Upper Mississippi River Pool 8
Long Term Resource Monitoring - 2015 Status Report

An element of the

Upper Mississippi River Restoration Program

Upper Mississippi River Restoration
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Wisconsin Department of Natural Resources
Mississippi River Monitoring Field Station
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Introduction

Fish, water quality, and vegetation data are collected each year through the Upper Mississippi River Restoration Program - Long Term Resource Monitoring (LTRM). A complete description of the program can be found at: http://www.umesc.usgs.gov/LTRM.html. Personnel from the Wisconsin Department of Natural Resources collect data in Navigation Pool 8, one of 6 study reaches included in the program. Water quality and fish data have been collected under a stratified random framework since 1993 and vegetation data since 1998. This report summarizes the 2015 dataset in the context of how it relates to the entire LTRM sampling frame.

2015 Hydrograph

Methods

Discharge data were obtained from the U.S. Army Corps of Engineers' web site for water information on the Mississippi River (http://www.mvp-wc.usace.army.mil/). For 2015, we used discharge estimates from Lock and Dam 8 at Genoa, WI, as we have done starting with the 2013 report. Previously, we had used actual gauge data from Lock and Dam 5, in Winona, MN, but those data are no longer available. This results in using a more local gauge, but having a shorter time series and an unofficial gauging station.

A historical hydrograph was constructed by computing the mean daily discharge values from the years 1959-2014. The daily discharge for 2015 was then compared to the long-term daily mean to observe departure from typical conditions. Additional analyses examined annual, growing season (May–September), and spring flood discharge characteristics. Mean discharge was calculated from daily values, plotted for years 1993-2015, and overlain on a plot containing the historic mean, 10^{th}, and 90^{th} percentiles for all years (1959 to 2015). Mean growing season discharge was calculated and plotted similarly to the mean annual discharge. The spring flood pulse was characterized according to timing, duration, and magnitude. The timing of the spring flood was ascribed to the month (March, April, or May) containing the preponderance of the dates in which the ten highest discharge values were observed each spring. Duration of the spring flood was characterized by the number of days each spring in which the discharge exceeded the historic 75^{th} percentile discharge value from March through May. Magnitude was reported as the maximum spring discharge value for each year.

Results

The 2015 Pool 8 hydrograph depicts several discharge anomalies from the long-term pattern, but no extreme departures from normal (Figure 1a). The timing of the spring flood was late, with peak river stages occurring in May (Table 1). Mean discharge for 2015 was remarkably close to historic averages (Figure 1b) and the mean growing season discharge for 2015 was nearly equal to the historic mean value, as well (Figure 1c). Late fall rains produced the highest discharge for the year in December (Figure 1a), and contributed to massive flooding (record setting) that occurred well downstream of Pool 8 around the end of the year.

Given that three of the highest mean annual discharges recorded during the LTRM period of record occurred in the past six years, and a major summer flood also occurred in 2014, a field season with typical water levels was a welcome change for the field staff. Perhaps, there was, or will be, a favorable biotic response to this “normalcy”, as well. Conversely, 2011 was the last year when the spring flood occurred during its normal April time period (Table 1).

Table 1. Spring flood pulse statistics by year during the LTRM period of record (1993-2014) for discharge at Lock and Dam 8 of the Upper Mississippi River. Duration represents the number of days each spring when discharge was above the 75th percentile from the long term record (1959-2014). Timing represents the month when the preponderance of the ten highest discharge days were observed each spring. Magnitude represents the maximum discharge observed each spring.

Year	Duration	Timing	Magnitude	Year	Duration	Timing	Magnitude
1993	53	April	117500	2004	3	April	80300
1994	21	May	107100	2005	19	April	96300
1995	28	May	86000	2006	26	April	104000
1996	30	April	140200	2007	18	April	87400
1997	40	April	188300	2008	40	May	101000
1998	24	April	122500	2009	11	April	83300
1999	32	May	110400	2010	26	March	114100
2000	0	March	66500	2011	69	April	168800
2001	54	April	225100	2012	0	May	76200
2002	21	April	121100	2013	50	May	116900
2003	23	May	116900	2014	49	May	133500
				2015	1	May	79600

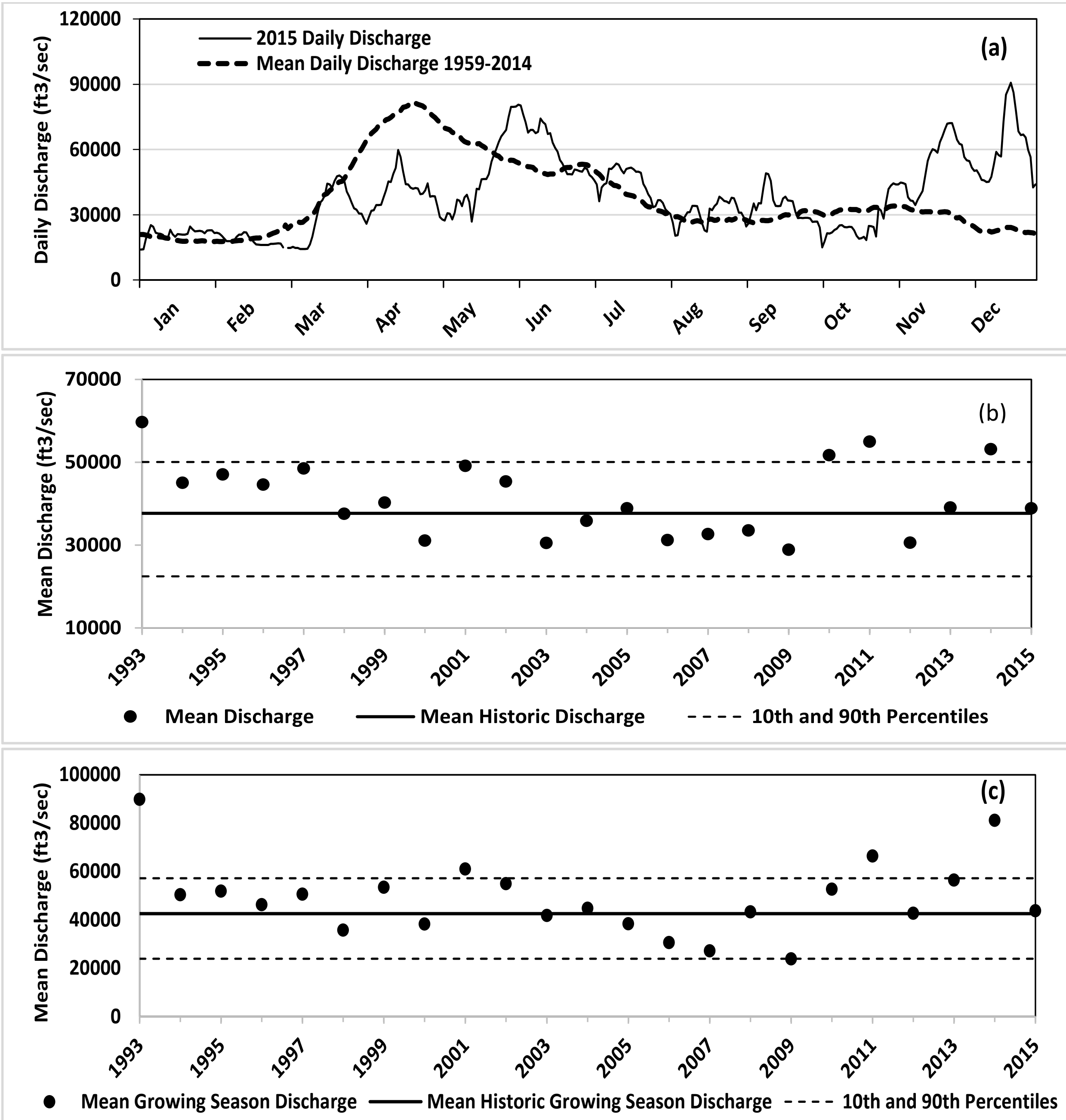


Figure 1. (a) Daily discharge at Lock and Dam 8 on the Upper Mississippi River for 2015 is represented by the solid line. Mean daily discharge by day of the year for 1959-2014 is represented by the dotted line. (b) Mean discharge by year is represented by the black dots. The solid line represents mean historic discharge for 1959-2015. The dashed lines represent the 10^{th} and 90^{th} percentiles for 1959-2015 discharge. (c) Mean growing season discharge (May-Sept.) by year is represented by the black dots. The solid line represents mean historic growing season discharge for 1959-2015. The dashed lines represent the 10^{th} and 90^{th} percentiles for 1959-2015 growing seasons.

2015 Water Quality

Methods

The focus of the water-quality component of the LTRM is to collect limnological information relevant to the suitability of aquatic habitat for biota and transport of materials within the system. The LTRM water-quality sampling design since 1993 incorporates year round 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, impounded and backwaters with high habitat value. The data used for this report are weighted poolwide median values from SRS sampling. Water temperature and 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). More details on LTRM 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 LTRM Water Quality Graphical Data Browser at: http://www.umesc.usgs.gov/data_library/water_quality/water_quality_page.html.

Results

Median water temperature in 2015 was relatively close to the long-term median, falling within the +/- 25th percentile range (Figure 2a). Water temperature can have direct and indirect effects on large river ecology. Warm water temperatures can result in higher respiration rates, leading to lower oxygen saturation concentrations, which can increase the frequency of hypoxic conditions (Houser et al., 2015; Likens, 2010). Water temperature also influences the rate of photosynthetic production in aquatic ecosystems (i.e. low rates of photosynthetic productivity at very low and very high water temperatures, and high rates of productivity at intermediate temperatures). The year 2015 falls into the intermediate temperature condition, but we have experienced some very cold years recently - i.e. three out of the past five years (2014, 2013 and 2011) had the coldest median spring water temperatures in Pool 8 for the period of record. Primary productivity differences between cold and average years do appear to be reflected in the chlorophyll a and vegetation data, and are discussed below.

Total suspended solids (TSS) were at or below the 25th percentile range for all seasons and below the 10th percentile for spring (Figure 2b). High TSS concentration can limit primary productivity by blocking light. It also negatively affects macroinvertebrate respiration and behavior, results in habitat loss, and affects fish by reducing feeding efficiency and smothering

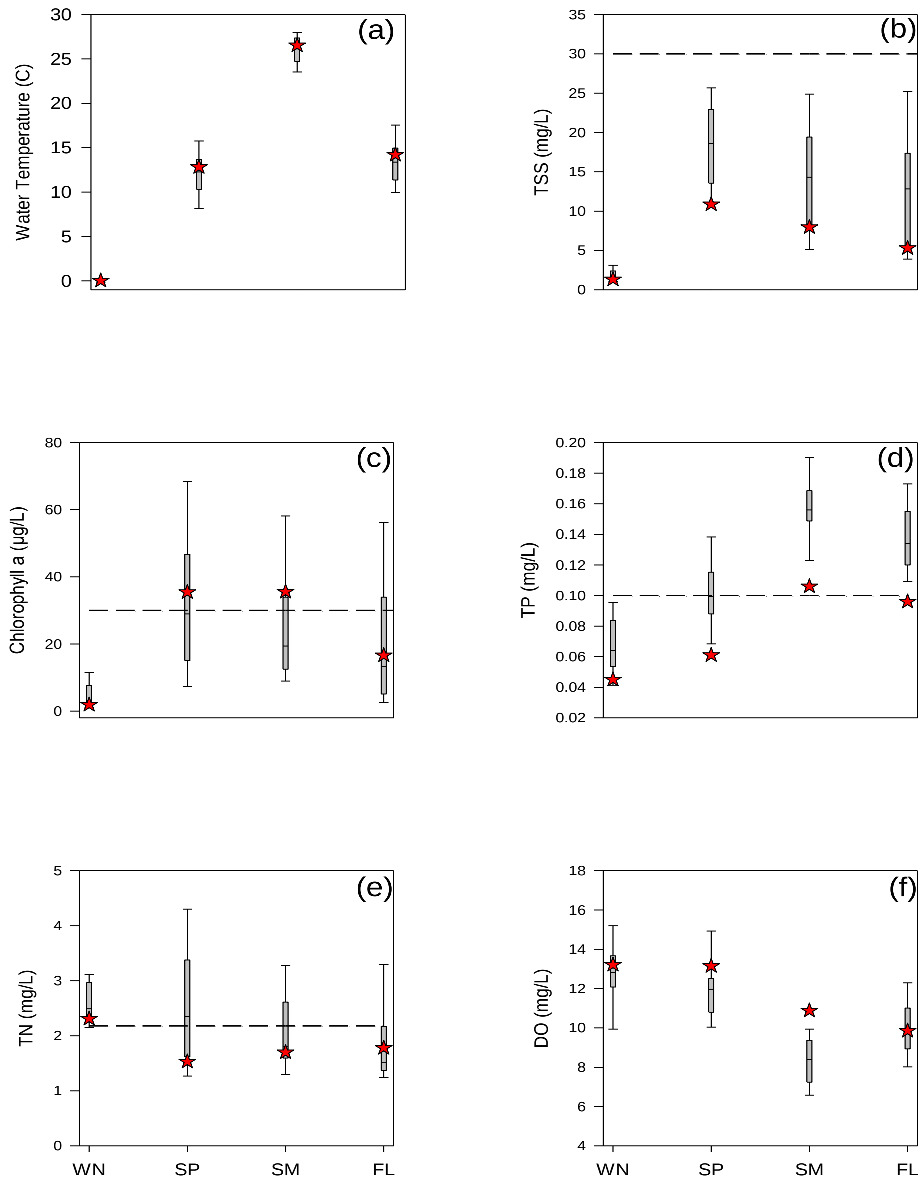


Figure 2. Box plot represents the 10th (lower arm), 25th (lower edge of box), 50th (line in middle of box), 75th (upper edge of box), and 90th (upper arm) percentiles of the medians by stratified random sampling season for the Long Term Resource Monitoring Program period of record (1993-2015). The star represents the weighted pool-wide median for each parameter by season for 2015. (b) The dashed line represents the upper limit to sustain submersed aquatic vegetation in the Upper Mississippi River from 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 as defined by NR 102.06. (e) The dashed line represents upper limit of the range suggested for total nitrogen as defined by the USEPA (2000).

spawning habitat (Walters, 1995). The lower TSS values observed in 2015 are likely due to the nature of precipitation events (e.g. less intense rain events), as well relatively lower discharge during the sampling episodes. We also observed increases in aquatic vegetation since the early 2000's, which may contribute to the lower TSS as it slows water velocity, and allows sediment to fall out of the water column. Aquatic vegetation also reduces resuspension of sediment from wind and boat wakes. These physical influences of aquatic vegetation on the river hydrology essentially create a positive feedback loop for growth of vegetation and lower TSS. In 2015, TSS concentrations were well below the criterion (<30 mg/L) required to sustain submersed aquatic vegetation (SAV) in the Upper Mississippi River (UMR) during all seasons (Giblin et al., 2010).

Chlorophyll a is an indicator of phytoplankton biomass in the water column. As in lakes, light, temperature, nutrients, and hydraulic retention time are the primary factors determining phytoplankton biomass and growth (Houser et al. 2015; Likens, 2010). In 2015, chlorophyll a levels were near the long-term average for winter, spring, and fall, but were near the 75^{th} percentile for summer (figure 2c). As mentioned above, water temperatures in 2015 were near the long-term median, and these essentially average, or intermediate, temperatures are good for primary production. Substantially higher chlorophyll a levels were evident in 2015, as compared to 2014, which was one of the colder years on record. While nutrient concentrations were low, they do not appear to be limiting, in terms of phytoplankton growth. Mean chlorophyll a was well below the eutrophic range (>30 µg/L) (Dodds et al., 1998) during winter and fall and slightly above it in spring and summer.

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, increases in rooted and free-floating plants, increased incidence of fish kills, reduction in species diversity, and reduction in perceived value of a water body (Smith and Schindler, 2009, Giblin et al. 2014).

Seasonal total phosphorous levels (TP) were extremely low during all 2015 SRS episodes and below the 10^{th} percentile for spring, summer, and fall (figure 2d). Elevated phosphorous levels in most years are largely due to inputs from point and non-point source pollution (e.g., municipal treatment plants and agriculture runoff). Significant release of phosphorous from the sediments can also occur, especially in backwaters during the warmer months, due to microbial activity.

Like TSS, TP levels are tied to severity of rain events, discharge, and abundance of aquatic vegetation. It is not surprising that unusually low TP levels were recorded, given the conditions we experienced in 2015. TP levels were near or below the Wisconsin TP criterion (0.10 mg/L) for non-wadeable rivers (Wisconsin administrative code NR 102.06) for 2015.

Nitrogen, like phosphorous, is an essential plant nutrient that can limit the biomass of phytoplankton and aquatic macrophytes in aquatic ecosystems. Excessive delivery of nitrogen, in the form of nitrate, to groundwater and surface waters, has been associated with a number of negative consequences for human and ecosystem health (Wolfe and Patz, 2002). 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). Total nitrogen (TN) was near the long-term median in winter, summer, and fall, but below the long-term median during spring (Figure 2e). In 2015, TN was only above the upper concentration recommended by the USEPA for ecosystem health (0.6-2 .18 mg/L) during winter (USEPA, 2000). Lower spring discharge and absence of extreme rain events likely played a role in the lower TN in spring, but in 2014 we had similarly low TN, even though discharge was high. Further investigation into the intensity of storms may help explain this somewhat contradictory phenomenon.

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

Higher DO concentrations in spring and summer may have been due to the lower organic loads from agricultural runoff, coupled with relatively high phytoplankton and aquatic plant production during the growing season. Anecdotal observations suggest that water column supersaturation, with DO concentrations up to 200% saturation, may be occurring more frequently. We are attempting to quantify the extent to which DO supersaturation occurs in Pool 8, as well as the effects of DO supersaturation on biota - especially fish and macroinvertebrates. Lack of adequate DO for biota did not seem to be an issue during 2015.

Ice and snow thickness can affect the concentration of DO in the underlying water column by reducing available light, and, thereby, suppress photosynthetic activity. Median ice and snow thickness were near the long-term median during the winter of 2015 (Figure3). The ice and snow conditions during winter sampling appear to have been suitable for light transmission, as median DO during winter was 13.21 mg/l, and only a few sites had DO below 5 mg/l. The low DO sites were largely in Blue Lake, which is an isolated backwater that is often hypoxic in winter; the remainder of low DO sites were shallow sites, with little available water depth below the ice, and, due to mixing with the sediments, were very turbid. The mixing of organic material from the sediment increases microbial activity, which elevates biological oxygen demand and reduces oxygen levels.

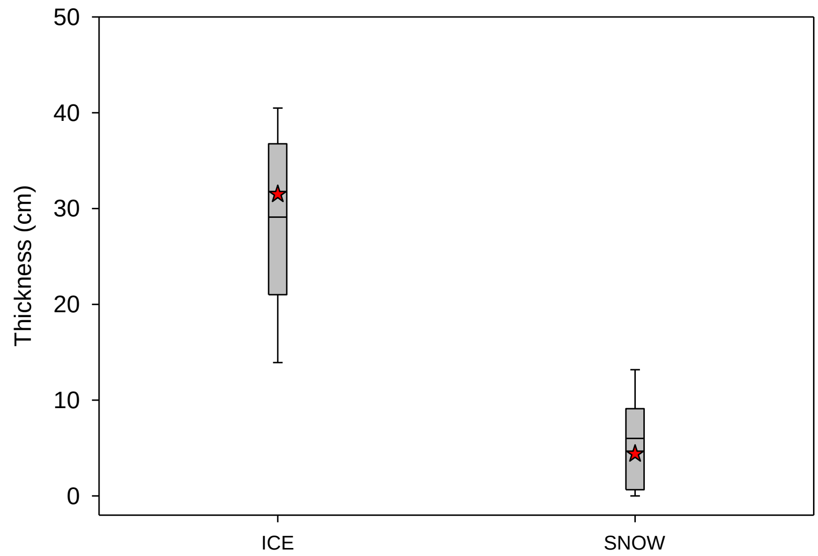


Figure 3. This box plot represents the 10th (lower arm), 25th (lower edge of box), 50th (line in middle of box), 75th (upper edge of box), and 90th (upper arm) percentiles of the medians for winter ice thickness and snow thickness above the ice sheet during winter for the LTRM period of record (1993-2014). The star represents the weighted pool-wide median for each parameter for the winter of 2015.

2015 Aquatic Vegetation

Methods

Aquatic macrophytes are an important habitat component in the Upper Mississippi River. They are responsible for a large fraction of primary production, and provide food and shelter for birds, fish and aquatic invertebrates. Aquatic macrophyte data were collected from June 15 to August 11, 2015. The sampling area (a 2-m area 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 retrieved on the rake was also given an abundance score of 1-5 based on calibration marks on the rake teeth. More detail on LTRM vegetation sampling protocol can be found in Yin et al., 2000 at: http://www.umesc.usgs.gov/documents/reports/1995/95p00207.pdf

Results

We visited 450 sites during the 2015 summer field season, with randomly selected sites distributed among the strata to reflect relative coverage in the Pool 8 ecosystem (Table 2). Vegetation abundance varied considerably between strata, with slow-moving and still waters (the backwater isolated, backwater contiguous, and impounded strata) supporting more vegetation than moving waters (side channels and the main channel boundary) in 2015. This is consistent with previous years. The relative abundance of submerged, emergent, and rooted floating-leaf species varied by stratum (Figure 4), as aquatic vegetation responds to a number of interacting drivers, especially water velocity and light availability (e.g. Kreiling et al. 2007). Although isolated backwaters (BWI) typically have low daytime dissolved oxygen (DO) concentrations during the summer period, the occurrence of aquatic vegetation in the BWI stratum was highest (Table 2, Figure 4). Thus, low summer DO does not appear to limit the distribution of aquatic vegetation in Pool 8.

Table 2. Summary of site distribution among strata for aquatic vegetation sampling in 2015. The % vegetated column was calculated by subtracting the number of unvegetated sites from the total site number for each stratum. Depths were collected at time of sampling and are not corrected for river stage, so provide only an indication of differences.

Stratum	Vegetation Sites (n) 2015	Average depth (m) ± SD	% vegetated
Contiguous Backwaters (BWC)	110	0.71 (± 0.85)	92.7%
Isolated Backwaters (BWI)	20	0.59 ± (0.22)	100.0%
Impounded (IMP)	185	1.26 (± 0.64)	89.7%
Main Channel Border (MCB)	70	2.03 (± 1.67)	34.3%
Side Channel (SC)	65	1.63 (± 1.09)	43.1%

Long-term patterns in vegetation abundance

Since LTRM probabilistic monitoring began in 1998, all three vegetation life forms (submerged, rooted floating leaf, and emergent) have generally increased in abundance in Pool 8 (Figure 5). In 2015, 77.9% of sites overall supported submersed vegetation, while 34.9% of sites supported rooting, floating vegetation and 44.5% supported emergent vegetation. Percent frequency occurrence (occurrence) was downloaded from the Upper Mississippi Environmental Science Center LTRM data repository at:
www.umesc.usgs.gov/data_library/vegetation/graphical/percent_frequency_query.shtml

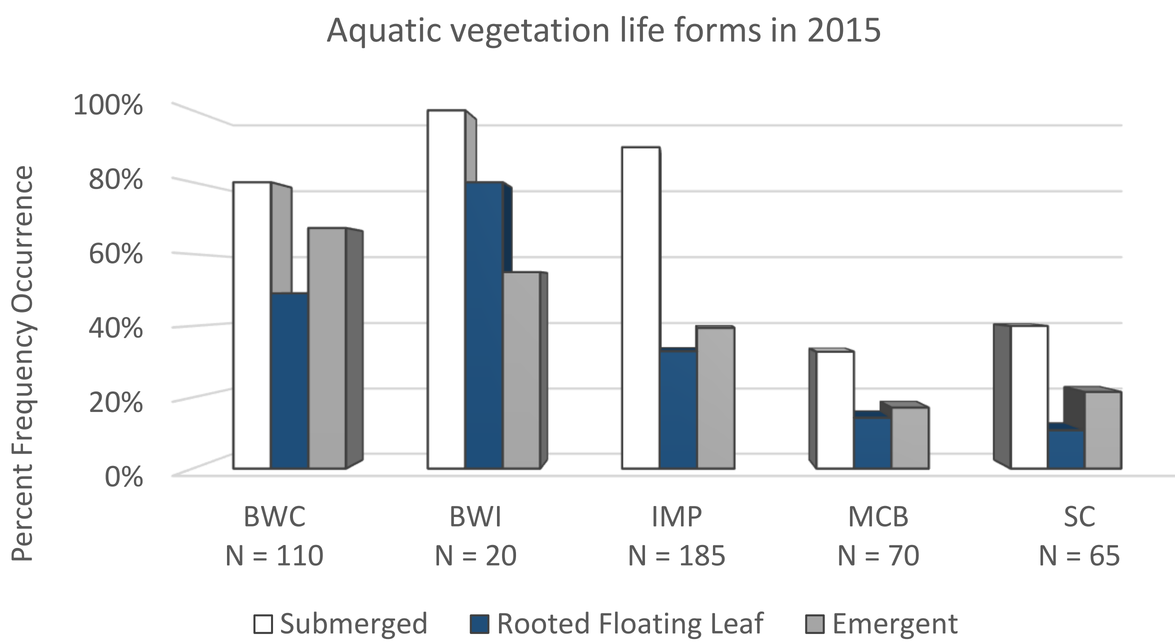


Figure 4. Percent frequency occurrence of vegetation types in each stratum, and the overall averages for Pool 8.

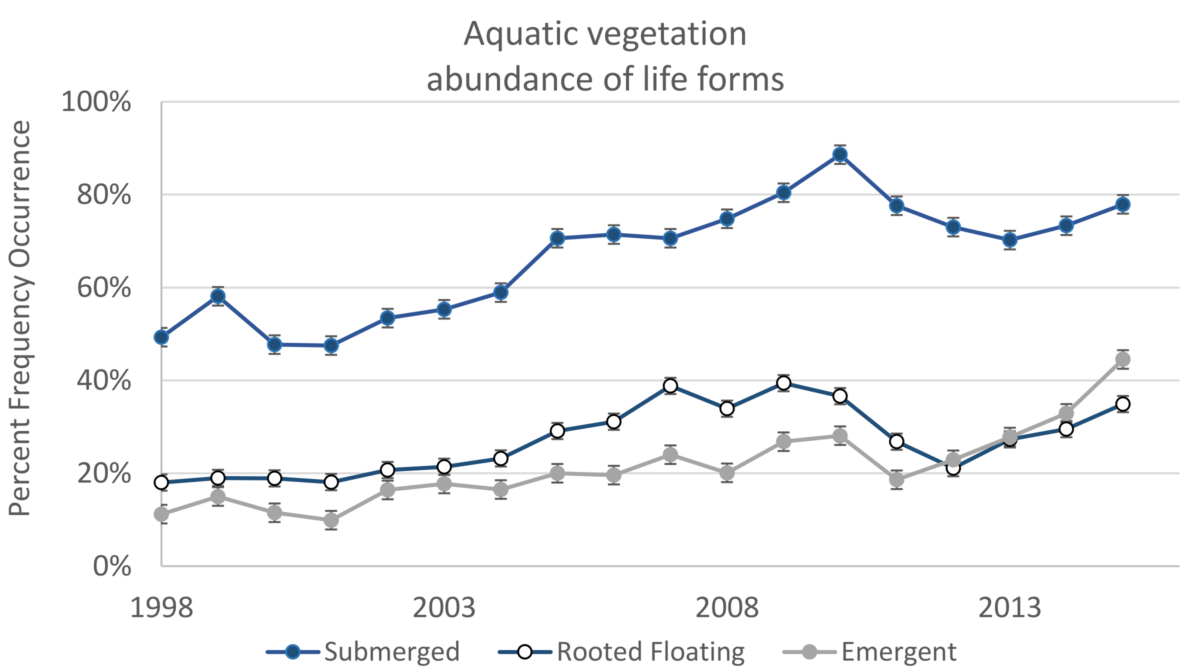


Figure 5. Occurrence of the three vegetation life forms over the period of LTRM probabilistic monitoring.

The percent frequency occurrence of submersed, rooted floating-leaf, and emergent vegetation were summed to generate "total aquatic plant index" (Figure 6). Because all three life forms can overlap, this index can exceed 100%. In 2015, both emergent vegetation and total aquatic plant index were highest of the entire 18-year record. An extended high-water period in 2014 (see 2014 report), evidently, did not negatively affect aquatic vegetation.

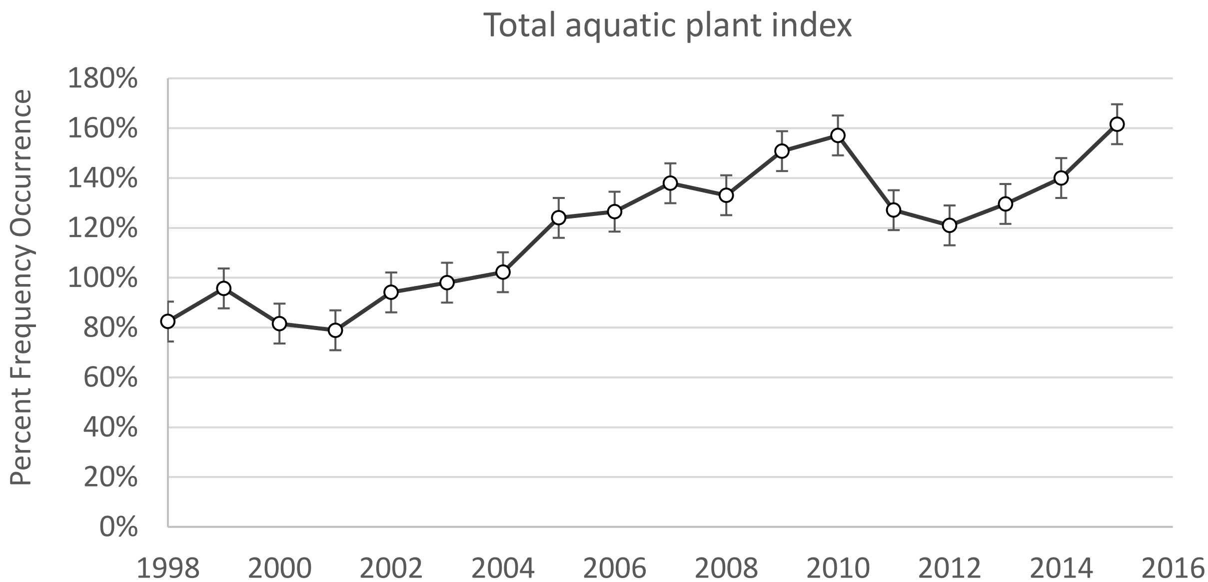


Figure 6. Summed percent frequency occurrence of all three life forms (veg sum). Because more than one life form can occur at the same site, percent frequency occurrence can exceed 100%.

A coarse comparison of composited data from the first part of the record (1998 – 2004) to more recent years (2005 – 2015) shows an overall increase in the occurrence of vegetation and a decrease in the occurrence of unvegetated sites (Table 3).

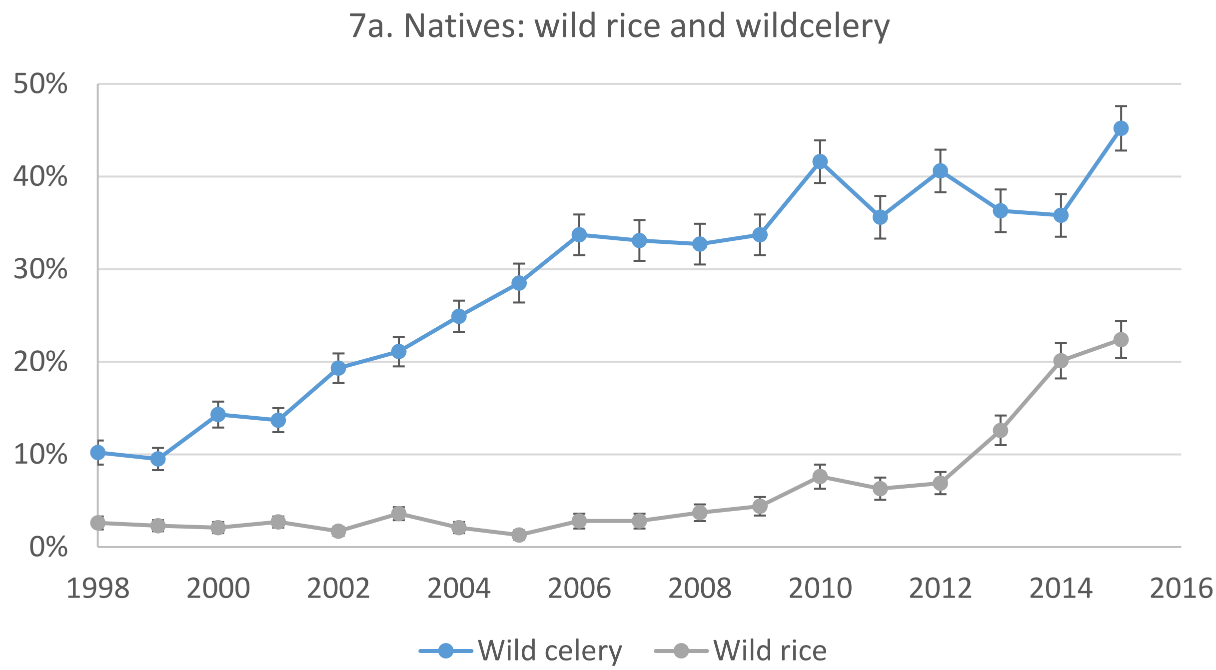
Table 3. Average occurrence of vegetation life forms during the first 7 years and the last 11 years of LTRM monitoring. Vegetation surveys were conducted at 443 - 1034 sites annually.

	Submerged	Rooted Floating	Emergent	Unvegetated
1998-2004	53%	20%	14%	44%
2005-2015	75%	32%	26%	24%

A portion of the increase in aquatic vegetation over time is attributable to two native species of special interest in the ecology of Pool 8 - wildcelery (*Vallisneria americana* Michx.), and wild rice (*Zizania aquatica* L.). Wildcelery is a predominantly clonal, perennial plant, and has high specific value as forage for canvasback (*Aythya valisineria* Wilson) and other migrating waterfowl. Long-term data show considerable increases in occurrence of wildcelery since 1998 (Figure 7a). Wild rice, an annual aquatic grass, can also be an important source of food and cover for wildlife. Prior to 2009, wild rice was only detected occasionally in surveys. Since then, especially in the last 5 years (Figure 7a), it has increased to be the most frequently detected emergent species in Pool 8 LTRM surveys and is a substantial contributor to the total vegetation index (Figure 6). Two invasive plants, Eurasian watermilfoil (*Myriophyllum spicatum*) and curly pondweed (*Potamogeton crispus*) occur at about 10-30% of sites annually (Figure 7b), but have not increased as dramatically as the native species described above or as much as the total vegetation index. Although sometimes locally abundant, they rarely appear to exclude native vegetation at the site level, and are virtually never the sole species detected at a site.

In 2015, at least three relatively rare submerged species were much more abundant than usual: Horned pondweed (*Zannichellia palustris*) was approximately 10x more abundant than all previous years averaged, *Chara* species were ~5x more abundant than in previous years, and bushy pondweed (*Najas flexilis*) was ~5x more abundant than in previous years. Abundance of both *Sagittaria latifolia* and *S. rigida* have increased notably between 2011 and 2015.

A total of 34 plant species (excluding algae) have been identified in Pool 8 over the course of LTRM monitoring. At individual vegetated sites, between 4-8 species are generally detected (Table 4). The maximum number of species found at a single site was 19 (including algae and the two invasive species), and the maximum number of native species (excluding algae) found at an individual site was 16.



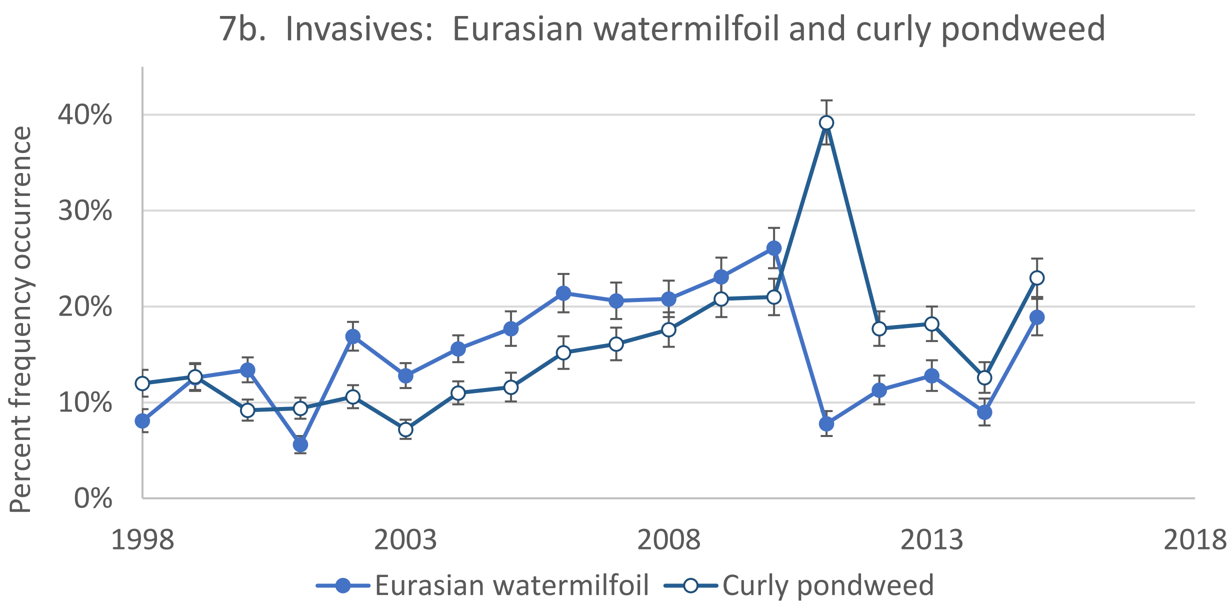


Figure 7a. Positive trends in the detection and abundance of wildcelery and wild rice in Pool 8 over the period of LTRM monitoring, and 7b. Possible cycling abundance of two exotic species over the period of monitoring.

Table 4. Average native and invasive species richness in the five strata in 2014 surveys. Unvegetated sites were excluded from richness calculations. Observations are not corrected for potential non-detection.

Stratum	Number of vegetated sites	Number of unvegetated sites	Native average richness ±SD	Invasive average richness ±SD
Backwater contiguous	102	8	7.4 (± 3.2)	0.7 (± 0.7)
Backwater isolated	20	0	6.8 (± 2.5)	0.2 (± 0.4)
Impounded	166	19	5.1 (± 3.2)	0.5 (± 0.7)
Main channel border	24	46	5.1 (± 4.1)	0.3 (± 0.6)
Side channel	28	37	4.9 (± 3.3)	0.6 (± 0.8)
All strata	340	110	5.9 (± 3.4)	0.5 (± 0.7)

The profusion of algae in freshwater systems is associated with eutrophication, and this is a common concern for managers and users of Pool 8. Filamentous algae is often found in dense mats or clinging to vegetation, and late in the summer blue-green algae appear as patchy films on the surface of the water. Notably, filamentous algae is often observed growing epiphytically on *V. americana*. Both blue-green films and submerged mats of filamentous algae are included in the observation of algae in vegetation surveys, and the incidence of algae has varied considerably over time (Figure 8). Occurrence of algae, however, has not clearly tracked increases in vegetation.

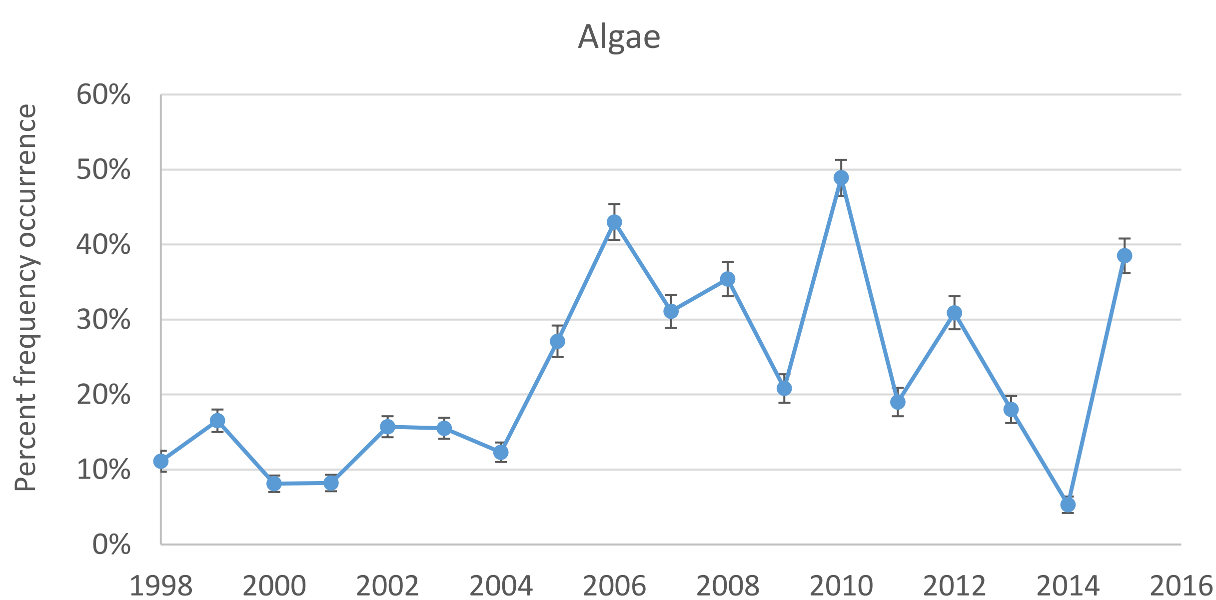


Figure 8. Occurrence of bluegreen algae over the period of monitoring.

2015 Fisheries

Methods

The LTRM fish component uses six standardized gear types, including daytime electrofishing, fyke nets, mini fyke nets, large and small hoop nets, and otter trawls, within 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. More detail on LTRM fish sampling can be found in Ratcliff et al. 2014 at: http://pubs.usgs.gov/mis/ltrmp2014-p001/pdf/ltrmp2014-p001.pdf /

The LTRM Fish Graphical Data Browser automates many routine 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.

Routine data analyses for overall fish community data include species richness, total catch by species, and community composition (presence/absence). Catch per unit effort (CPUE) and frequency of occurrence are calculated for all species, and proportional stock density (PSD) is calculated for species of interest. Proportional Stock Density (PSD) is a measure of species size structure. The metric is a ratio (expressed as percentage) between the number of quality-sized or larger individuals and stock-sized individuals. Stock and quality size designations vary by species, and were defined in published manuscripts (see the LTRM Fish Life History Database for details: http://www.umesc.usgs.gov/data_library/fisheries/graphical/LTRM_fish_life_history.mdb).

This report summarizes sampling effort, overall catch rates and species richness, as well as the five most abundant species sampled and data on species of special concern. We also report any Asian carp collections and other anecdotal observations on the fish community. CPUE and PSD trends from day electrofishing data are provided for ten common sport fish of interest to anglers and fish managers. Shannon-Wiener Diversity Index (Zar 1984) scores were computed from day electrofishing collections to indicate fish community diversity relative to previous years.

Data were omitted for 2003 in all cases because of reduced sampling that year. Also, catches of fish from wingdams are reported in total catch and species richness, but are excluded from CPUE calculations because wingdams are objects and not spatially quantified. CPUE values for the individual strata, including wingdams, are available on the Fish Graphical Data Browser at the link provided above.

Results

The fisheries component made 270 fish collections in 2015, achieving all planned sampling. Discharge during the entire field season tracked closely with mean historic levels, and there were no water-level related anomalies to report this year.

Planned sampling allocation among gear types has remained consistent for many years. Sampling effort was highest for daytime electrofishing (84 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. Please note that the strata names imply habitat features, but a wide variety of habitat conditions exist within each stratum.

Total catch in 2015 was 23,975 fish, which is a slightly higher total than in 2014, but essentially an average catch. Pool 8 LTRM fish catches per sample have been about average, as well, in recent years. The 2015 mean catch per sample was 88.8. Anecdotally, it seemed as though the extremes of high and low water in recent years, plus several harsh winters may have reduced fish population; however, the total catch and catch per sample data do not suggest that. Species richness (64 in 2015), by contrast, has remained consistent with the LTRM period of record and appears to be stable (Figure 8).

The top 5 species, in order of catch, were weed shiner (4,785), bluegill (4,577), spotfin shiner (2,142), yellow perch (1,579), and largemouth bass (1,543). This marks a change back to lentic species dominating the catch, after several years when a few of the lotic minnows had surged in abundance. Other notable species in abundance were mimic shiner, black crappie, and bullhead minnow, with over 1,000 of each species sampled. Shorthead redhorse and emerald shiner were the only other species yielding more than 500 individuals. Total catch information for each year and gear type can be found on the LTRM Fish Graphical Data Browser, as referenced previously.

Historically, there are 37 species that have been detected in Pool 8 LTRM samples every year since SRS began in 1993, and an additional 25 species have been detected in at least half of the 23 years. There are 28 species that have been detected in 11 or fewer years. Included among that group in the 2015 catch were: yellow bass and Mississippi silvery minnow (5 of 23 years), lake sturgeon (6 of 23 years), speckled chub and burbot (7 of 23 years), troutperch (10 of 23 years), and brown bullhead and banded darter (11 of 23 years).

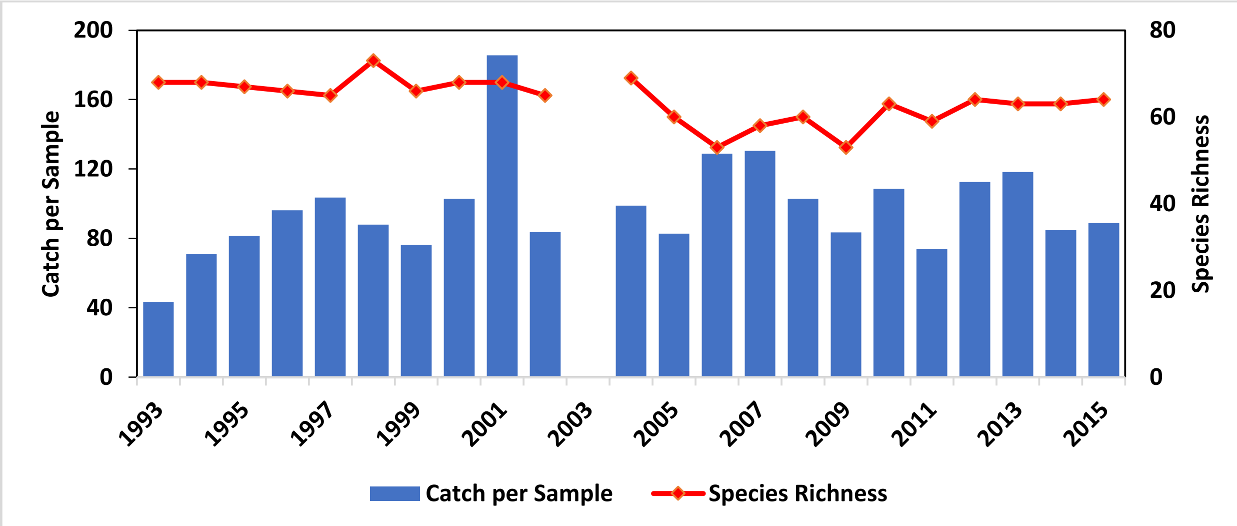


Figure 8. Catch per sample and annual species richness, for UMRR-LTRM fish collections in Pool 8 of the Upper Mississippi River. Data represent samples collected with daytime electrofishing, fyke nets, mini fyke nets, large and small hoop nets, and otter trawls. Data are omitted for 2003 due to limited sampling that year. Period 1 (June 15 – July 31) was not sampled from 2005-2009.

Single specimens were sampled of the following species in 2015: bigmouth buffalo, brown bullhead, burbot, mooneye, river darter, speckled chub, troutperch, white sucker, and yellow bass. Fewer than 10 individuals were sampled for an additional 17 species. Thus, about 40% of the species detected were very uncommonly encountered.

Wisconsin revamped its working list of threatened and endangered species for 2014. Two of these species, blue sucker (8) and river redhorse (8), both on the threatened list, were collected in the Pool 8 LTRM catch this year.

To date, the Pool 8 LTRM sampling efforts have not detected any Asian carp (bighead and silver). We caught 152 common carp this year, continuing the long-term trend of decreased carp observations.

The burbot we caught this year was the first one since 1998, a 16-year absence, and Mississippi silvery minnow and yellow bass reappeared after 10-year absences. However, we did not see any more pallid shiners, pirate perch, or northern hog suckers in 2015, each of which were caught the previous year.

Figure 9 depicts the trend in Shannon-Wiener Diversity Index scores for day electrofishing in Pool 8 LTRM samples. Diversity began to decline in the late 1990's thru 2007, but has begun to rebound recently. The decline was most likely due to high numbers of bluegill, weed shiner, largemouth bass, and yellow perch, which dominated the catches during those years, coupled with the decline of many lotic species. Scores increased from 2011 to 2014, as the fish community became less dominated by these lentic species again. A plausible explanation for these changes would be the increase in aquatic vegetation that occurred through the late 1990's and early 2000's, resulting in a robust lentic fish community, with a return to a more balanced community, as observed in 2012 to 2014, following several high-water years and harsh winters. However, the 2015 diversity index score was a bit lower, leaning slightly toward a more homogeneous community. Given the more typical water temperature and water regime in 2015, it appears the fish community may be oscillating about a lentic equilibrium.

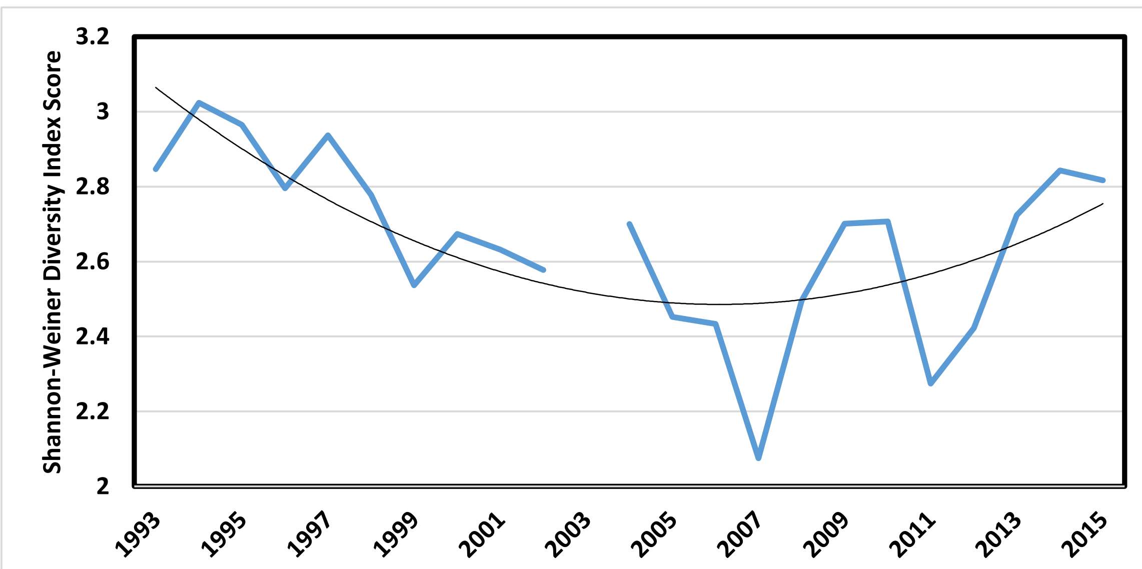


Figure 9. Shannon-Wiener Diversity Index Scores calculated from LTRM Pool 8 day electrofishing samples from 1993-2015. Data are omitted for 2003 due to limited sampling that year. Trend line is a second-order polynomial representation of the data.

Species of Interest

Trend data for 10 fish species of interest to anglers are briefly discussed on the following pages. These are cursory examinations only, using daytime electrofishing data, and including all sizes of fish collected. Further, sample size is very limited for PSD calculations in some instances.

Thus, interpretation of these results is best limited to general characterizations. Further examination of patterns and trends may be possible through the use of data from other LTRM gear types, such as fyke nets and hoop nets (see LTRM Graphical Fish Browser, referenced previously).

In general, over the LTRM period of record, catch rates for black crappie, channel catfish, and flathead catfish seem stable; catch rates for bluegill, largemouth bass, northern pike, and yellow perch have increased; and catch rates for sauger, smallmouth bass, and walleye have decreased.

PSD scores have remained essentially stable for bluegill, channel catfish, flathead catfish, and walleye, while slight increasing trends over time were apparent for black crappie, largemouth bass, sauger, smallmouth bass, and yellow perch; northern pike PSD decreased slightly over time.

Black Crappie

The increasing trend in black crappie CPUE that began after a low in 2011 reversed again in 2015 (Figure 10). However, this species exhibits high variability in catch rates, and appears to be stable over time. Not only is there variability from one year to another, but also at sites within years, as the error bars are quite wide. The PSD score for black crappie in 2015 declined to 43, suggesting a greater proportion of small fish in the catch. Numerous young-of-the-year black crappies were caught in June and July, which indicates a good year class was produced in 2015.

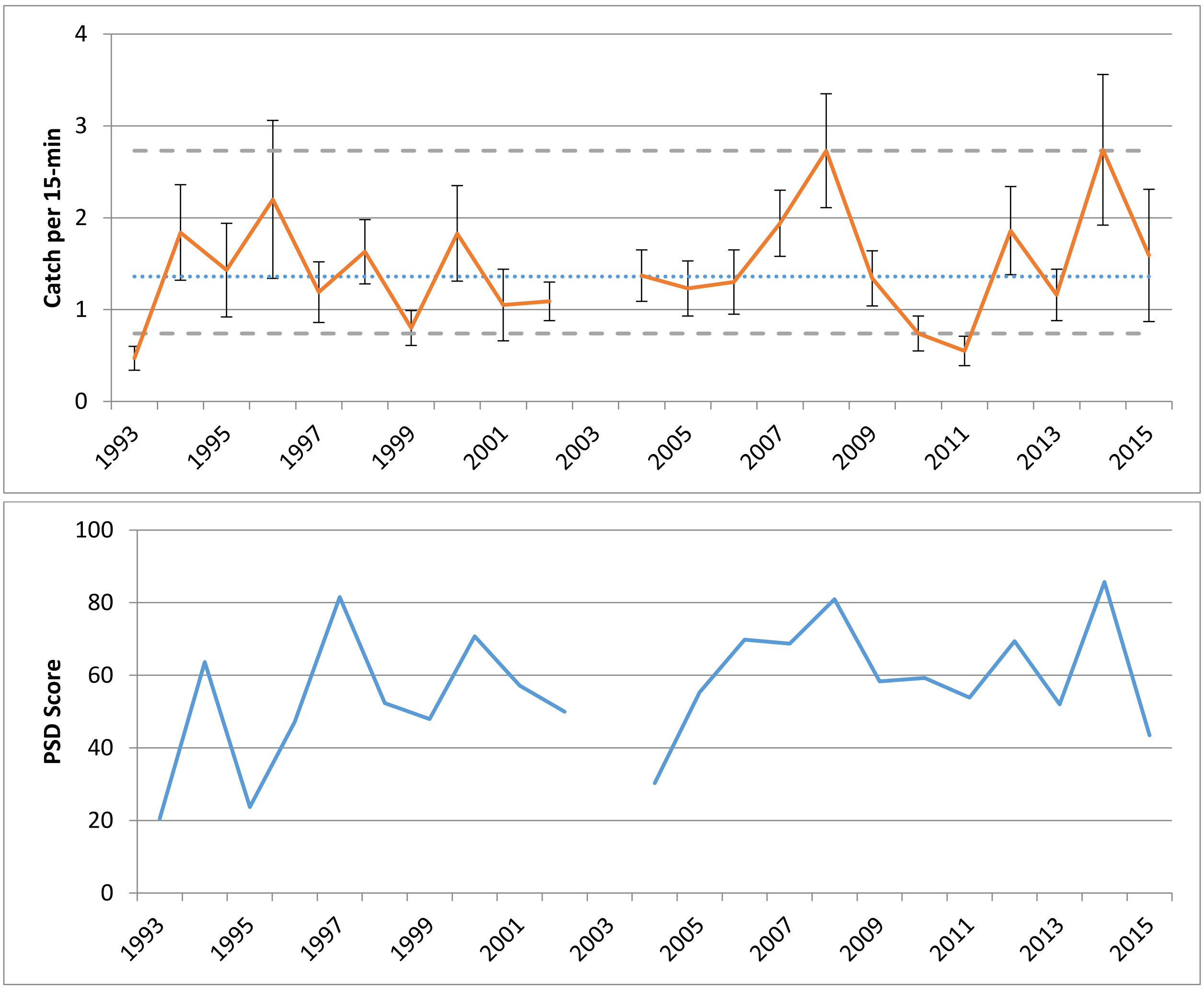


Figure 10. Catch per unit effort (± 1SE) and proportional stock-density of black crappie collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRM. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2015).

Bluegill

Bluegill CPUE in 2015 was below the long-term mean, similar to 2014 (Figure 11). Catch rates for bluegill have been below their peak for seven consecutive years now, maintaining a downward trajectory. Causes for this are unknown. PSD values for bluegill have been remarkably consistent and low for bluegill for most of the LTRM time frame, coming in at 25 for 2015. The decline in CPUE, coupled with a consistently low PSD score, suggests a general decline in abundance for bluegills of all sizes, perhaps due to weak year classes for a number of years.

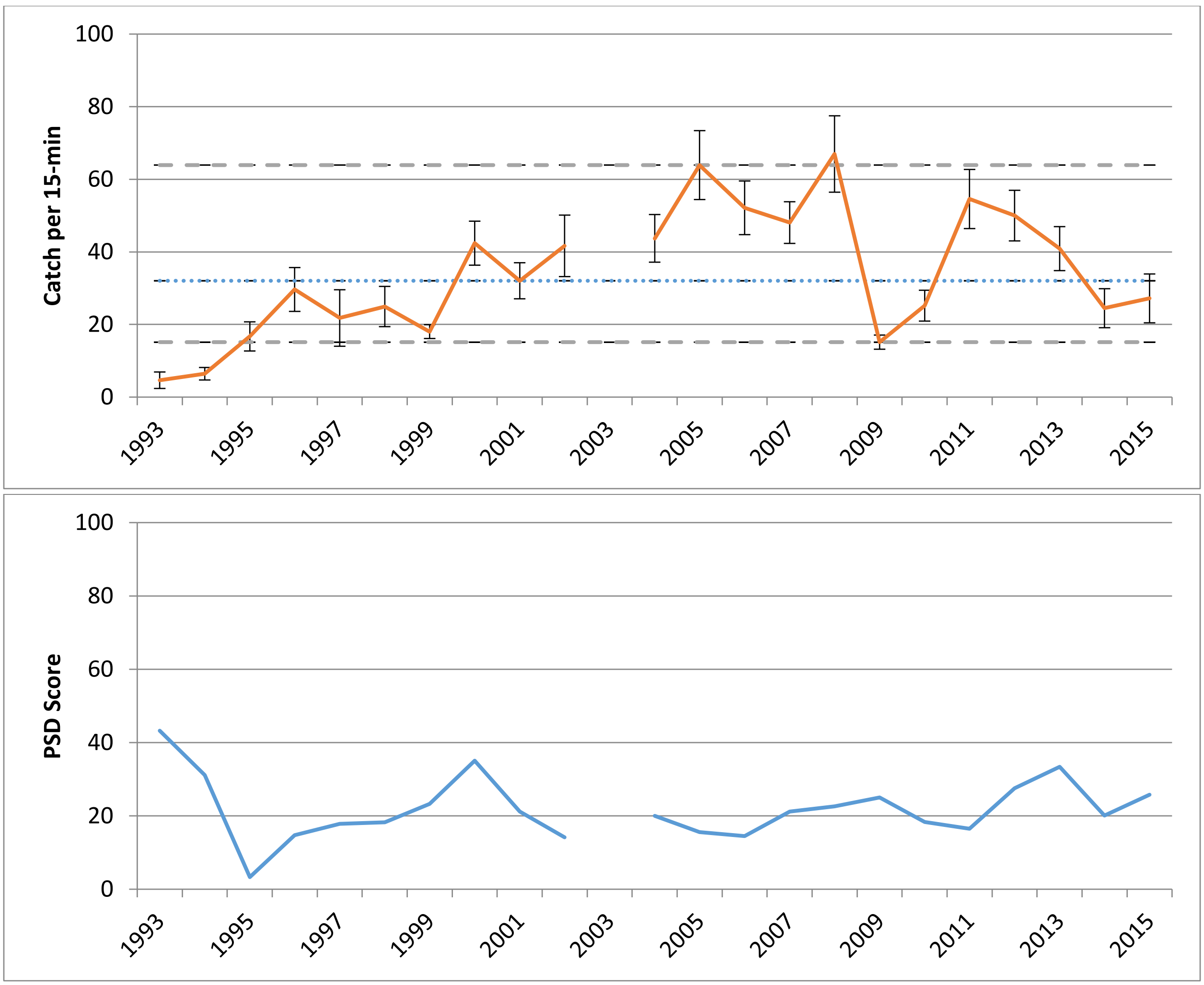


Figure 11. Catch per unit effort (± 1SE) and proportional stock-density of bluegill collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRM. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2015).

Channel catfish

Channel catfish electrofishing CPUE in 2015 equaled the long-term average in Pool 8 (Figure 12). Channel catfish CPUE has been generally low, but stable, over time. Wide error bars also indicate variability among sites within given years - many daytime electrofishing sites do not provide good habitat for channel catfish (i.e., low flow rates). The PSD value for channel catfish remained consistent with most years, in the 80-100 range, suggesting possible gear selectivity or a mature population with infrequent and small year classes entering the fishery.

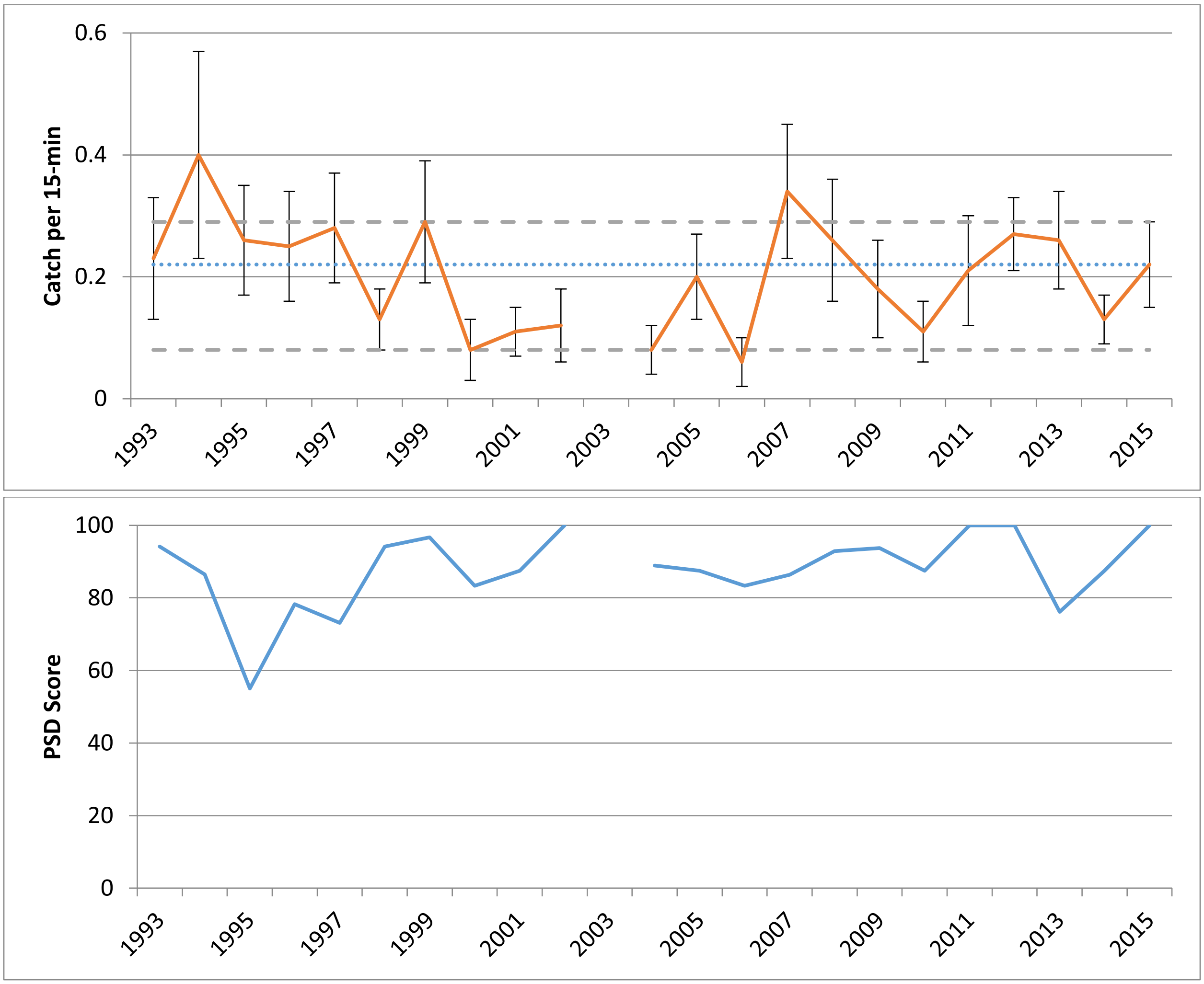


Figure 12. Catch per unit effort (± 1SE) and proportional stock-density of channel catfish collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRM. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2015).

Flathead catfish

CPUE for flathead catfish increased in 2015, and approached the 90th percentile boundary (Figure 13). An increase from about six years ago seems evident, but error bars are wide, suggesting caution in evaluating trends. PSD score for flathead catfish declined considerably in 2015 to 30. The increasing CPUE, coupled with decreasing PSD over the past six years suggests some recruitment of younger fish into the population.

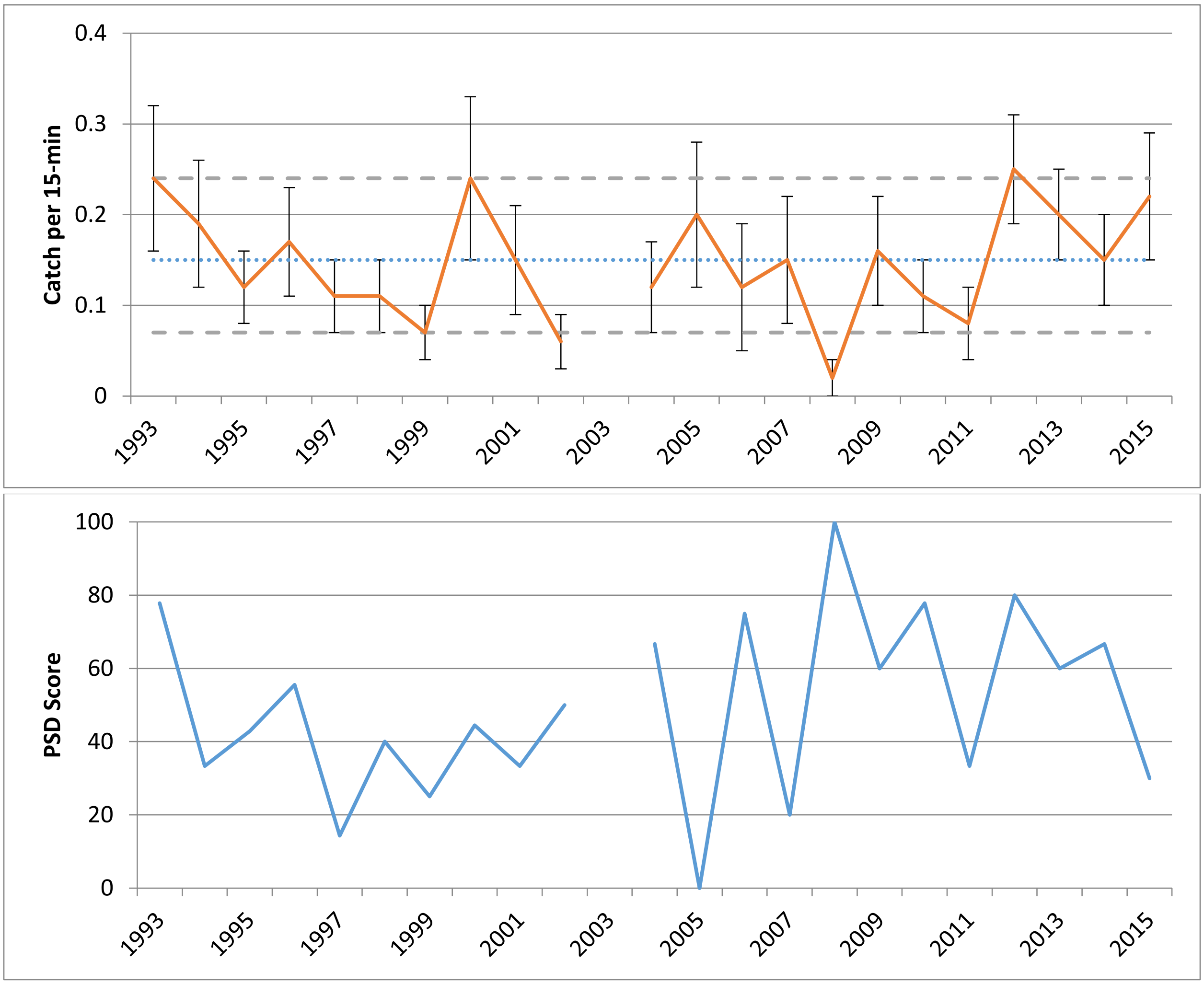


Figure 13. Catch per unit effort (± 1SE) and proportional stock-density of flathead catfish collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRM. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2015).

Largemouth bass

Largemouth bass CPUE has fluctuated about the long-term mean for seven years (Figure 14), and increased in 2015 from the previous year. Similar to bluegill, largemouth CPUE decreased precipitously in 2009, after what had been a long-term increase. A gradual long-term increase in PSD continued, and the 2015 value remained at the second highest in the LTRM time frame. Stable PSD and increasing CPUE means that all size categories of fish increased in relative abundance.

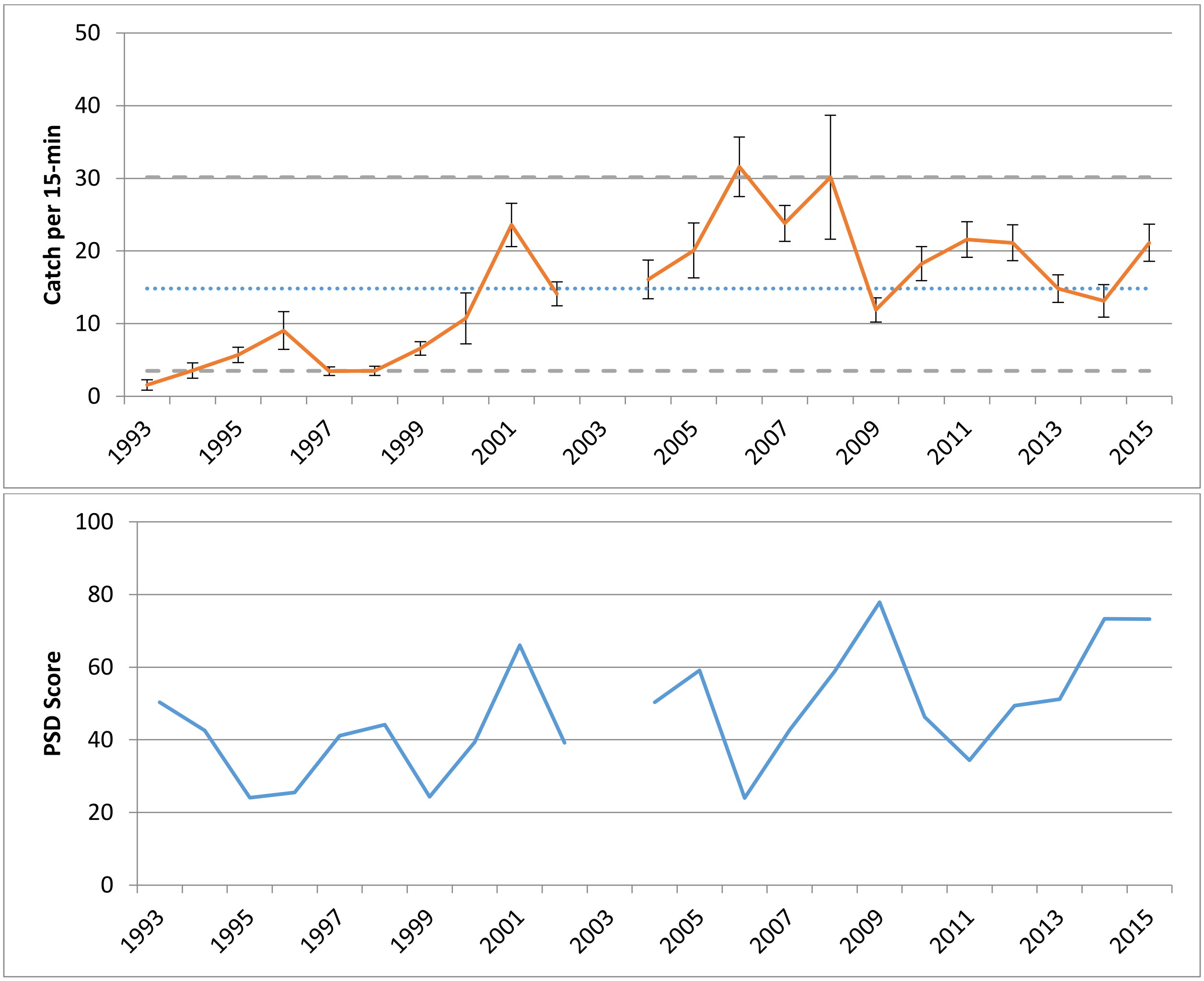


Figure 14. Catch per unit effort (± 1SE) and proportional stock-density of largemouth bass collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRM. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2015).

Northern pike

Northern pike CPUE declined slightly in 2015, but remained above the long-term mean (Figure 15). As catch rates have increased in the last 10 years, standard errors have also increased, suggesting patchiness. The PSD value for northern pike dropped to an all-time low in 2015, and has been on a slight decline over the LTRM sampling frame. This pattern merits further investigation

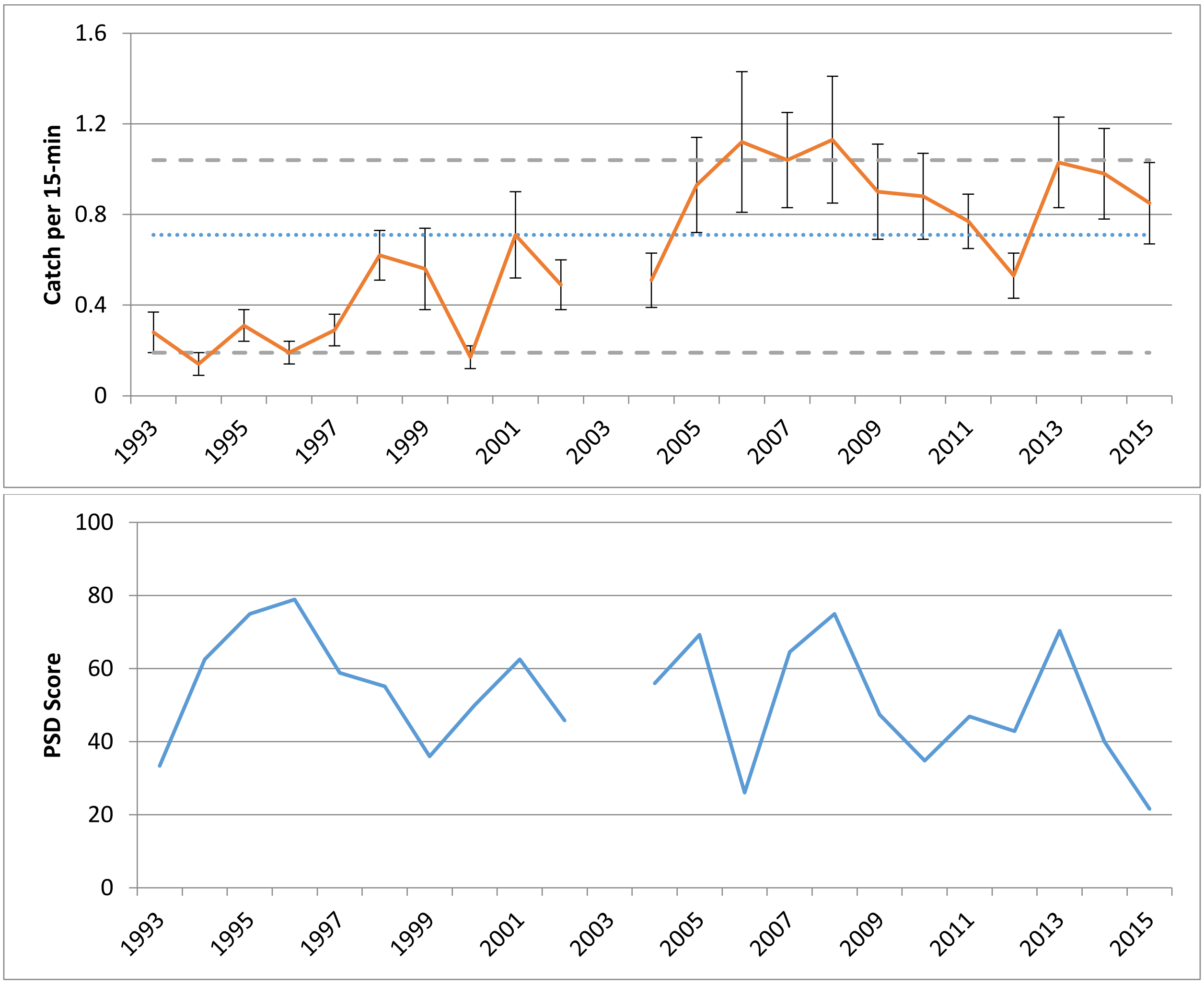
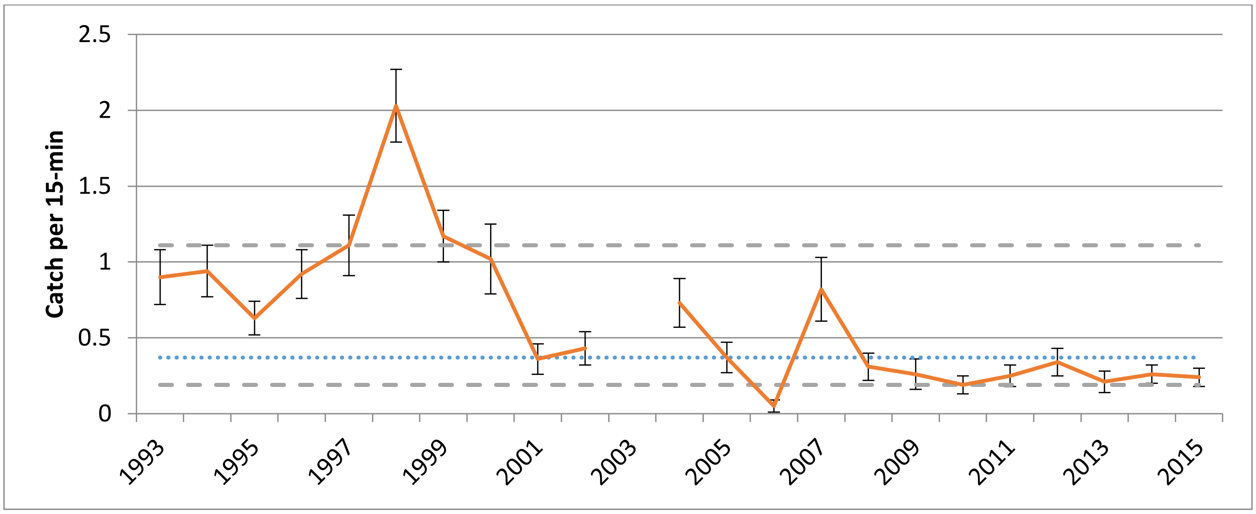


Figure 15. Catch per unit effort(± 1SE) and proportional stock-density of northern pike collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRM. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2015).

Sauger

Sauger CPUE has indicated a long decline in catch rate, which continued in 2015 (Figure 16). The last time sauger CPUE was above the mean in Pool 8 was 2007. Sauger PSD continues to be variable. The 2015 PSD score was 47. Stable CPUE and increasing PSD suggest that the average size of the fish may be increasing. However, the Pool 8 LTRM sample size for sauger has consistently been small since night electrofishing was eliminated in 2002, so cautious interpretations are advised.



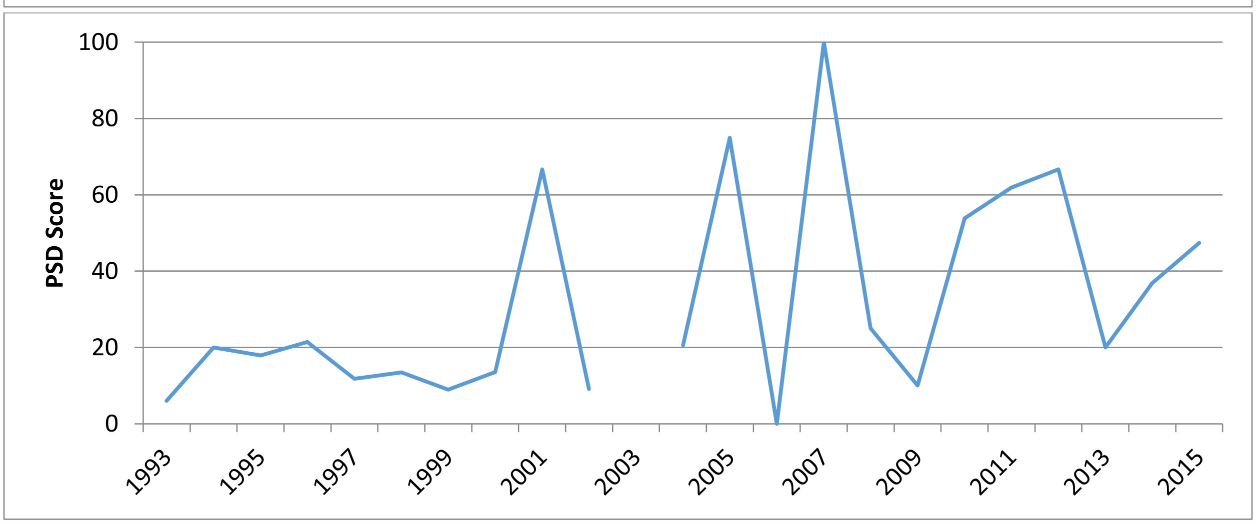


Figure 16. Catch per unit effort (± 1SE) and proportional stock-density of sauger collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRM. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2015).

Smallmouth bass

Smallmouth bass CPUE continued an increasing trend from an all-time low in 2013, and were back above the long-term mean (Figure 17). The relative abundance for smallmouth bass appears to be stable since the turn of the century, but it remains to be seen whether populations will rebound to levels seen in the 1990's. The PSD graph shows stable size structure over time, with the 2015 score of 57 being consistent with most previous years.

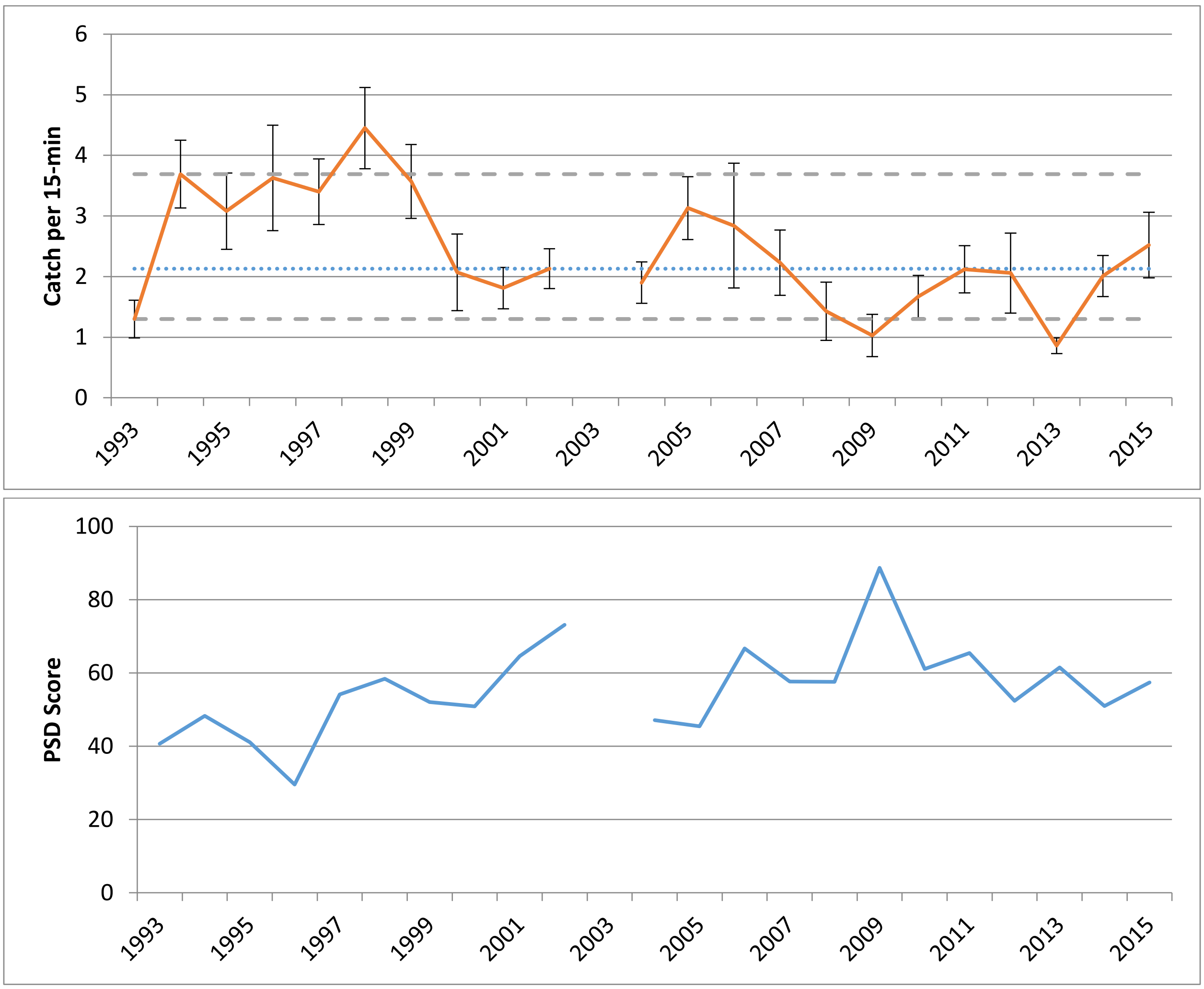


Figure 17. Catch per unit effort (± 1SE) and proportional stock-density of smallmouth bass collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRM. The long dashed lines represent the 10^{th} and 90^{th} percentiles and the dotted line represents the long-term average for the period of record (1993-2015).

Walleye

CPUE for walleye returned to the long-term mean value of 0.21 fish per electrofishing run in 2015 (Figure 18), marking only the third time in 15 years where it was at or above the mean. Despite that fact, catch rates remain very low, and for reasons unknown. Walleye PSD values depict a stable, albeit fluctuating, pattern over time, with scores ranging from about 40 to 80. The 2015 PSD score was 61. Increasing CPUE and increasing PSD suggest some success in both recent and past recruitments.

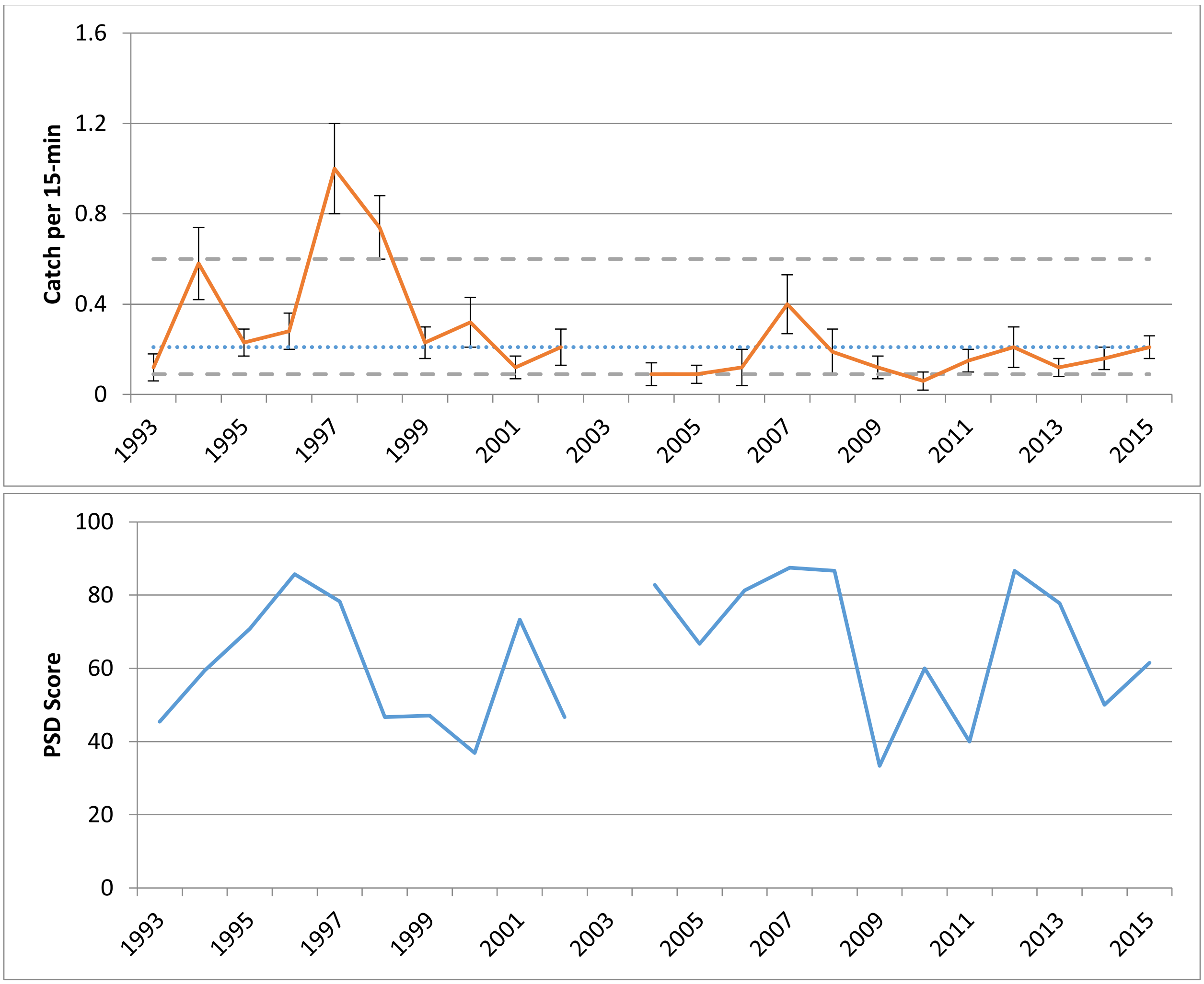


Figure 18. Catch per unit effort(± 1SE) and proportional stock-density of walleye collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRM. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2015).

Yellow perch

The 2015 CPUE for yellow perch was the highest on record for Pool 8 LTRM sampling (Figure 19). This followed a down year, but is consistent with a dramatic increase in catch rates over the last 8 years. Yellow perch seem strongly entrenched as one of the most abundant sport fish in the system at this time. The 2015 PSD score of 45 continued a general pattern of increase through time, as well, suggesting the increases in relative abundance have occurred for adults, as well as young fish.

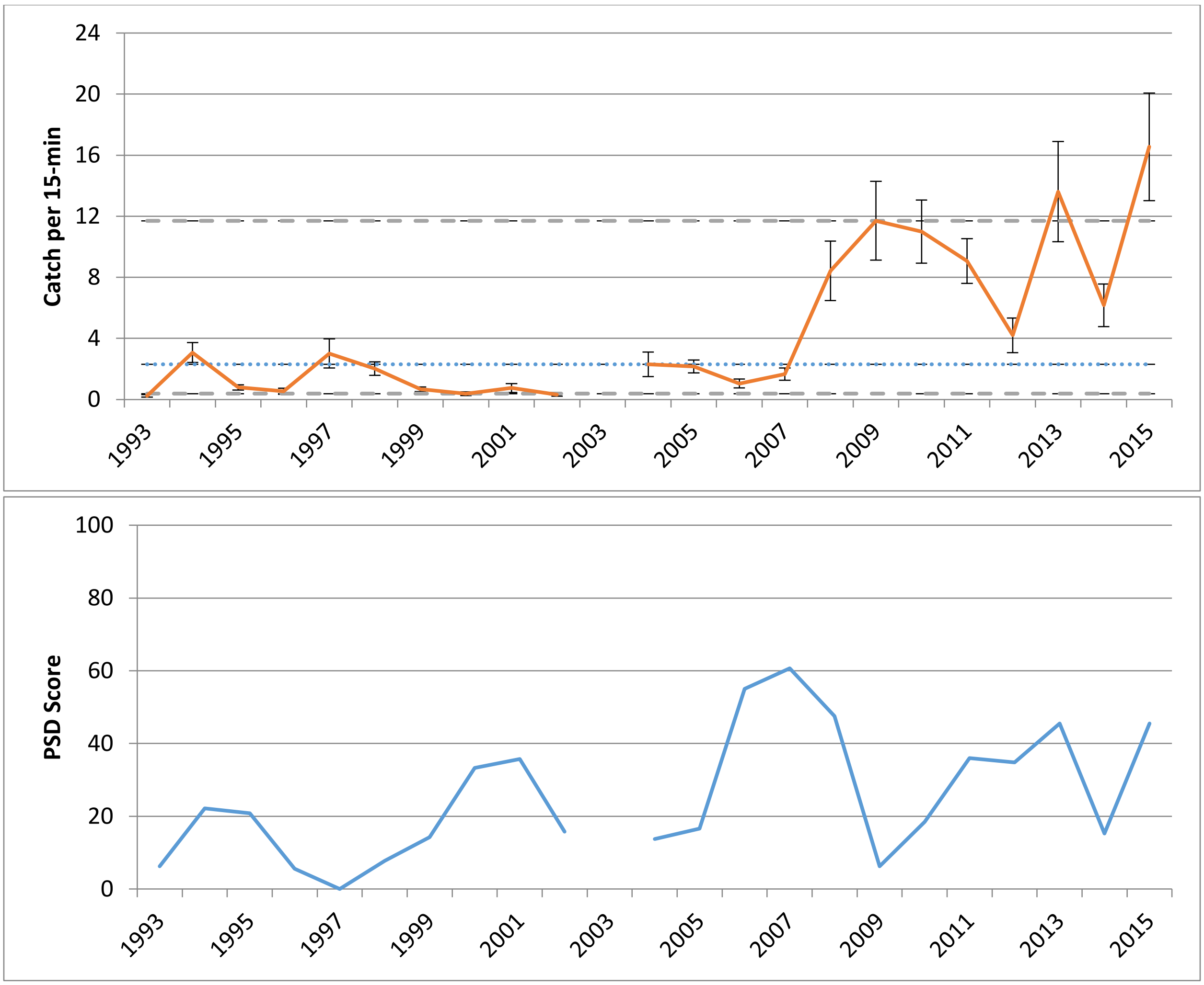


Figure 19. Catch per unit effort (± 1SE) and proportional stock-density of yellow perch collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRM. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2015).

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