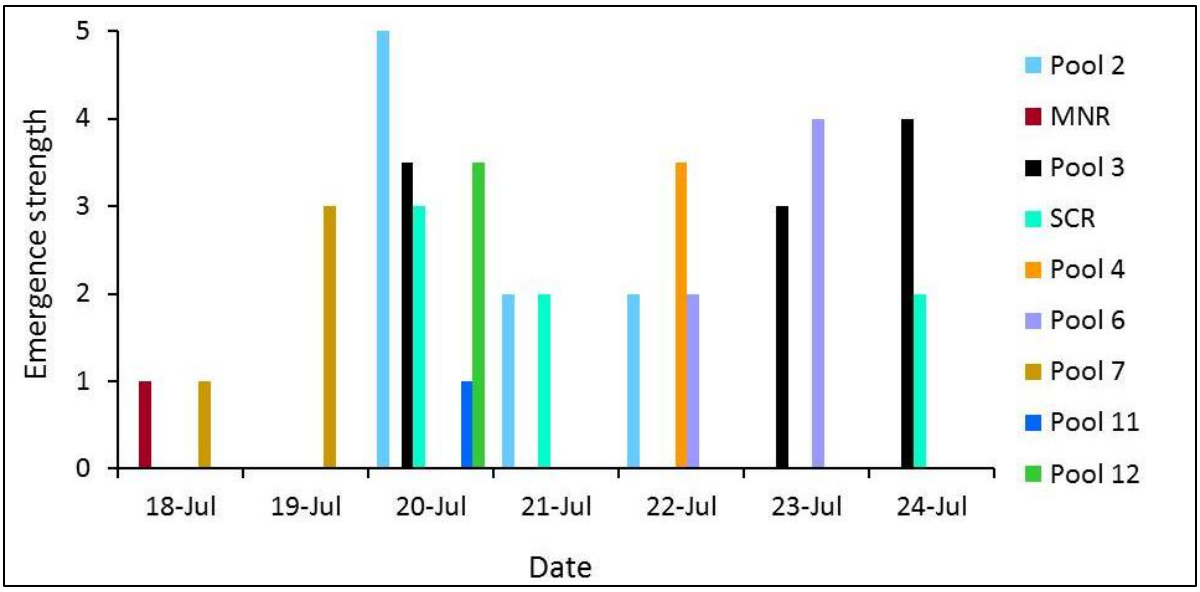


Figure 3. Daily magnitude (mean value) of *H. bilineata* mayfly emergence events reported for UMR pools and tributaries, 18-24 July 2013. Note: Minnesota River (MNR); St. Croix River (SCR).

One week after the conclusion of the primary emergence period in July, a secondary emergence peak abruptly commenced on 1 August and continued through 6 August (Figure 4). Reports of emergent *H. bilineata* at this time came from five UMR navigation pools that span a distance of about 120 river miles from Hastings, Minnesota (Pool 2) to La Crosse, Wisconsin (Pool 8). Mayfly emergence activity during this period peaked suddenly on 1 August when the cumulative emergence strength value for the day (14) ranked second greatest for the year. Emergent *H. bilineata* were also reported during this period at the mouth of the St. Croix River.

More than a dozen relatively weak emergence events (emergence strength $\leq$ 3) preceded the peak periods in widespread mayfly emergence activity. These began late in June as temporally discrete and localized phenomena that by mid-July were commonly synchronous and spatially expanding events. The majority of mayfly emergence activity observed early in this transitional period came from two of the most southern locations (Pool 12 and Pool 16) in the reporting

network (Figure 5). Such events are likely a reflection of warmer daily water temperatures that are more likely to occur here at lower latitudes, which in turn can accelerate the temperature-dependent growth and transformation of mayflies from aquatic nymphs into emergent adults.

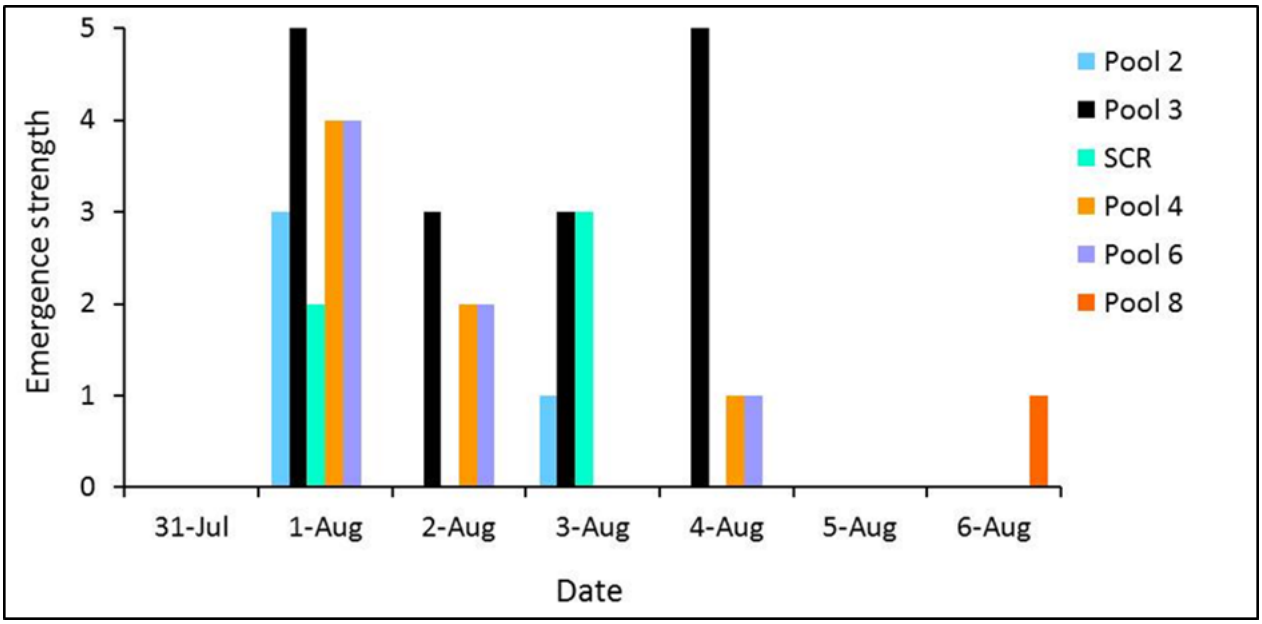


Figure 4. Daily magnitude (mean value) of *H. bilineata* mayfly emergence events reported for UMR pools and tributaries, 31 July – 6 August 2013. Note: St. Croix River (SCR).

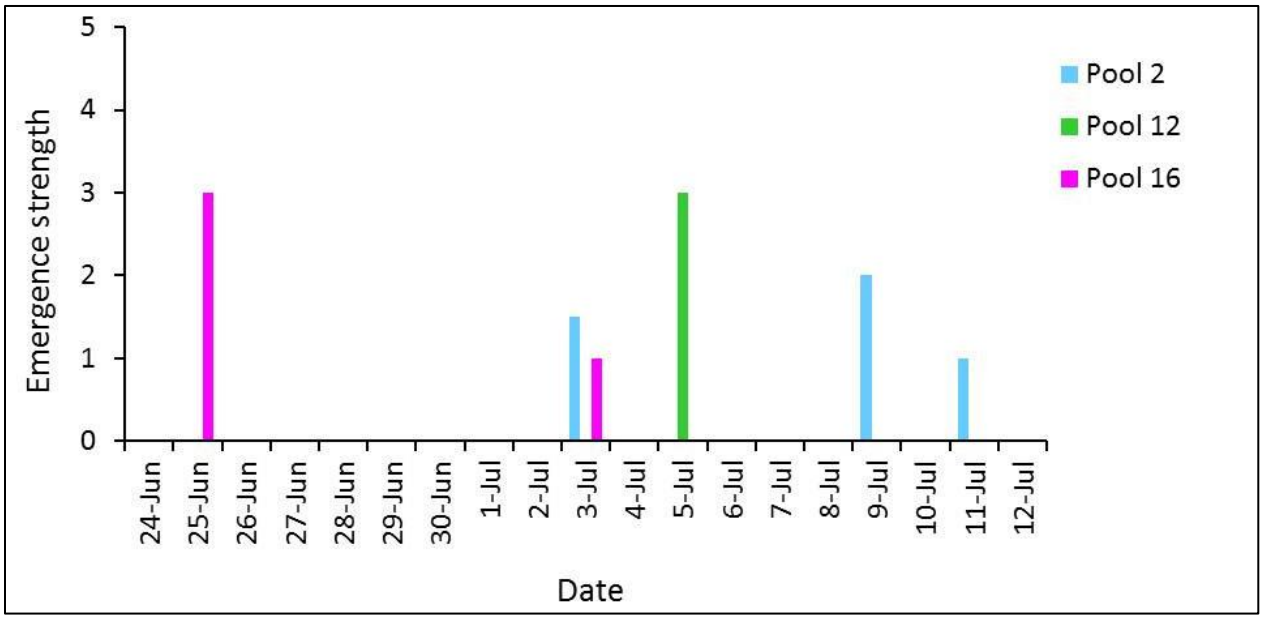


Figure 5. Daily magnitude (mean value) of *H. bilineata* mayfly emergence events reported for UMR pools, 24 June – 12 July 2013.

The science-based models used to help estimate when the first annual mass emergence of mayflies is likely to occur in a particular reach of the river are based on local daily water temperature observations and assume a 1-year life cycle, provided that all other conditions for growth and development are optimal.

Based on citizen-scientist reports of *H. bilineata* mayfly emergence events observed during summer 2012, models were prepared according to Wright *et al.* (1982) to estimate the timing of mass emergence events in six reaches of the UMR (Pools 2, 4, 6, 8, 12, 16) during 2013 (Figure 6). Mild weather should have promoted the continued growth of *H. bilineata* nymphs well into the fall of 2012 at all of the sites until river water temperatures ultimately dropped below the 10.1°C (50°F) threshold for this species' growth. An unseasonably cool weather pattern followed during the spring and early summer of 2013, particularly at the more northern located reaches of the river where diminished rates of growth were anticipated. Thus, model-predicted dates for mass emergence events were several weeks earlier in the more southern located reaches of the river than those in the north (*e.g.,* 5 July in Pool 16 at Muscatine, Iowa *vs.* 5 August in Pool 2 at St. Paul, Minnesota). The predicted 2013 date of mass emergence in each of these river reaches was subsequently compared to the observed date(s) of mass emergence reported by citizen-scientists to assess the spatial performance of these models.

For the 2013 cohort of emergent mayflies, the estimated and observed dates of mass emergence were identical (20 July) in Pool 12 (Figure 6). Meanwhile, observed dates of mass emergence preceded predicted dates by: nine days in Pool 6; ten days in Pool 16; thirteen days in Pool 4; sixteen days in Pool 2; and twenty-three days in Pool 8. Observed dates of mayfly mass emergence events reported by citizen-scientists also fell within the range of dates (*i.e.*, the 95% confidence interval) that the model predicts a mass emergence is most likely to occur in all but one of these river reaches (Pool 8). These measures of model accuracy and precision are largely consistent with those I have observed at these and other sites along the UMR in past years and provide a growing record for the credibility and validation of this water temperature-based model for mayfly growth and development.

The mass emergence of burrowing mayflies from the UMR in 2014 is now only a matter of days or weeks away. I hope that if you work, reside, commute, or recreate near the river or one of its major tributaries this summer, you will take a few moments to join the growing number of citizen-scientists who annually report these spectacular phenomena and help resource managers keep their finger on this important pulse of new life coming from "Old Man River"!

*Mark Steingraeber U.S. Fish & Wildlife Service, Onalaska, WI 13 June 2014*

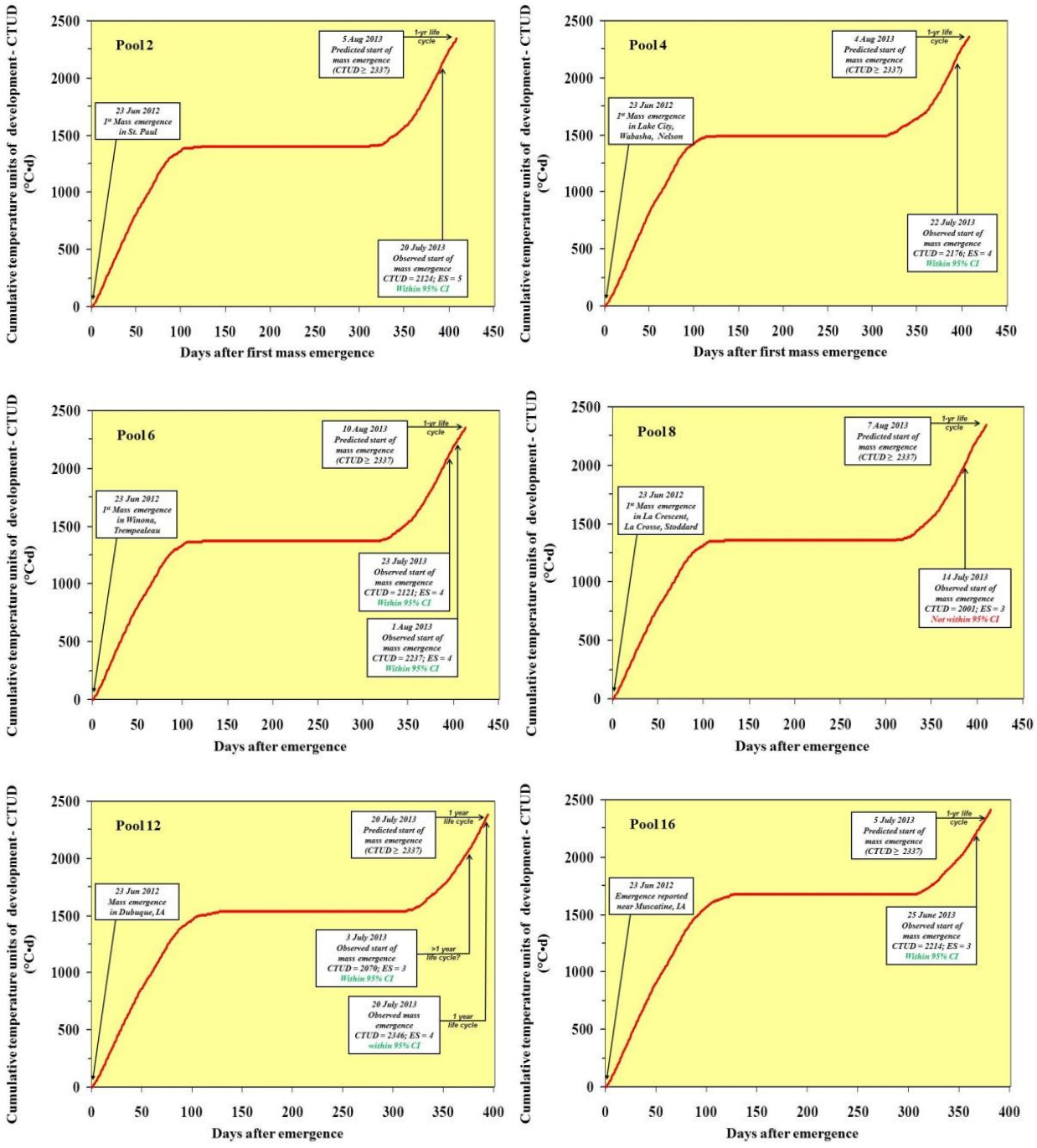


Figure 6. Estimated annual thermal development and 2013 dates (predicted *vs.* observed) of *H. bilineata* mayfly mass emergence events in six reaches of the UMR. Note: Emergence strength (ES).

Wright, L.L., J.S. Mattice, and J.J. Beauchamp. 1982. Effect of temperature and sex on growth patterns in nymphs of the mayfly *Hexagenia bilineata* in the laboratory. *Freshwater Biol.* 12:535-545.