Harry and Laura Nohr Chapter of Trout Unlimited

Scott Ladd Memorial Internship Report (2010-2011)

Assessment of Lee Creek and Harker-Lee Creek Restoration

(or The Mystery of the Missing Sculpin)

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Project Objective

The objective of this project was to examine potential differences in riparian vegetation, stream habitat, aquatic macroinvertebrates and fish among sections of the Harker-Lee system on the Wisler property. Each section of stream underwent floodplain and stream restoration at different times, so we expected to see significant differences among the sites due to different stages of succession and recovery following restoration activities.

Study Area and Methods

We surveyed three sections of stream which included Lee Creek and Harker-Lee Creek in Iowa County, WI. All of the sections of the stream were considered Class 1 by the Wisconsin DNR which indicates that the sections of the streams are of high water quality and they support natural reproduction of wild trout populations. We divided the stream into three 300 meter long sites that corresponded with the year that each section was restored (Figure 1). The different years of restoration were 2006, 2009, and 2010. The site that was restored in 2006 was a section of Harker-Lee Creek that was the furthest north (N 43˚01.085' W 90˚14.418') of the three sites and was also downstream of the other two sites. The 2009-restored section included the point where the Harker and Lee converge and thus contained a portion of the Lee Creek as well as the Harker-Lee. The 2009-restored section was located downstream of the 2010-restored site and had a starting location of N 43˚00.835' W 90˚14.442'. The 2010-restored section is located the furthest upstream of the three sites and consisted only of Lee Creek. The 2010-restored site started at the location N 43˚00.743' W 90˚14.384'. We surveyed each site twice; once in June and once in August. Coupling this data with the sites of different restoration years allowed for both seasonal and yearly succession comparisons. Sites were named by year of restoration

followed by Early or Late, depending on whether the data were collected in June or August, e.g. 2006 Late.

We sampled 12 transects at each site evenly spaced every 25m. For most in-stream habitat variables we followed the WI DNR Habitat Survey Protocol and measured width, depth, embeddedness, substrate, macrophyte cover, streambank erosion, canopy cover, water temperature, dissolved oxygen, and pH. We sampled invertebrates at 6 randomly chosen transects; 5 were sorted on location and the final sample was taken to the lab to sort. Fish were sampled by using a two-person team; one person used a backpack electro-fisher, while the other person netted the fish. Proximate riparian vegetation was sampled at each transect where invertebrate samples were taken. This was accomplished by taking two measurements inside a sampling area of one square foot, one meter away from the stream, on both sides of the stream. For the cover estimate we estimated the amounts of grasses, forbs, and sedges covering the sample area. Secondly we recorded the stem count of each type of plant (grasses, forbs, and sedges) within the sample area.

Results and Discussion

The most striking observation was the low number of total fish surveyed in the 2010 Late section (Figure 2). There were also comparatively low numbers in the 2006 Early section; however, we believe these low numbers were largely due to an initial voltage setting on the electro-fisher that was insufficient and later corrected. Unlike the 2006 Early results, the dramatically low 2010 Late numbers could not be accounted for by sampling error. **Thus, a primary focus of this project became explaining why this loss of fish in 2010 Late might have occurred.**

Examination of the fish composition of each survey revealed that at least 62.5% of all fish from each site and sample period were Mottled Sculpin (*Cottus bairdi)* with the distinct exception of 2010 Late where sculpin were completely absent (Figure 3). Further examination of the abundance of all fish species, *excluding* Mottled Sculpin, indicated all the sites and sample periods were otherwise comparable with respect to their fish communities (Figure 4). However, when comparing only the Mottled Sculpin numbers among sites and sample periods (Figure 5), each site contained over 40 specimens except 2010 Late which contained no Mottled Sculpin. Indeed, even two months earlier there were 92 Mottled Sculpins recorded at 2010 Early.

Could the absence of Mottled Scuplin in 2010 Late be related to any congruent site differences in habitat, riparian vegetation, macroinvertebrates, and/or other fish species?

Habitat

There were no distinct differences among the sites or sample periods with respect to overall substrate composition (Figure 6). As noted earlier, each section of stream was restored in a different year, and the restoration of the 2010 section was completed only a few weeks prior to our early summer surveying. Because Mottled Sculpins prefer rocky substrates, addition of fines from the restoration efforts may have compromised sculpin habitat. On the contrary, 2010 Late had the lowest average composition of fines (5.2% ±18.1 STD) of the surveyed sections (Figure 7). With respect to Mottled Sculpin's preferred substrates of gravel and cobble, 2010 Late had the second highest average composition of gravel (34.4% ±39.2 STD) and similar average composition of cobble (8.96% ±24.3 STD) among sites and sample periods (Figures 8 & 9 respectively). Thus, it was unlikely substrate composition contributed to the absence of Mottled Sculpin from 2010 Late.

It was also unlikely that excessive macrophyte growth influenced the distribution of Mottled Sculpin. Compared to other sites and sample periods 2010 Late had extremely low average macrophyte cover (0.83% ±2.9 STD) (Figure 10). However, among the sites there were drastic differences in macrophyte cover between 2006 Early (13.3% ±23.5 STD), 2009 Early (2.9% ±5.8 STD), and 2010 Early (0%) (Figure 10). This illustrates the successive growth of macrophytes in a stream as the number of years after restoration increases.

Because Harker Creek converges with Lee Creek in the 2009-restored section of the stream, temperature and discharge differences may have influenced Mottled Sculpin habitat. Unlike the 2010-restored section, both the 2006-restored and 2009-restored sections were potentially influenced by the Harker Creek input. However, there were very little differences among the sites with respect to water temperatures. Early survey temperatures among the three sites only ranged from 13.7-14.1˚C while the late survey temperatures only ranged from 16.2-17˚C among the three sites. In contrast, stream discharge had much wider ranges among the sites than the temperatures. As expected, in the early surveys the least discharge was observed upstream in 2010 Early (0.14 m^3/sec) and the highest discharge was observed downstream in 2006 Early (0.74 m^3/sec). Differences among sites in the late surveys were less dramatic but reflected a similar upstream-downstream trend from 0.17 m^3/sec in 2010 Late to 0.29 m^3/sec in 2006 Late. This was likely due to the additional input of water from Harker Creek. While the discharge of the 2006-restored section has the full influence from Harker Creek, only part of the 2009-restored section receives water from Harker Creek, and none of the 2010-restored section receives any water from Harker Creek. Although the 2010-restored section has comparatively low discharge it is not likely the culprit in the Mottled Sculpin absence. As noted earlier 2010 Early was not devoid of Mottled Sculpin as 2010 Late site was. When the discharge of the two

sample periods were compared, it was found that 2010 Late actually had a greater discharge than the 2010 Early site. If discharge was the lone factor, one would presume that 2010 Early would not have had any Mottled Sculpin in it either.

Riparian Vegetation

While it is important to consider the condition of the in-stream habitat, riparian zones along these streams can play a role in determining the in-stream conditions and communities (Gregory et al. 1991). In terms of percent coverage, the 2006-restored section differentiated itself from the other sections because of its high proportion of forbs (Figure 11). For example, 2006 Early had an average composition of 77% (±29 STD) forbs and 10% (±21 STD) grasses, whereas 2009 Early had 43% (±32 STD) forbs and 33% (±38 STD) grasses, and 2010 Early had 49% (±31 STD) forbs and 39% (±31 STD) grasses. More dramatic differences throughout the restoration sites were observed from stem counts for both forbs and grasses (Figure 12). For forbs stems 142 were recorded in the 2006-restored section, 188 in the 2009-restored section, and 275 in the 2010-restored section. The stem count of the grasses followed a similar pattern with counts of 77, 199, and 364 for the 2006-restored, 2009-restored, and 2010-restored sections respectively. Differences in sedge stems were much less ranging from 59 and 97 stems.

Although riparian vegetation may not directly relate to the Mottled Sculpin issue, it does illustrate how the cover changes from the 2009 and 2010-restored sections to the 2006 section. The 2006 section has had enough time from being restored that the cover crop of annual ryegrass (*Lolium multiflorum*) is no longer present as it is in the 2009 and 2010-restored sections, and therefore has less grass cover. Also having more time passed since restoration, the forbs have had more time to establish themselves and grow in size. The streambank vegetation also shows the effects that maturing plants have on stem counts. Not only does the amount of grass stems

decrease due to the absence of annual ryegrass, but the forbs stem count also decreases. This illustrates vegetative succession after a disturbance (i.e. restoration) as maturing plants out-compete neighboring plants for sunlight and fewer total plants are left.

Aquatic Macroinvertebrates

Macroinvertebrates are not only a staple of Mottled Sculpin's diet, but are also effective indicators stream health. Thus comparisons among the sites were intended to examine two things: (1) any differences in the availability of food for Mottled Sculpins, and (2) possible indications of lower water quality if the abundance of any invertebrate species fell drastically in 2010 Late.

Taxa richness was lowest in 2010 Late (10) and highest in 2006 Early (15) (Figure 13). However, it is unlikely this provides much evidence for the loss of Mottled Sculpin in 2010 Late, because 11 of the taxa identified throughout the study were only represented by 5 or less total specimens. This means that although one site may have had higher taxa richness, it likely had little effect on the overall abundance of individuals (i.e. potential food) found within the sites. Indeed, although 2006 Early had significantly more total invertebrates than the other early sample period, there was little difference between 2009 Early and 2010 Early (Figure 14). Despite a major drop in invertebrate totals between early surveys and late surveys (Figure 14), invertebrate totals in 2010 Late were the highest among sites in the late surveys (Figure 14). Consequently, it was unlikely that Mottled Sculpin left the site in search of food.

Was the drastic drop in invertebrate populations from early to late sample periods due to an environmental pressure or due to aquatic insects with two-stage life cycles (one aquatic, one terrestrial) emerging into their terrestrial forms? Of the 10 most abundant invertebrates overall, 6 of them were insects with two-stage life cycles (Figure 15). In fact, these 6 insects also made

up 6 of the 7 most common invertebrates, and all 6 came from just 3 orders: Ephemeroptera (mayflies), Trichoptera (caddisflies), and Diptera (true flies). There was a substantial decrease in the abundance of these 3 orders at each section of stream between early and late summer (Figure 16). The 2006-restored section decreased from 345 to 72, the 2009-restored went from 216 to 35, and 2010-restored fell from 240 to 76. Thus, this decrease in overall invertebrates can very likely be attributed to summer emergence.

Comparing the abundance of the 3 orders of aquatic insects individually provided additional insight into habitat quality among the sites because Diptera is generally more tolerant of poor conditions and both Ephemeroptera and Trichoptera are generally less tolerant. If Ephemeroptera and Trichoptera numbers were low in 2010 Late, it could have indicated that stream quality may have been low enough to affect Mottled Sculpin. This was not the case however, as the greatest difference in the 2010-section was Trichoptera dropping from 183 to 34 specimens (Figure 17). Not only did this site have the greatest number of pre and post-emergence Trichopterans, but its post-emergence Trichoptera total is only 4 individuals less than the pre-emergence number of Dipterans. This suggests habitat quality in the 2010-restored section of stream was not compromised and was likely not what caused the Mottled Sculpin numbers to decrease.

Trout

Mottled Sculpins are often found in streams with brook trout and brown trout because they all generally favor similar habitat conditions. Because Mottled Sculpins are also preyed upon by larger individuals of both types of trout, differences in trout populations among the sites may have contributed to the lack of Mottled Sculpins from 2010 Late.

The total number of trout surveyed, both brook and brown, was somewhat low for a stream of this quality and ranged from 11-35 among sites and sample periods (Figure 18). The low numbers were likely due to the predominance of glide habitat (not distinct riffle or pool) throughout the stream. In contrast to electro-fishing streams with distinct riffles and pools where trout may be corralled in pools or trapped at the foot of a riffle, streams with a more uniform U-shaped channel allow the trout to continuously move upstream and possibly out of the survey area. Nevertheless, the number of trout consistently increased from early surveys to late surveys across all sites (Figure 18). There was also an increase of the proportion of brown trout to brook trout at each site (Figure 19). This suggests as the summer progressed more brown trout moved upstream and contributed to the increase of total trout sampled. Ultimately, there was no indication the trout population contributed to the loss of Mottled Sculpins from 2010 Late.

The average trout length in each section varied slightly between early and late summer (Figure 20). The average trout lengths of the 2006-restored section were 207mm (±53.5 STD) for early summer and 202mm (±68.0 STD) for late summer. The 2009-restored section averages were 209mm (±42.6 STD) for early summer and 215mm (±41.4 STD) for late. The 2010-restored sections averages were lower than the other two sections having the lengths of 183mm (±16.1 STD) early summer and 169mm (±33.5 STD) late summer. Though this lower average may be attributed to the disturbance of the section caused by restoration earlier in the year, it cannot be determined for certain. However, the smaller sizes of trout in Late 2010 compared to the other sites, further reduces the likelihood that trout contributed to the loss of Mottled Sculpins from 2010 Late.

Conclusion

The objective of this project was to examine potential differences in riparian vegetation, stream habitat, aquatic macroinvertebrates and fish among sections of the Harker-Lee system on the Wisler property. As expected, there were differences among the sites due to different stages of succession and recovery following restoration activities. In particular, the sites differed in substrate types, macrophyte cover, riparian vegetation, and macroinvertebrate composition. The most striking observation was the loss of Mottled Sculpin from the late summer survey of the most recently restored site. Upon further examination, this absence of a single fish species did not appear related to any congruent site differences in habitat, riparian vegetation, macroinvertebrates, and/or other fish species. The reason for the lack of Mottled Sculpin from this specific site and sample period remains unknown. To be continued…

Figure 1. 2010 study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI. The stream flows to the north.

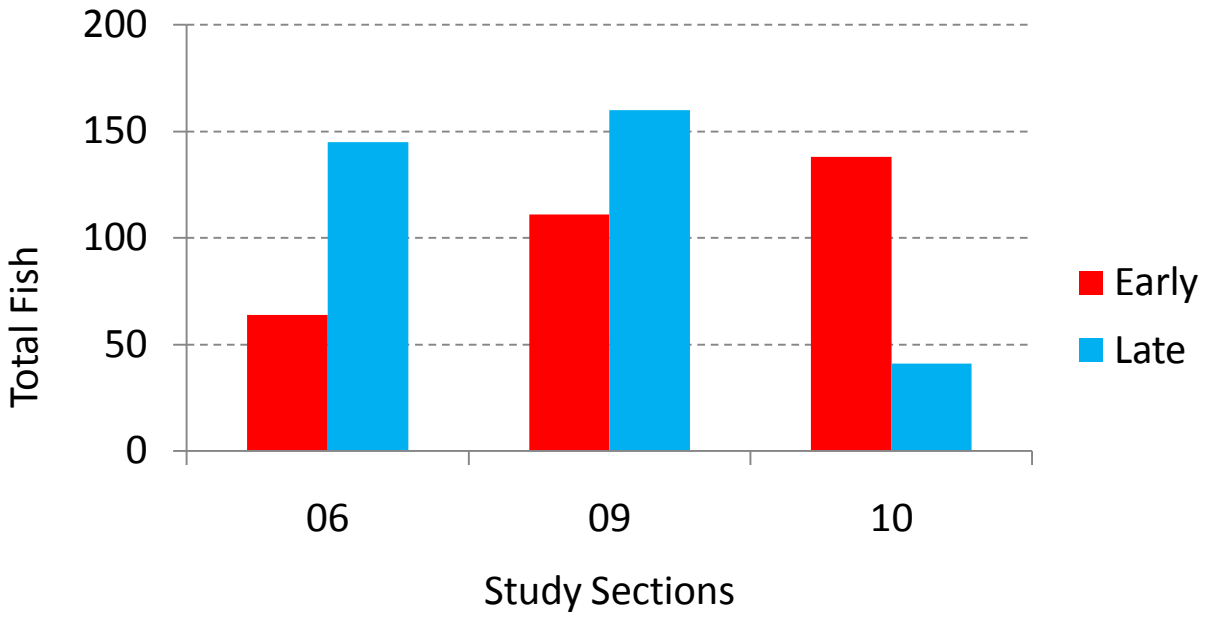

Figure 2. Total numbers of fish sampled from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

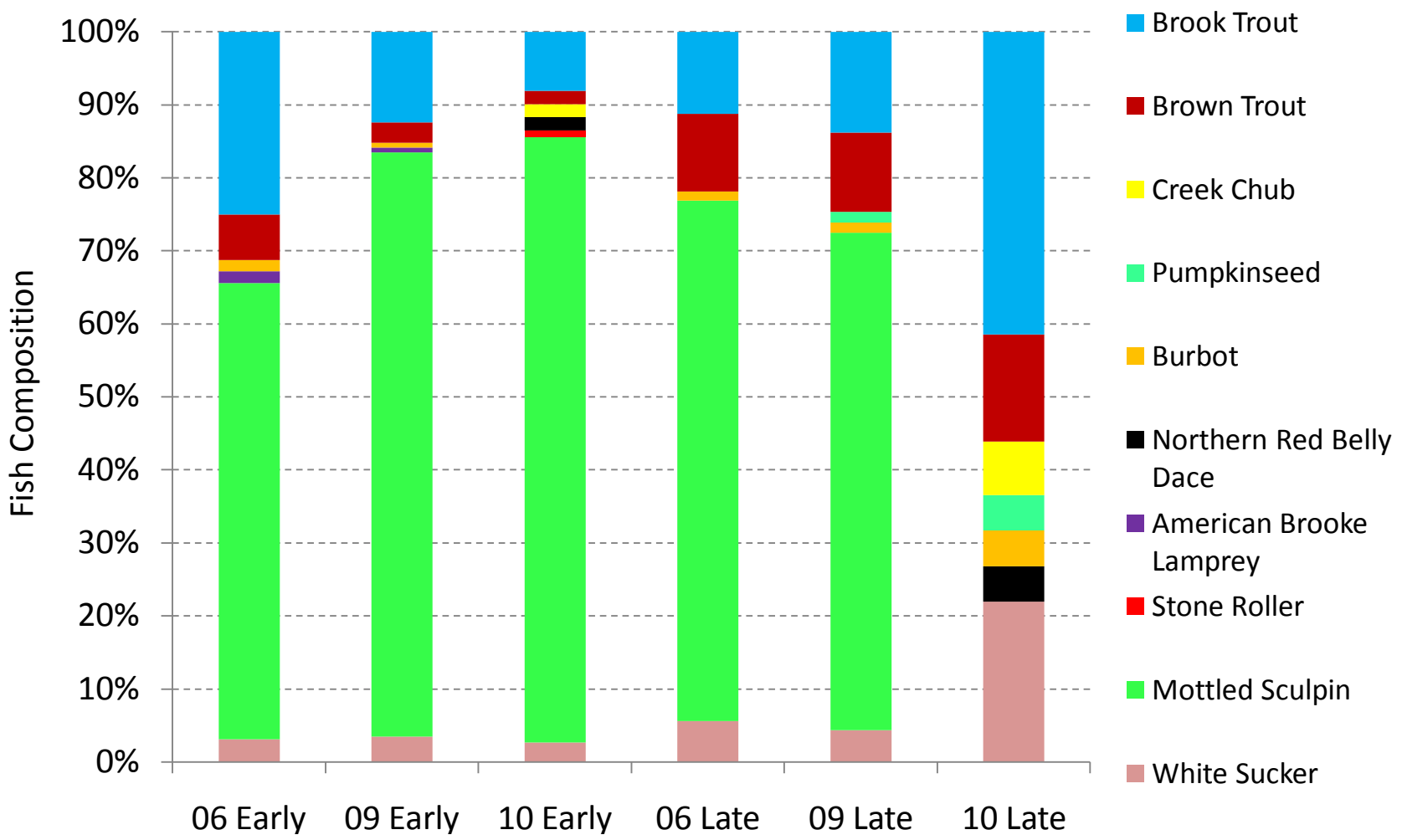

Figure 3. Relative abundance of all fish sampled from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

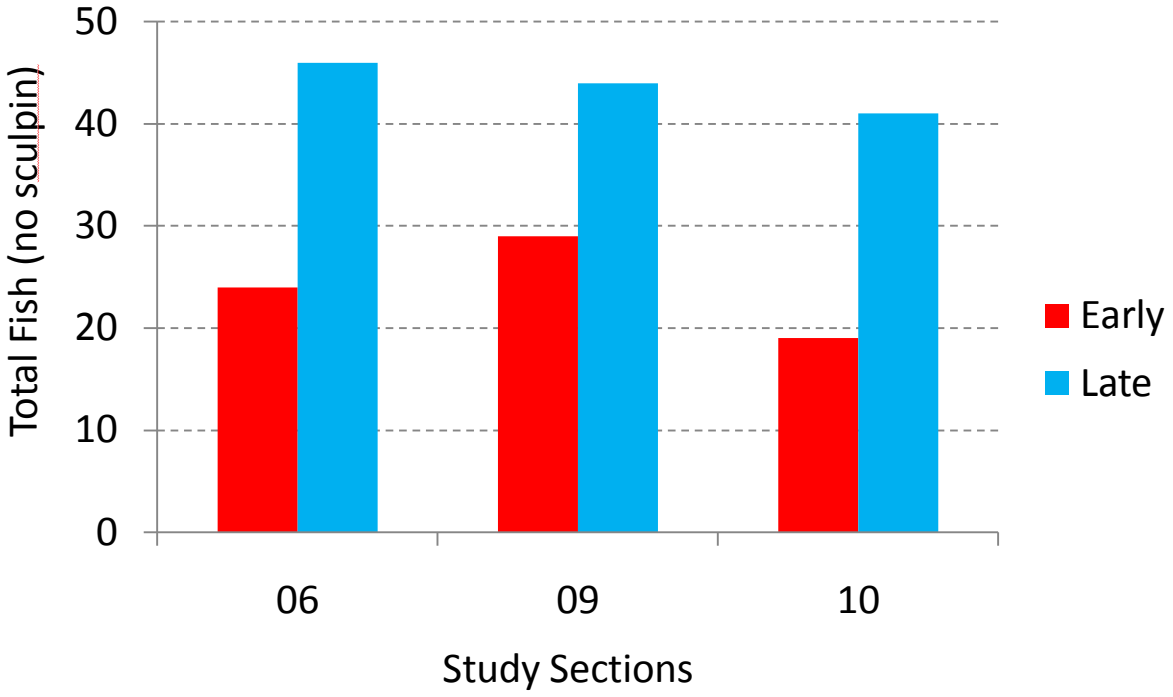

Figure 4. Total numbers of fish sampled, excluding Mottled Sculpin, from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

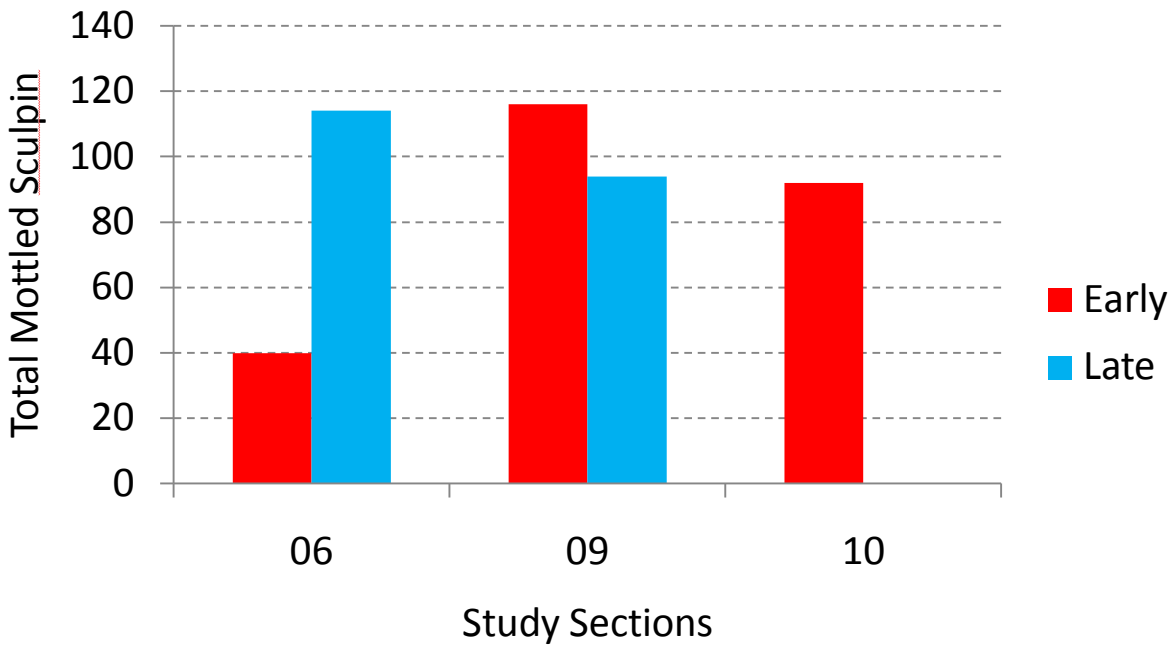

Figure 5. Total numbers of Mottled Sculpin sampled from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

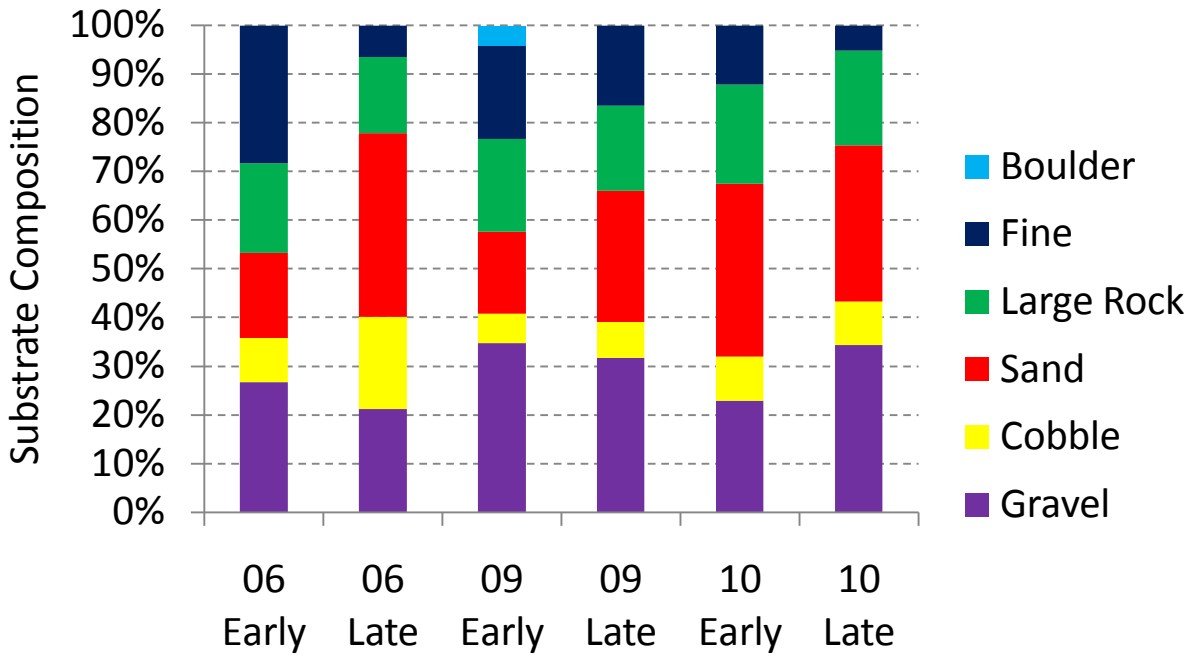

Figure 6. Relative abundance of substrates from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

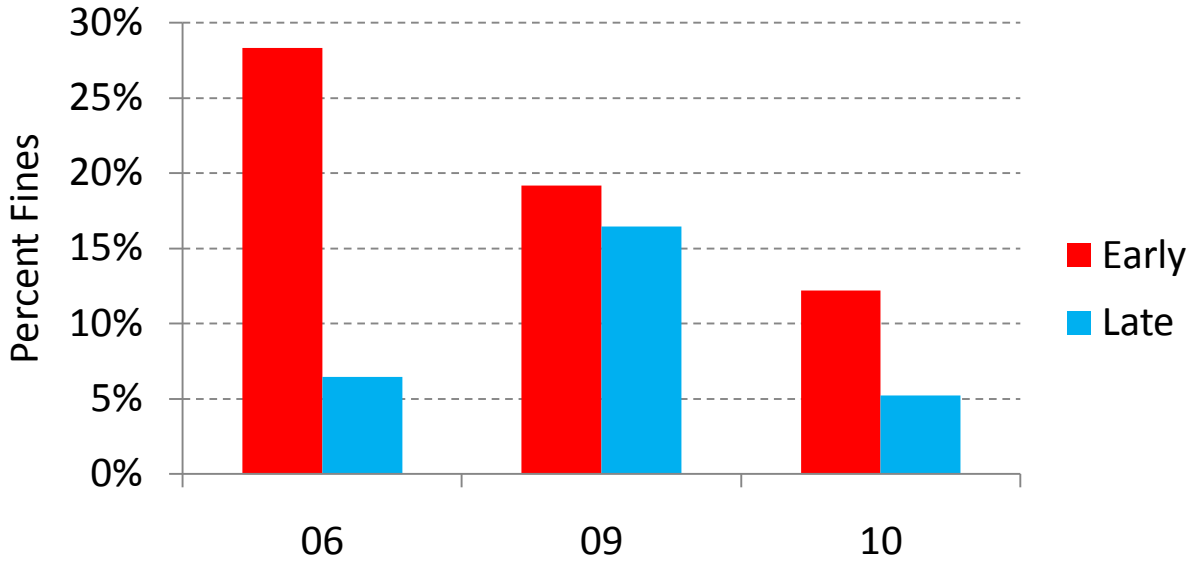

Figure 7. Proportions of fine substrate observed from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

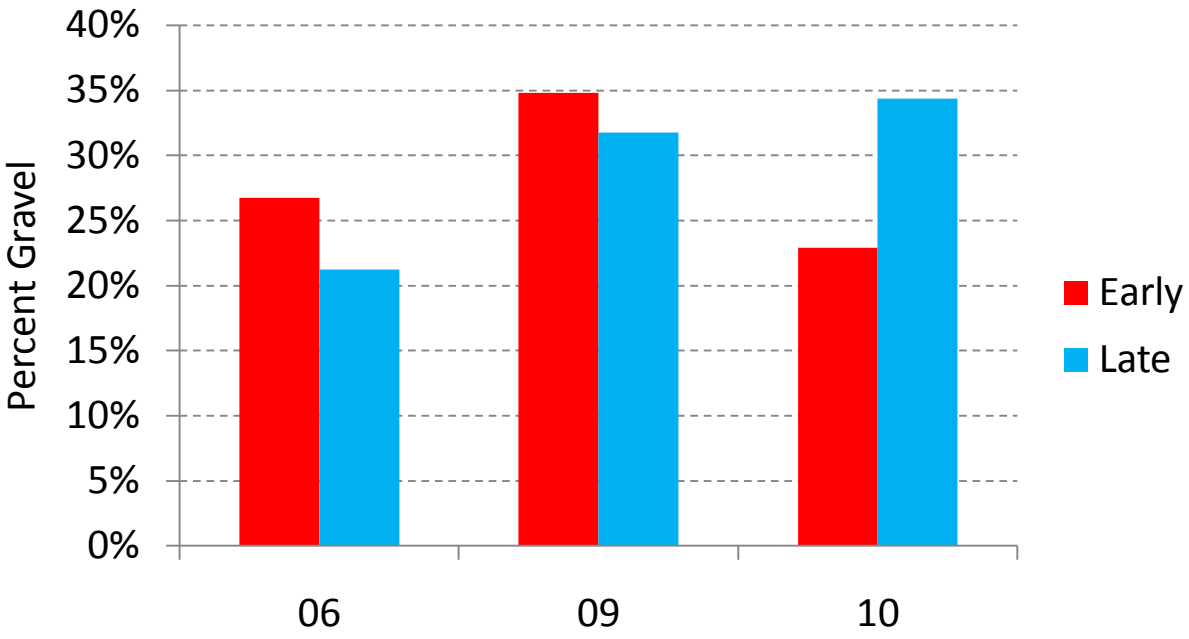

Figure 8. Proportions of gravel substrate observed from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

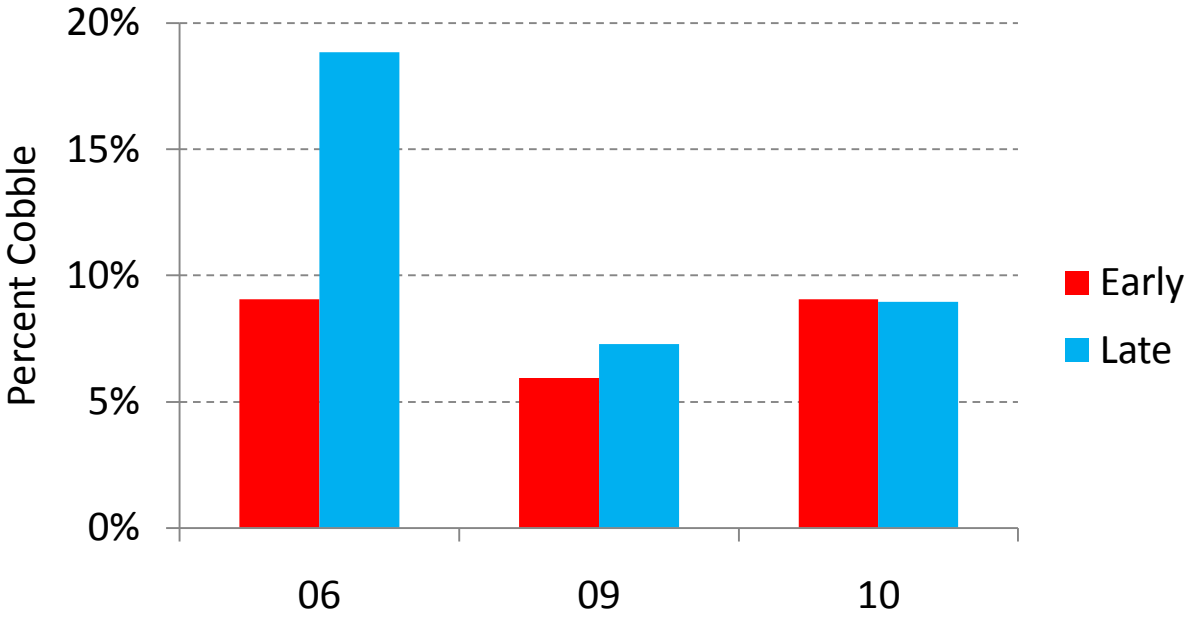

Figure 9. Proportions of cobble substrate observed from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

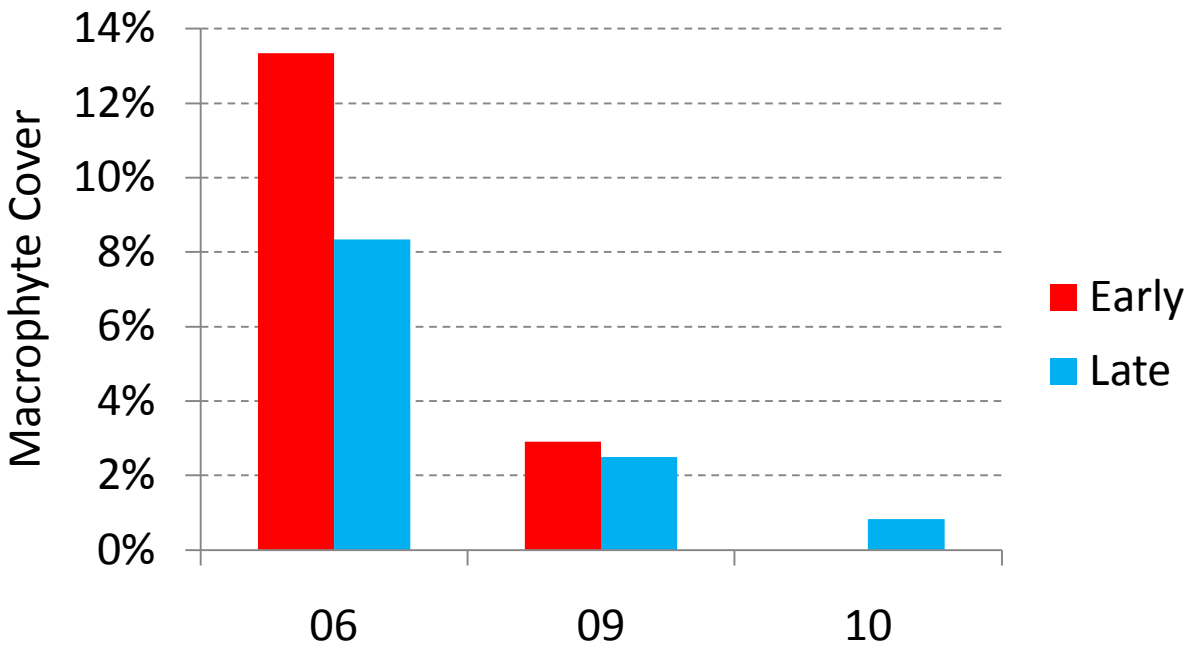

Figure 10. Percent macrophyte cover observed from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

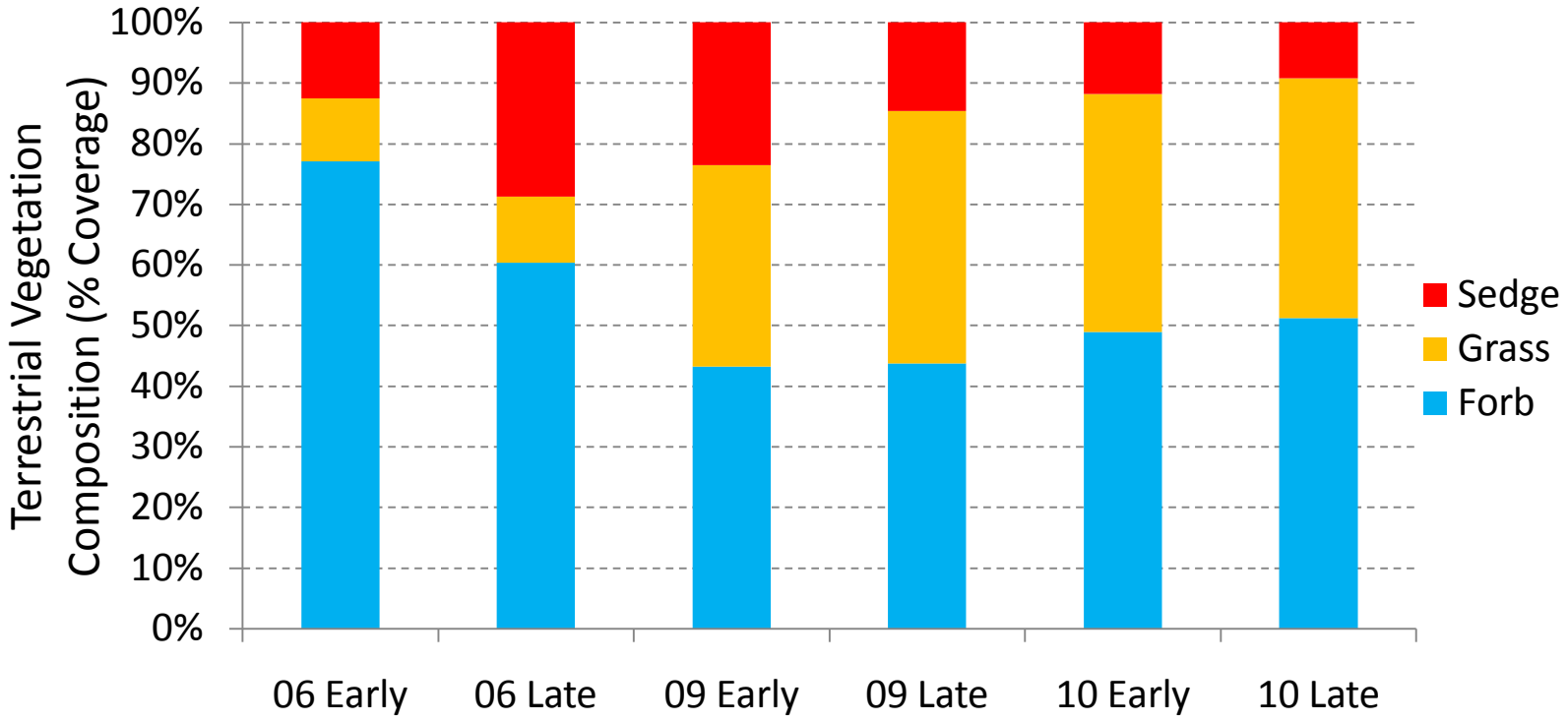

Figure 11. Proportions of riparian vegetation types observed as percent cover from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

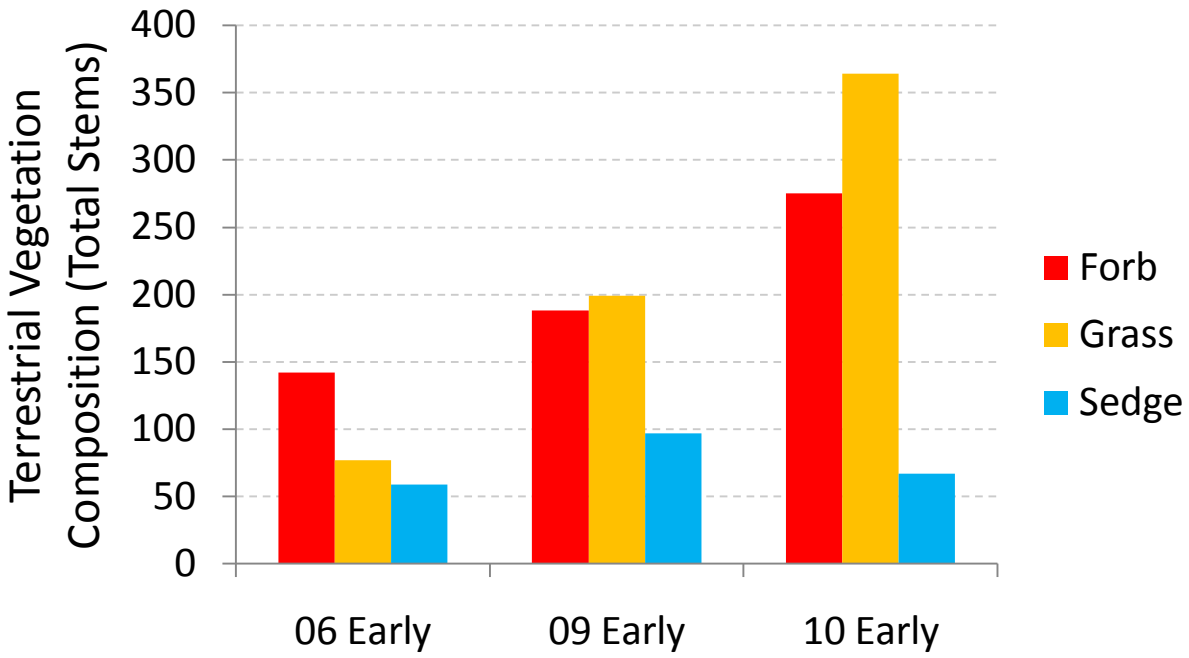

Figure 12. Total stem counts of riparian vegetation observed from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

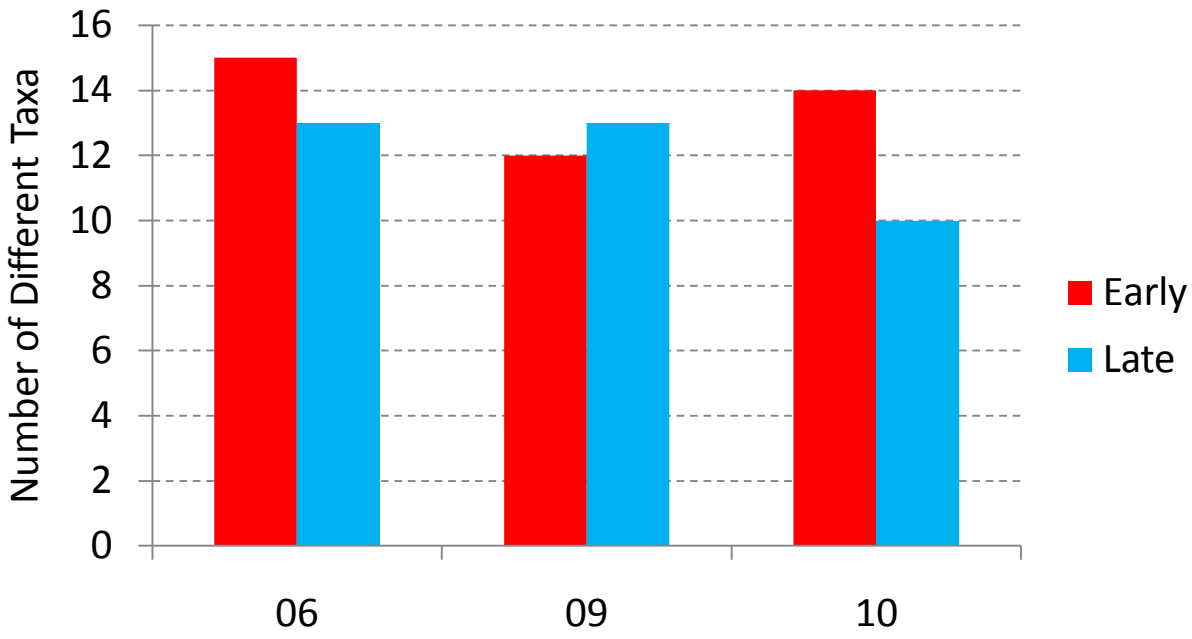

Figure 13. Numbers of different macroinvertebrate taxa (taxa richeness) sampled from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

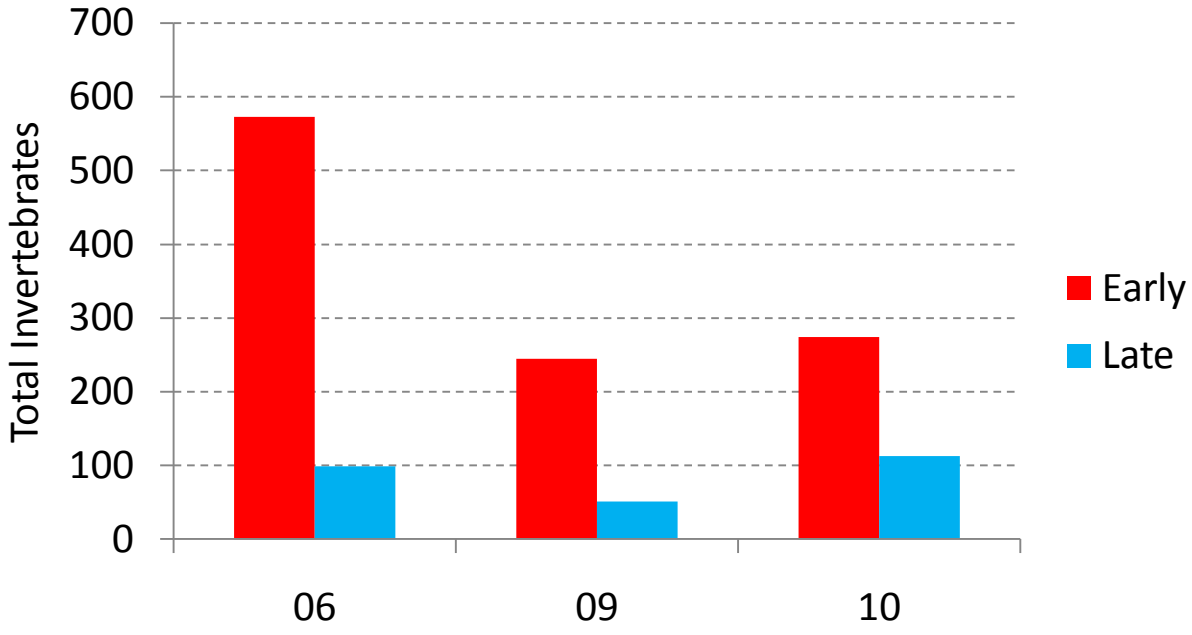

Figure 14. Total numbers of macroinvertebrates sampled from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

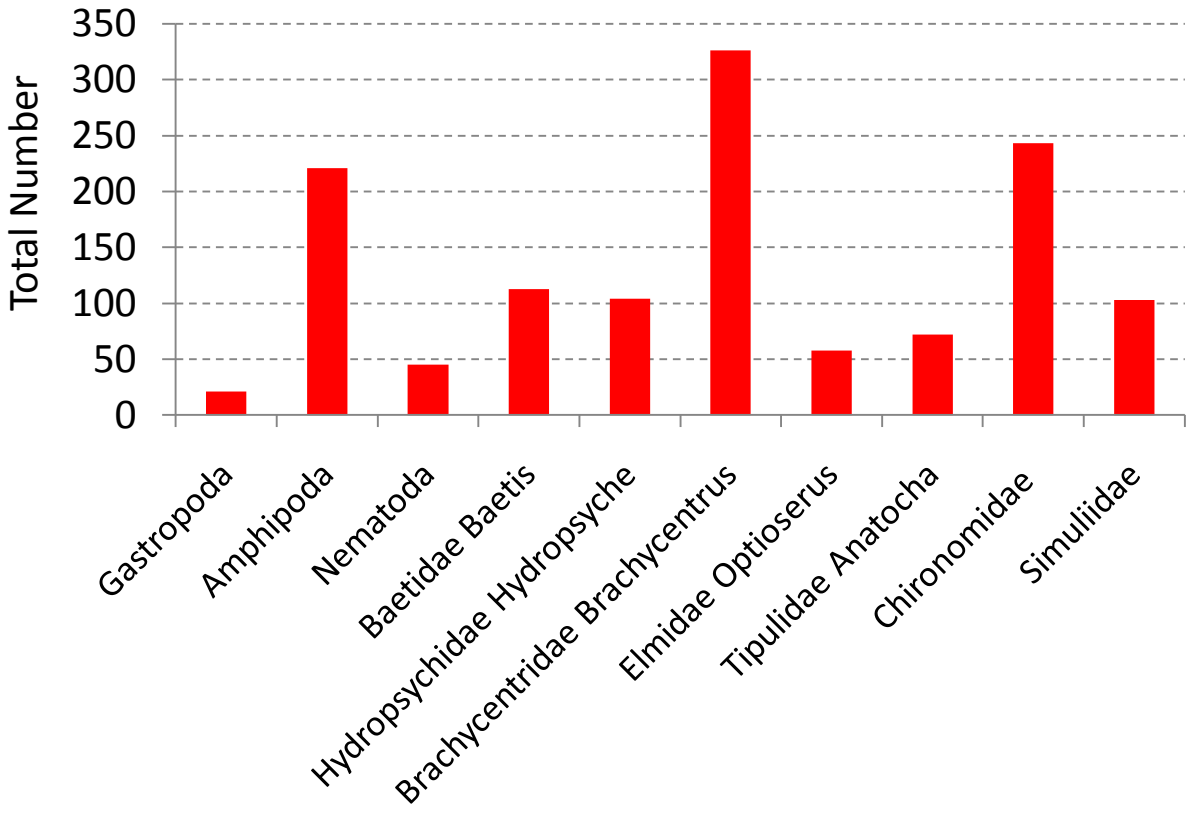

Figure 15. Total numbers of the ten most common macroinvertebrates sampled from all 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late).

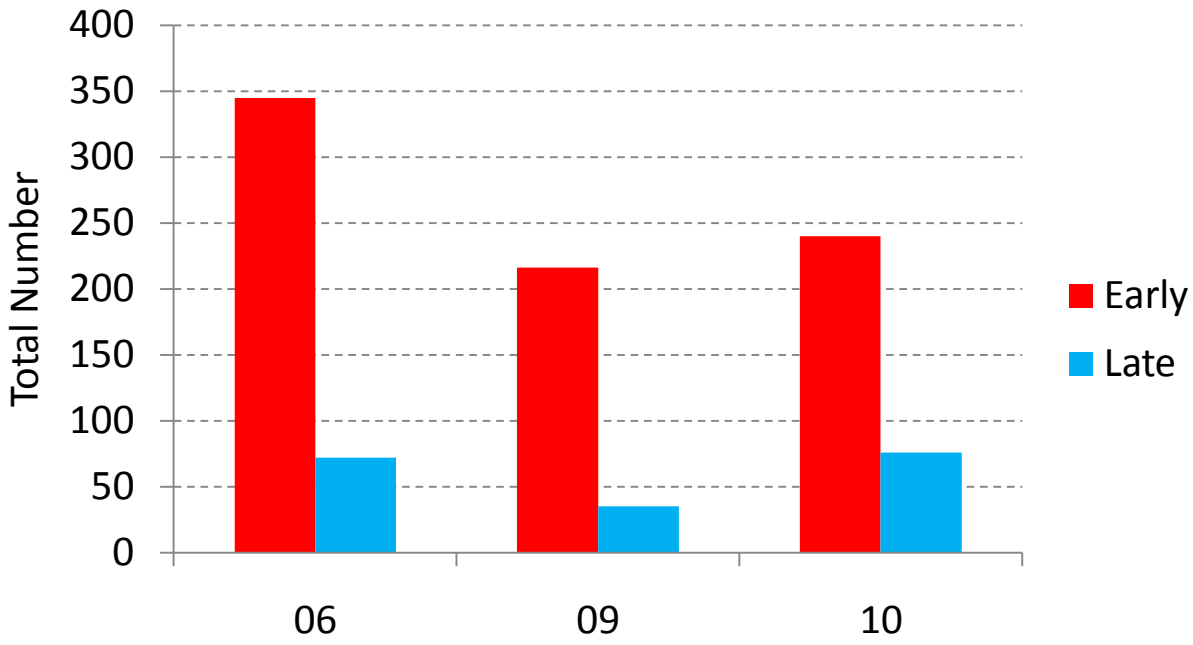

Figure 16. Total numbers of Ephemeroptera, Trichoptera, and Diptera macroinvertebrates sampled from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

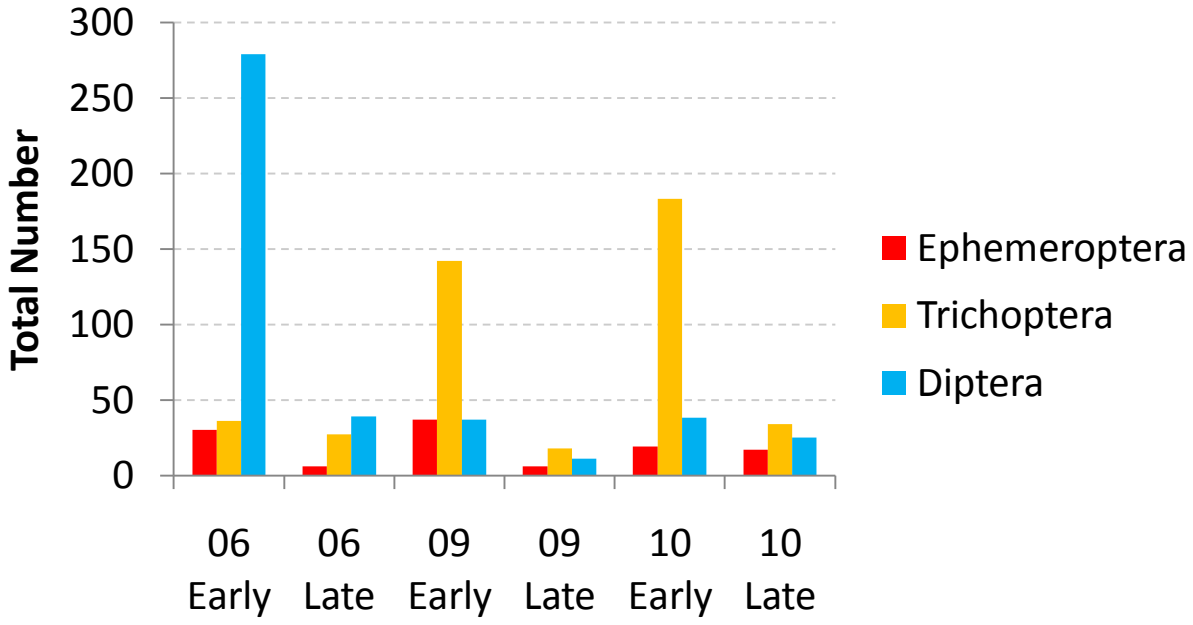

Figure 17. Abundance of Ephemeroptera, Trichoptera, and Diptera macroinvertebrates sampled from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

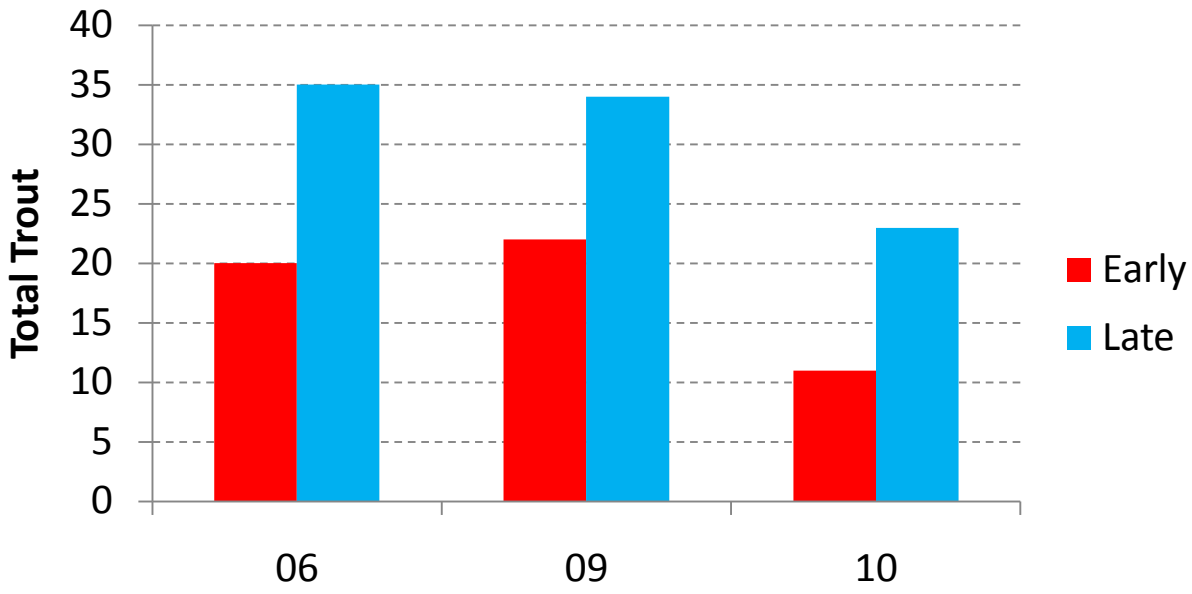

Figure 18. Total numbers of trout (brook and brown) sampled from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

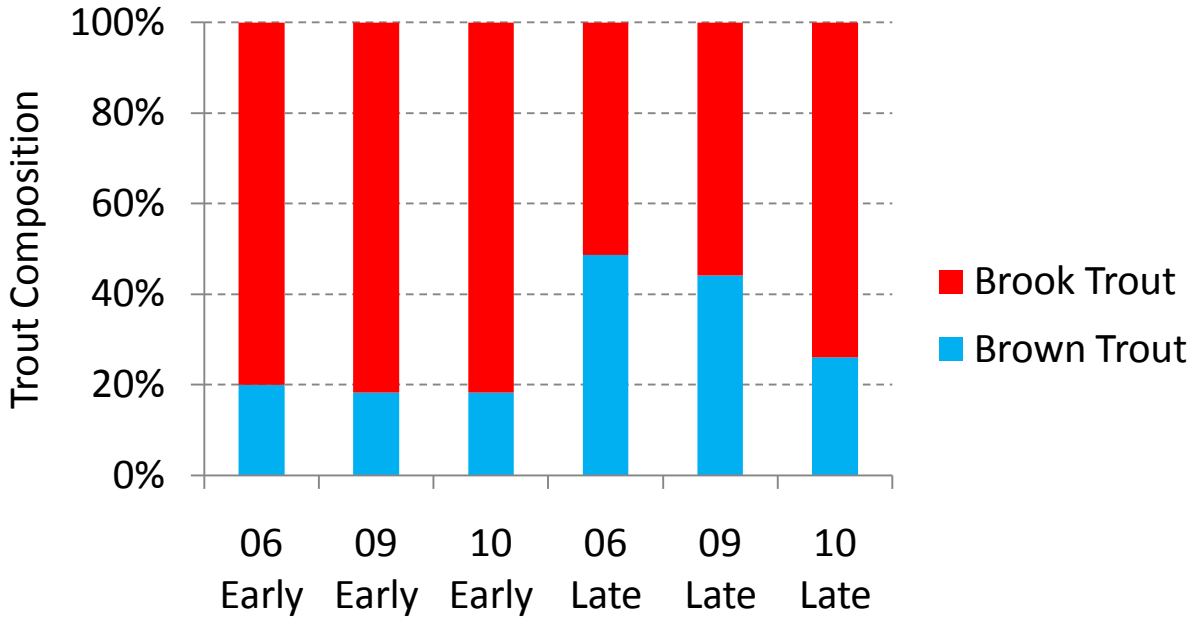

Figure 19. Relative abundance of brook trout and brown trout sampled from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.

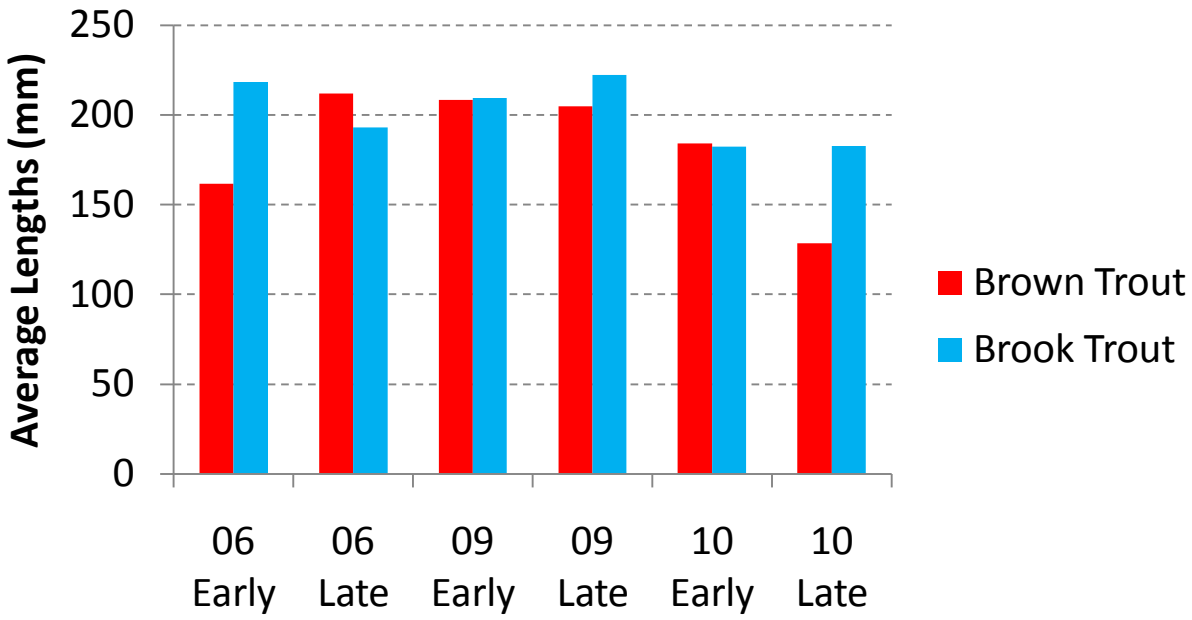

Figure 20. Average lengths (mm) of brook trout and brown trout sampled from 300m study sections of the Lee and Harker-Lee Creek on the Wisler property in Iowa County, WI in 2010 June (Early) and August (Late). Study sections are based on the year they were restored: 06 = restored in 2006, 09 = restored in 2009, 10 = restored in 2010.