2011 Pool 8 State of the Ecosystem Report

Long Term Resource Monitoring Program

a component of the

Upper Mississippi River Restoration –

Environmental Management Program

Wisconsin Department of Natural Resources

Mississippi River Monitoring Field Station

Introduction

Fish, water quality and vegetation data are collected each year through the Upper Mississippi River Restoration- Environmental Management Program- Long Term Resource Monitoring Program (LTRMP). A complete description of the program can be found at: http://www.umesc.usgs.gov/ltrmp.html. Personnel from the Wisconsin Department of Natural Resources collect data in Pool 8, one of 6 study reaches included in the program. Data have been collected under a stratified random framework for fish and water quality since 1993 and for vegetation since 1998. This report summarizes the 2011 dataset.

2011 Hydrograph

Substantial flooding was predicted for the spring of 2011. A water-laden snowpack existed over much of the floodplain for the Upper Mississippi River Basin upstream of La Crosse. However, gradual thawing and the absence of major precipitation events led to only minor or moderate flooding in most areas. The river exceeded flood stage locally for about a month, mostly during April, and gradually receded (Figure 1). However, flows and elevations were still 2-5 feet above average values from May through mid-August. Dry mid-summer weather persisted into autumn, and river stage was slightly below normal from September through the end of the year.

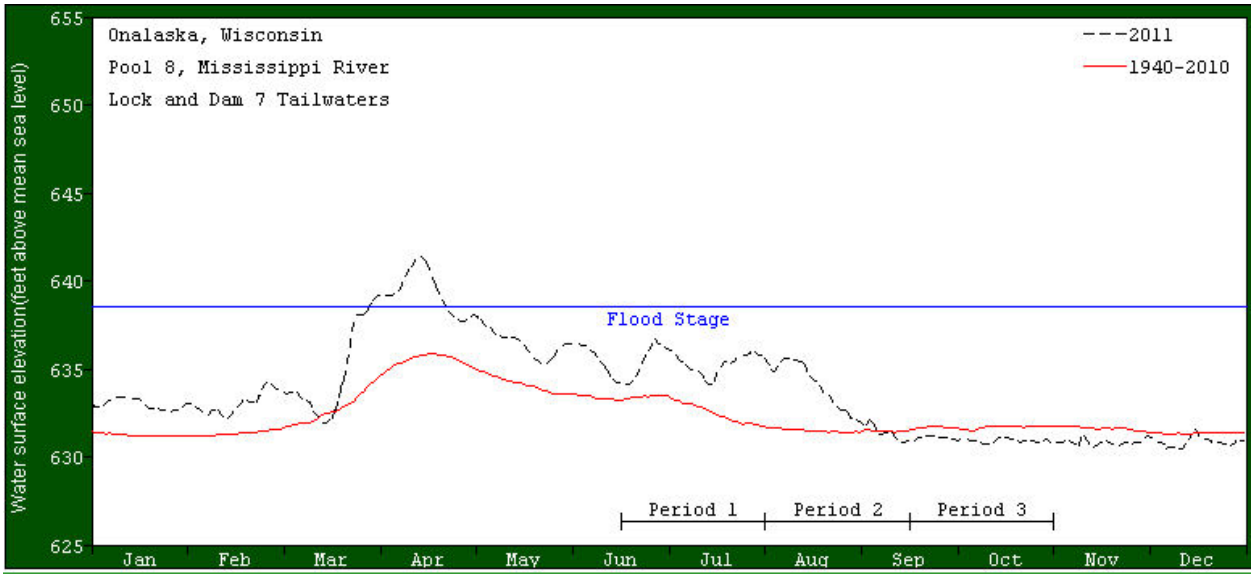

Figure 1. Daily water surface elevation from Lock and Dam 7 for Pool 8, Mississippi River, in 2011 and mean elevation since 1940 (screen grab from Fish Graphical Data Browser). The U.S. Army Corps of Engineers discharge data were obtained in accordance with Upper Midwest Environmental Sciences Center established procedures (Wlosinski et al., 1995). Periods 1-3 indicated on graph illustrate fish sampling periods.

2011 Water Quality

Methods

The focus of the water quality component of the Long Term Resource Monitoring Program (LTMRP) is to collect limnological information relevant to the suitability of aquatic habitat for biota and transport of material within the system. The LTRMP water quality sampling design since 1993 incorporates biweekly fixed-site sampling (FSS) and quarterly stratified random sampling (SRS). The mixed-model design provides information at both broad spatial scales with low temporal resolution (i.e., SRS), and at small spatial scales with higher temporal resolution (i.e., FSS). SRS tracks conditions at spatial scales corresponding to sampling strata or larger (i.e., whole pool or sampling reach) and at seasonal to annual time scales or longer. In contrast, FSS provides information at more frequent intervals (i.e., within season) at specific points of interest such as tributaries, tailwaters, and backwaters with high habitat value. The data used for this report were collected from the main channel during SRS sampling. Dissolved oxygen (DO) concentrations used were surface measurements taken at 0.20m. Water was collected near the surface (0.20m) to quantify total suspended solids (TSS), chlorophyll a, total phosphorus (TP), and total nitrogen (TN). Discharge data were obtained from the U.S. Geological Survey gauge in Pool 6 at Winona, MN. More detail on LTRMP water quality sampling methods can be found in Soballe and Fischer (2004) at: http://www.umesc.usgs.gov/documents/reports/2004/04t00201.pdf. More in-depth graphical display of data pertaining to water quality metrics by season, reach and sampling stratum can be found by utilizing the LTRMP Water Quality Graphical Data Browser at: http://www.umesc.usgs.gov/data_library/water_quality/water_quality_page.html.

Results

River discharge is the key variable influencing limnological variables and biota. Changes in discharge result in variable rates of delivery of sediment, nitrogen and phosphorus (Balogh et al., 1997; Goolsby et al., 2000; Likens, 2010). Discharge in 2011 was well above the long-term median for the LTRMP period of record (1993-2001) during winter, spring, and summer (Figure 2a). Discharge was slightly below the long-term median during fall sampling.

Excessive TSS concentration can limit primary productivity by blocking light, negatively affects macroinvertebrate respiration and behavior, results in habitat loss, and affects fish by reducing feeding efficiency and smothering spawning habitat (Walters, 1995). Mean TSS values were below the long-term median during all seasons despite elevated discharge during winter, spring, and summer (Figure 2b). High coverage of submersed aquatic vegetation (SAV; Figure 3) was likely a contributing factor to the low TSS values due to reduced sediment resuspension and increased sediment accretion (James and Barko, 1990). TSS concentration was well below the suggested criteria (<30 mg/L) to sustain SAV in the Upper Mississippi River (UMR) during all seasons (Giblin et al., 2010).

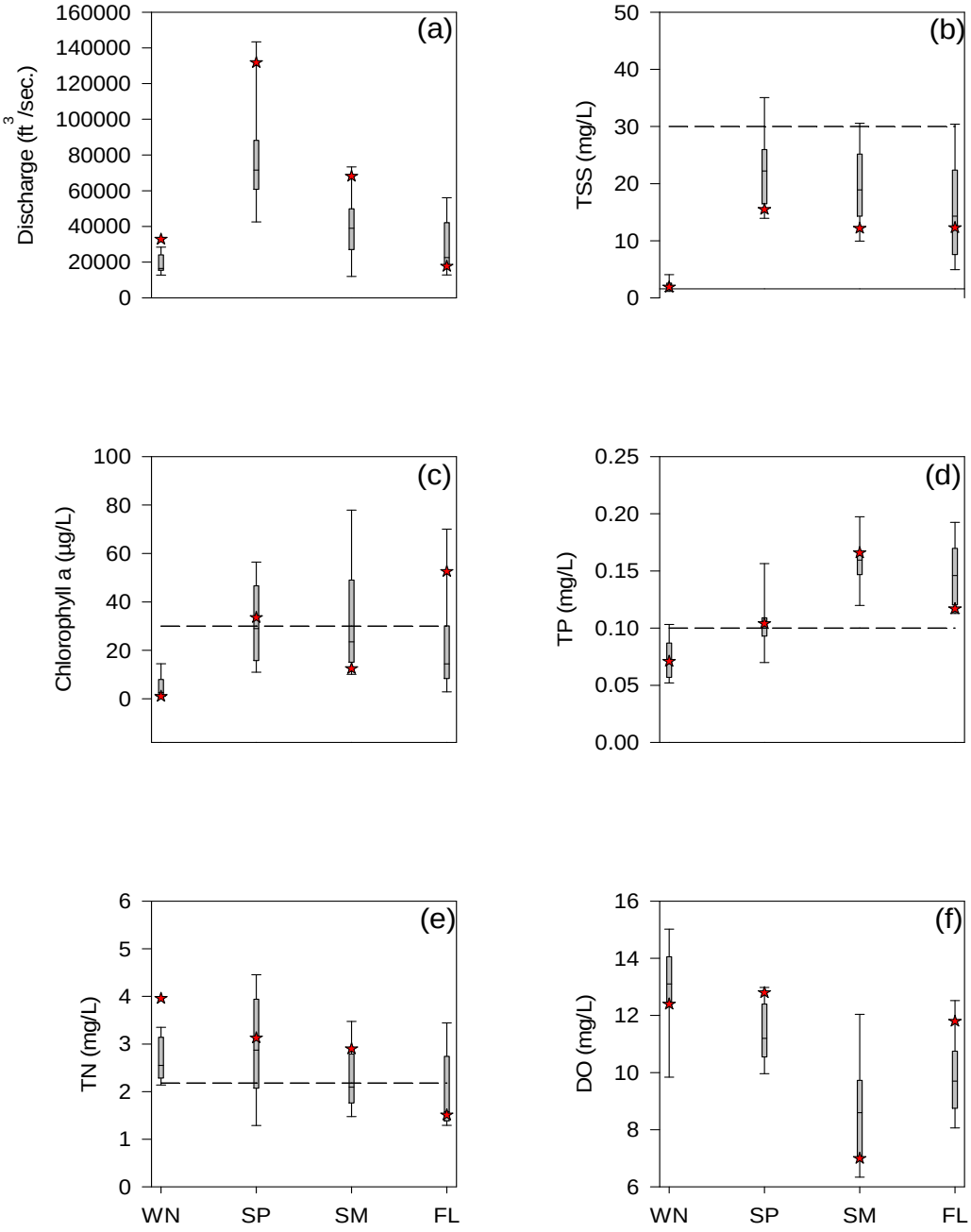

Figure 2. Box plots represent the 10th, 25th, 50th, 75th, and 90th percentiles by stratified random sampling season for the Long Term Resource Monitoring Program period of record (1993-2011). The star represents the mean for each parameter by season for 2011. (b) The dashed line represents the upper limit to sustain submersed aquatic vegetation in the Upper Mississippi River as defined by Giblin et al., 2010. (c) The dashed line represents the lower limit of the eutrophic range as defined by Dodds et al. 1998. (d)The dashed line represents the total phosphorus criterion for non-wadeable rivers in Wisconsin. (e) The dashed line represents upper limit of the range suggested by for total nitrogen as defined by the USEPA (2000).

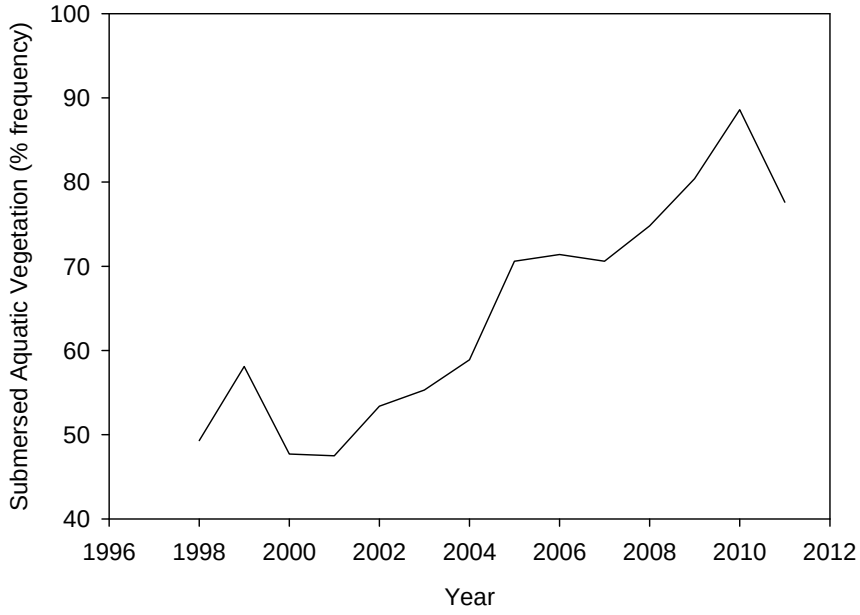

Figure 3. Percent frequency of submersed aquatic vegetation within Pool 8 by year. Percent frequency is a measure of the percentage of sites where a particular plant species or life form is encountered. Data is from the Long Term Resource Monitoring Program vegetation component.

Chlorophyll a is an indicator of phytoplankton biomass in the water column. As in lakes, light, nutrients and hydraulic retention time are the primary factors determining phytoplankton biomass and growth (Likens, 2010). Chlorophyll a was below the long-term median in winter and summer and above the long-term median in spring and fall (Figure 2c). Mean chlorophyll a was in the eutrophic range (>30 µg/L) during the spring and fall of 2011 (Dodds et al., 1998).

Phosphorus is an essential plant nutrient that can limit the biomass of phytoplankton and aquatic macrophytes in aquatic ecosystems. Excessive phosphorus loading can result in increased biomass of phytoplankton and rooted vegetation, increased incidence of fish kills, reduction in species diversity, and reduction in perceived value of a waterbody. TP was near the long-term median during winter and spring, above the long-term median in summer, and below the long-term median in fall (Figure 2d). Mean TP was above the Wisconsin TP criterion (>0.10 mg/L) for non-wadeable rivers during spring, summer, and fall.

Nitrogen is also an essential plant nutrient that can limit the biomass of phytoplankton and aquatic macrophytes in aquatic ecosystems. Nitrogen concentration tends to increase with increasing discharge as non-point input from agriculturally dominated tributary watersheds is delivered to the UMR (Goolsby et al., 2000). TN was above the long-term median during winter, spring and summer. TN was below the long-term median in fall. Mean TN was above the upper concentration recommended by the USEPA for ecosystem health (0.6-2 .18 mg/L) during winter, spring and summer (Figure 2e; USEPA, 2000).

Adequate DO is critical to sustain aquatic life. Dissolved oxygen concentration can be reduced through decomposition of organic material from point and non-point sources, plant and animal respiration, and demand from the sediments. Mean DO was below the long-term median during winter and summer. DO was above the long-term median during spring and fall (Figure 2f).

Ice and snow thickness can affect the concentration of DO in the underlying water column by reducing available light and thereby photosynthetic activity. Ice and snow thickness were well above the long-term median in the winter of 2011 (Figure 4). It's likely that the thick ice and snowpack contributed to DO concentrations below the median during winter.

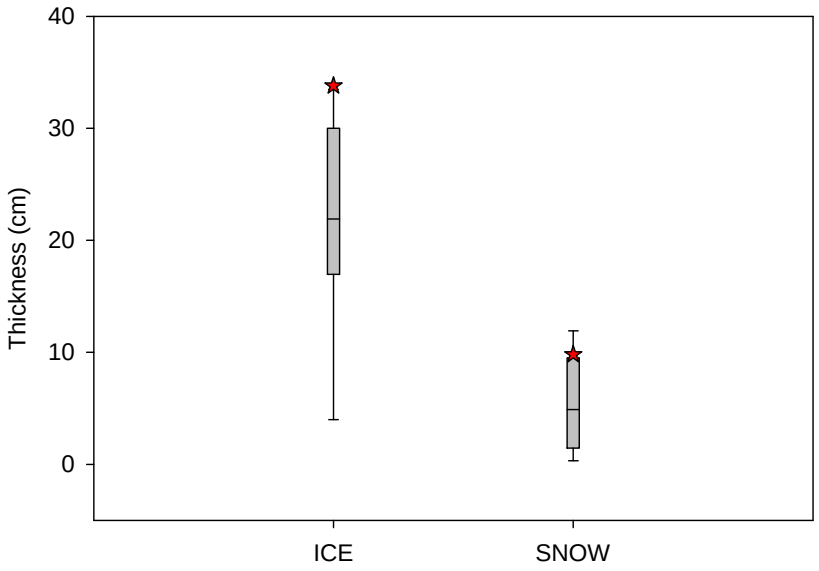

Figure 4. Box plot represents the 10th, 25th, 50th, 75th, and 90th percentiles for winter ice and snow thickness on top of the ice during winter for the Long Term Resource Monitoring Program period of record (1993-2011). The star represents the mean for each parameter for the winter of 2011.

2011 Aquatic Macrophytes

Methods

The LTRMP vegetation component was designed to accumulate data on distribution, frequency and relative abundance of aquatic macrophytes over time. In 2011, aquatic macrophyte data were collected from June 15 to July 28. The sampling area (a 2-m ring around the boat) was searched visually. Six subsampling locations were sampled within the 2-m area with rake grabs. All species on the rake and observed during the visual search were identified and recorded. Each submersed species on the rake was also given a rake score (1-5) based on how much of the rake teeth were filled. More detail on LTRMP vegetation sampling can be found in Yin et al., 2000 at:
http://www.umesc.usgs.gov/documents/reports/ltrm_components/vegetation/95p00207.pdf

Results

447 sites were sampled within 5 different strata (isolated and contiguous backwaters, impounded, secondary channel, and main channel border). In Pool 8, submersed macrophytes were found at 78% of the sites, rooted floating macrophytes at 27% and emergent macrophytes at 19% (Figure 5). All three life forms decreased in frequency from 2010 to 2011.

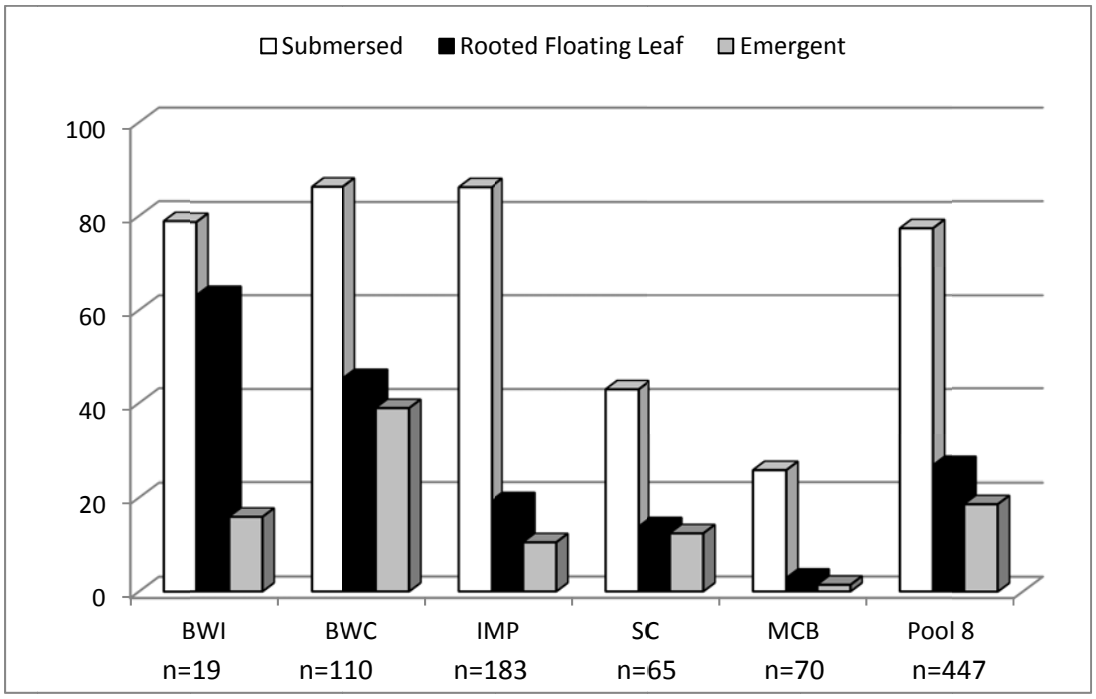

Figure 5. Percent frequency of life form by strata. (BWI=isolated backwater, BWC=contiguous backwater, IMP= impounded, SC=secondary channel, MCB=main channel border)

Pool-wide, the most frequent emergent species included stiff arrowhead (6.7%; *Sagittaria rigida*), broadleaf arrowhead (6.3%; *Sagittaria latifolia*) and wild rice (6.3%; *Zizania aquatic*). White waterlily (19.2%; *Nymphaea odorata*) was the most common rooted floating leaf and narrowleaf pondweeds (55.3%, mean rake score 2.3; *Potamogeton foliosus* and/or *P. pusillus*) and coontail (50%, mean rake score 1.8; *Ceratophyllum demersum*) were the most common submersed. Mean number of species per site with all strata combined was 3.6 down from 5.0 in 2010. Mean number of species per site was highest in the contiguous backwater strata (5.0).

In general, percent frequencies for species were lower in 2011 than 2010. For submersed macrophytes, most of the decrease was recorded in the main channel border and side channel strata. Among submersed species, Canadian waterweed (*Elodea canadensis*) had the largest decrease in percent frequency (from 89% to 37%). Among emergent species, stiff arrowhead decreased the most dropping from 17% in 2010 to 6% in 2011. Filamentous algae also decreased in frequency from 49% to 19%. Two species increased by over 10% from 2010 to 2011, sago and curly pondweeds (*Stuckenia pectinata* and *Potamogeton crispus*, respectively). In 2011, water elevations were unusually high throughout the sampling period most likely lowering the amount of light available to the submersed vegetation. Sago pondweed is known to be tolerant to lower light levels. Curly pondweed is an exotic from Europe that sprouts in the fall and grows slowly all winter under the ice. It has peak biomass in the spring and dies back sometime in August. It is adapted to spring conditions and most likely was not affected by the

unusually high water during the summer. More in-depth graphical display of data pertaining to aquatic macrophytes can be found on the LTRMP Vegetation Graphical Browser: http://www.umesc.usgs.gov/data_library/vegetation/graphical/veg_front.html

2011 Fisheries

Methods

The LTRMP fish component uses six standardized gear types, including daytime electrofishing, fyke nets, mini fyke nets, large and small hoop nets, and otter trawls. LTRMP employs a randomized sampling scheme and stratification based on broad habitat features. Fish sampling is conducted within three consecutive six-week episodes, from June 15 to October 31, to ensure both temporal, as well as spatial, interspersion of the sampling gear deployments (Figure 1). More detail on LTRMP fish sampling can be found in Gutreuter et al., 1995 at: http://www.umesc.usgs.gov/documents/reports/1995/95p00201.pdf

Routine data analyses for overall fish community data include species richness, frequency of occurrence, relative abundance and community composition. Total catch, catch per unit effort (CPUE), proportional stock density (PSD) and length distribution are calculated for species with adequate sample sizes. The LTRMP Fish Graphical Data Browser automates many of these analyses and provides on-demand analytical products for end users. This information can be accessed at: http://www.umesc.usgs.gov/data_library/fisheries/graphical/fish_front.html

Results

The fisheries component made 268 fish collections in 2011, two short of the planned allocation. The two failed collections were day electrofishing sites on wingdams where the current velocity in sampling period 1 was too high for sampling. Although high water prevented sampling at only two sites, it also likely decreased catch rates for much of time periods 1 and 2.

Sampling effort was highest for daytime electrofishing (82 collections), followed by mini fyke nets (66 collections), and fyke nets (48 collections). Effort was greatest in the contiguous backwater stratum (84 collections), with side channel (60 collections) and main channel border (48 collections) also receiving considerable effort.

Catches were typical during 2011. Fewer small fish were observed than usual, and few fish were preserved prior to the third sampling period. Total catch was 19,783 fish, representing 59 species. These totals were down substantially from the 2010 totals of 29,311 fish and 63 species, but similar to the five-year averages of 21,879 fish and 57.4 species.

The top 5 species, in order of catch, were bluegill – 7682, largemouth bass – 2477, weed shiner – 2168, yellow perch – 1355, and spotfin shiner – 909. The top fish species in the catches were dominated by lentic species. There has been a pronounced shift from lotic to lentic species that has taken place over the past ~10 years within Pool 8. We intend to explore this analytically, and hope to correlate observed

trends with vegetation and water quality data. This analysis is proposed as an item in the 2013 LTRMP scope of work.

Some other noteworthy items during 2011:

- Two juvenile skipjack herrings (listed as endangered in Wisconsin) were sampled in September in a single electrofishing run, near the warm water discharge for a local power plant.
- We also sampled 2168 weed shiners, 15 mud darters, 3 western sand darters, 1 silver chub (all listed as special concern in Wisconsin), and 4 river redhorse (listed as threatened in Wisconsin).
- A noticeable increase in catches of bullheads was observed in 2011, including some adult fish up to 12" long. Bullheads of all species have been scarce in our catches since the inception of LTRMP.
- To date, we have not sampled or observed any bighead, silver, grass, or black carp in Pool 8 LTRMP fish sampling.

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