2014 Pool 8 State of the Ecosystem Report

Long Term Resource Monitoring Program

An element 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 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 2014 dataset in the context of how it relates to the entire LTRMP sampling frame.

2014 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 2014, 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 1959-2013. The daily discharge for 2014 was then compared to the long-term daily mean to observe departure from typical conditions (Figure 1a). Additional analyses examined annual, growing season (May–September), and spring flood discharge characteristics. Mean discharge was calculated from daily values, plotted for years 1993-2014, and overlain on a plot containing the historic mean, 10th, and 90th percentiles for all years (1959 to 2014; Figure 1b). Mean growing season discharge was calculated and plotted similarly to the mean annual discharge (Figure 1c). 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 75th percentile discharge value from March through May. Magnitude was reported as the maximum spring discharge value for each year (Table 1).

Results

The Pool 8 hydrograph in 2014 was characterized by extended spring floods (Figure 1a) - a similar pattern to the 2013 hydrograph. The timing and magnitude of the spring flood was not unusual, but it was a long-duration flood event, lasting 49 days (table 1). The repeated crests and subsequent flooding that lasted through July was atypical, resulting in a mean annual discharge that was above the 90th percentile, and placing 2014 among the top 3 for the LTRMP era (Figure 1b). The highest discharge occurred from late-June to mid-July, which was the third time the river exceeded flood stage in 2014.

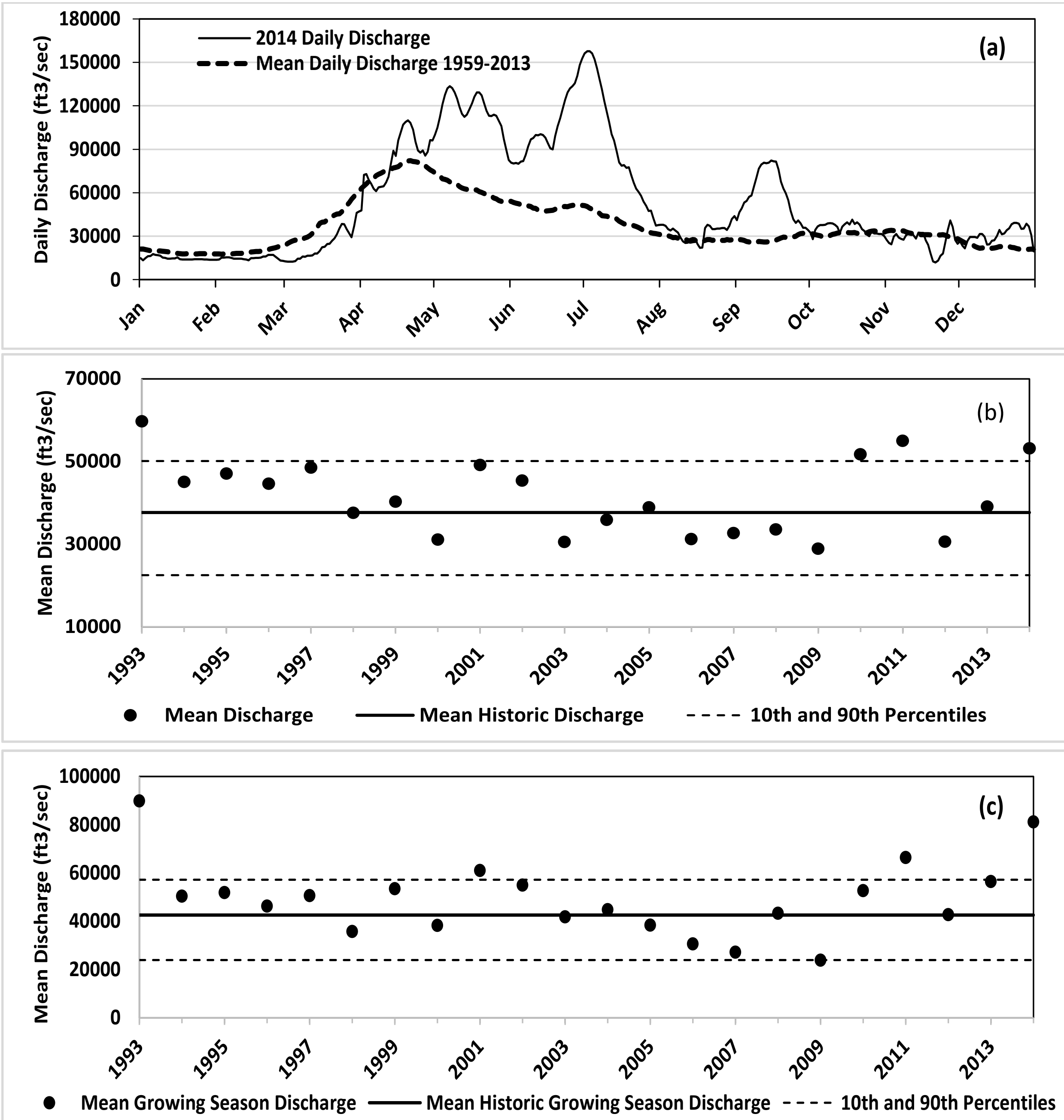


Figure 1. (a) Daily discharge at Lock and Dam 8 on the Upper Mississippi River for 2014 is represented by the solid line. Mean daily discharge by day of the year for 1959-2013 is represented by the dotted line. (b) Mean discharge by year is represented by the black dots. The solid line represents mean historic discharge for 1959-2014. The dashed lines represent the 10th and 90th percentiles for 1959-2014 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 1959-2014. The dashed lines represent the 10th and 90th percentiles for 1959-2014 growing seasons.

Because of the July flood, the growing season mean daily discharge (Figure 1c) was an even greater departure from normal, rivaling 1993 for highest during the LTRMP era and well above the 90th

percentile. A slow thaw due to an historically cold winter, where deep snow covered much of the northern part of the basin, likely contributed to the sustained high discharge in spring, while above average precipitation in the basin drove the historic discharge levels in summer. The only portions of 2014 with typical water levels were the cold season and the month of August.

River discharge is a key variable influencing water quality and biotic variability. Changes in discharge result in variable rates of delivery of sediment, nitrogen and phosphorus (Balogh et al., 1997; Goolsby et al., 2000; Likens, 2010). This mid-summer flood event is noteworthy because previous significant growing season floods have been shown to affect biota for a number of years afterward (Barko et al, 2006, Gutreuter et al, 1999). Three out of the last four years have experienced high mean growing season discharge and the impacts of these events on pool 8 warrant further investigation.

Table 1. Spring flood pulse statistics by year during the LTRMP 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

2014 Water Quality

Methods

The focus of the water-quality component of the LTMRP is to collect limnological information relevant to the suitability of aquatic habitat for biota and transport of materials within the system. The LTRMP 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 were 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 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

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). Three out of the past four years (2014, 2013 and 2011) had the coldest median spring water temperatures in Pool 8 for the period of record (8.0, 5.5 and 8.6^{o}C, respectively). All three years were colder than even the spring mean tenth percentile http://www.umesc.usgs.gov/data_library/water_quality/graphical/water_front.html , which is 10.6 C (generated from summary data 1993-2014). The southward shift of the polar vortex we experienced made the first two months of 2014 the third coldest on record for the period 1895-2014 (http://www.weather.com/news/news/winter-ncdc-state-climate-report-2013-2014-20140313). Median water temperature in winter, summer and fall 2014 were relatively close to the median, falling within +/- 25 percentile range of the long term median (Figure 2a).

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 spawning habitat (Walters, 1995). Median TSS values in 2014 were near the long-term median during winter and spring and well below (10-25 percentile range) the long-term median during summer and fall. (Figure 2b). The lower TSS in summer and fall is likely due to the nature of precipitation events (frequent but less intense rain events), as well as lower chlorophyll a levels. In 2014, 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 2014, chlorophyll a levels were below the long-term median during all seasons (Figure 2c). Below average spring temperatures coupled with a robust spring flood pulse, followed by sustained high water in summer likely contributed to the low chlorophyll a levels (i.e. low sestonic algae production), observed during these periods (Figure 1a, 2c).

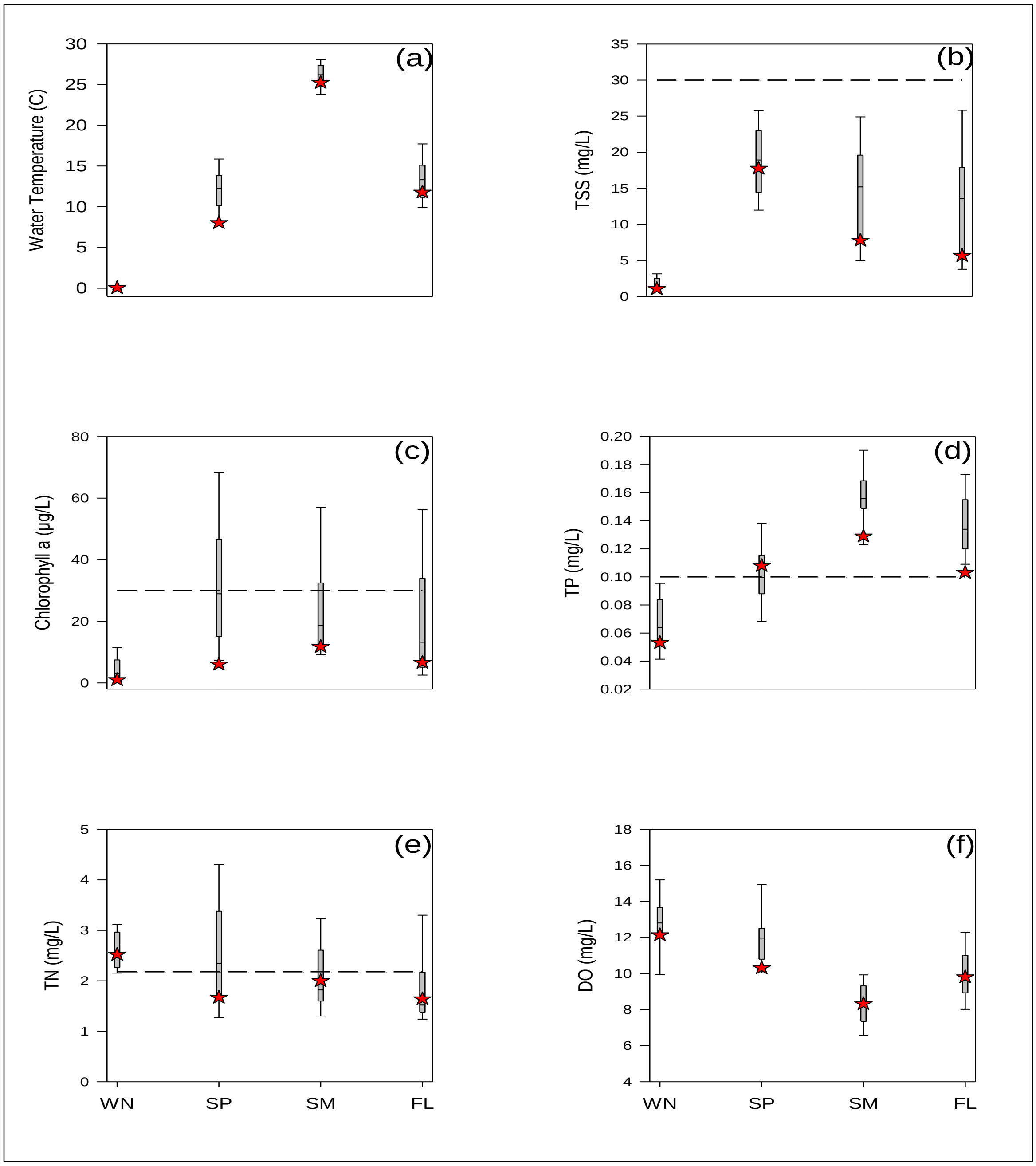


Figure 2. Box plots represent the 10th, 25th, 50th, 75th, and 90th percentiles of the medians by stratified random sampling season for the Long Term Resource Monitoring Program period of record (1993-2013). The star represents the weighted pool-wide median for each parameter by season for 2014. (b) The 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).

The winter chlorophyll a levels were as low as reported during any season or year but are not surprising with the thicker ice and deeper snow recorded (Figure 3), limiting the light available for photosynthesis. Mean chlorophyll a was well below the eutrophic range (>30 µg/L) during all seasons in 2014, and characteristic of an oligotrophic state for this parameter (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, 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). TP was well below the long-term median during winter, summer and fall and about the same as the long-term median in spring of 2014 (Figure 2d). While median TP for summer 2014 was below the long-term median, it was still about 30% higher than the Wisconsin TP criterion (0.10 mg/L) for non-wadeable rivers (Wisconsin administrative code NR 102.06).

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) NO_2^-+ NO_3^- was near long-term median in winter, summer and fall and below the long-term median during spring (Figure 2e). In 2014, TN was only above the upper concentration recommended by the USEPA for ecosystem health (0.6-2 .18 mg/L) during winter (USEPA, 2000). High spring discharge is often associated with higher nitrogen levels; however, we note that the LTRMP data show the opposite occurred in 2014.

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 sediments. Median DO was near the long-term median during summer and fall and below the long-term median during winter and spring (Figure 2f). While median spring DO was in the 10 percentile range, it was still fairly high (10.31 mg/l, 85% saturation) and was not an issue for biota.

Ice and snow thickness can affect the concentration of DO in the underlying water column by reducing available light and thereby suppressing photosynthetic activity. Median ice and snow thickness were well above the long-term median during the winter of 2014 (Figure3). It’s likely that the increased ice and snow thickness reduced light penetration and photosynthetic activity (evidenced by low chlorophyll a levels), which contributed to DO concentrations below the long-term median during the winter of 2014.

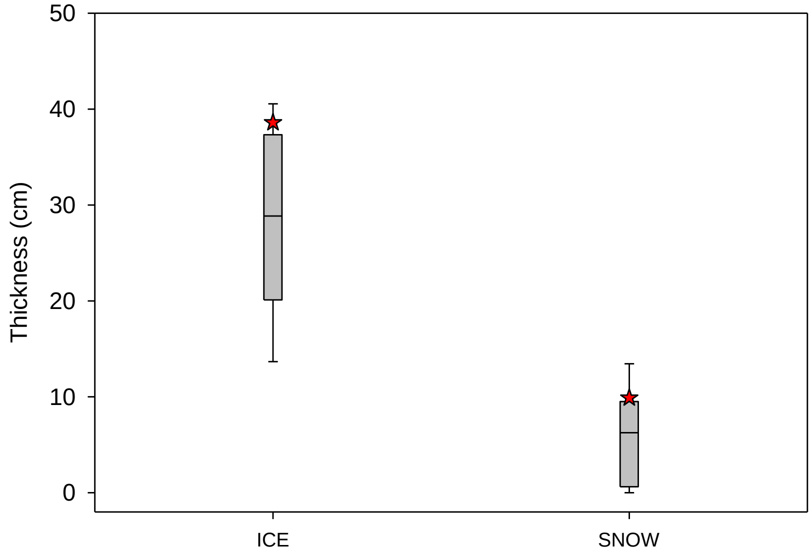


Figure 3. Box plot represents the 10th, 25th, 50th, 75th, and 90th percentiles of the medians for winter ice thickness and snow thickness above the ice sheet during winter for the Long Term Resource Monitoring Program period of record (1993-2014). The star represents the weighted pool wide median for each parameter for the winter of 2014.

2014 Aquatic Macrophytes

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 17 to August 11, 2014. 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 LTRMP vegetation sampling protocol can be found in Yin et al., 2000 at:
http://www.umesc.usgs.gov/documents/reports/1995/95p00207.pdf

We surveyed 443 sites during the 2014 summer field season, with sites distributed among strata to reflect relative coverage of each stratum in the Pool 8 ecosystem (Table 2). Water depth, velocity and total suspended solids (an indicator of water clarity) are known environmental constraints for establishment and growth aquatic vegetation. Dissolved oxygen (DO) concentration reflects the balance between physical conditions and biological processes, including photosynthesis and respiration of aquatic vegetation. Average values of these parameters measured in summer 2014 water quality monitoring suggest fundamental differences in water quality characteristics between strata (Table 2). Isolated backwaters (BWI) were notably low in DO with no measurable water movement, and mean TSS varied considerably from 5.7 – 10.1 mg/l between strata. Low vegetation abundance was observed in the main channel and side channel strata, which are characterized by relatively fast water and higher concentrations of suspended solids (Table 2 and Figure 4). Contiguous backwater (BWC) sites supported dense vegetation (Figure 4) but are similar in depth to main channel and side channel sites (Table 2). Taken together these relationships suggest (under conditions in Pool 8) that water velocity and suspended solids, which co-vary to some extent (Figure 5), are primary drivers for establishment of aquatic vegetation, and that water depth is a secondary constraint. It is not surprising that the amount of light penetrating the water, modified by water velocity and suspended solids, can limit vegetation. A more specific question that arises from this observation is whether vegetation establishment is particularly sensitive to the light environment at a particular time of year (perhaps early in the growing season when plants are very small and furthest from the surface).

Table 2. Summary of physical characteristics by stratum. Data are taken from both aquatic vegetation sampling (17 June – 11 August 2014) summer water quality surveys (21 July – 5 August 2014).

	Vegetation sampling 2014		**Water quality sampling, summer 2014**			
Stratum	**Number of sites (n)**	**Average depth at sites (m) ± SD**	**Number of sites (n)**	**Mean water velocity (m/s) ± SD**	**Mean suspended solids (mg/l) ± SD**	**Mean DO (mg/l) ± SD**
Contiguous Backwaters (BWC)	106	1.71 (± 0.75)	60	0.03 (± 0.09)	6.7 (± 5.3)	8.3 (±3.1)
Isolated Backwaters (BWI)	19	1.29 (± 0.51)	10	0.00 (± 0.00)	5.7 (± 6.6)	2.3 (± 2.4)
Impounded Areas (IMP)	185	0.77 (± 0.50)	25	0.20 (± 0.18)	7.9 ± (5.0)	9.2 (± 1.3)
Main Channel Border (MCB)	68	1.81 (± 1.28)	25	0.56 (± 0.19)	10.1 (± 2.4)	8.1 (± 0.4)
Side Channels (SC)	65	1.78 (± 0.82)	30	0.30 (± 0.21)	9.4 (± 2.4)	8.2 (± 0.9)
Total	443		150			

Slow-moving and still waters (BWI, BWC and IMP) supported a greater abundance of aquatic vegetation than moving waters (SC and MCB) in 2014 (Figure 4). This pattern is consistent with previous years of monitoring. Although isolated backwaters (BWI) typically had very low DO concentrations during the summer sampling period (Table 2), the overall abundance of aquatic vegetation in these areas was relatively high (Figure 4). Low summer DO does not appear to limit the distribution of aquatic vegetation in Pool 8.

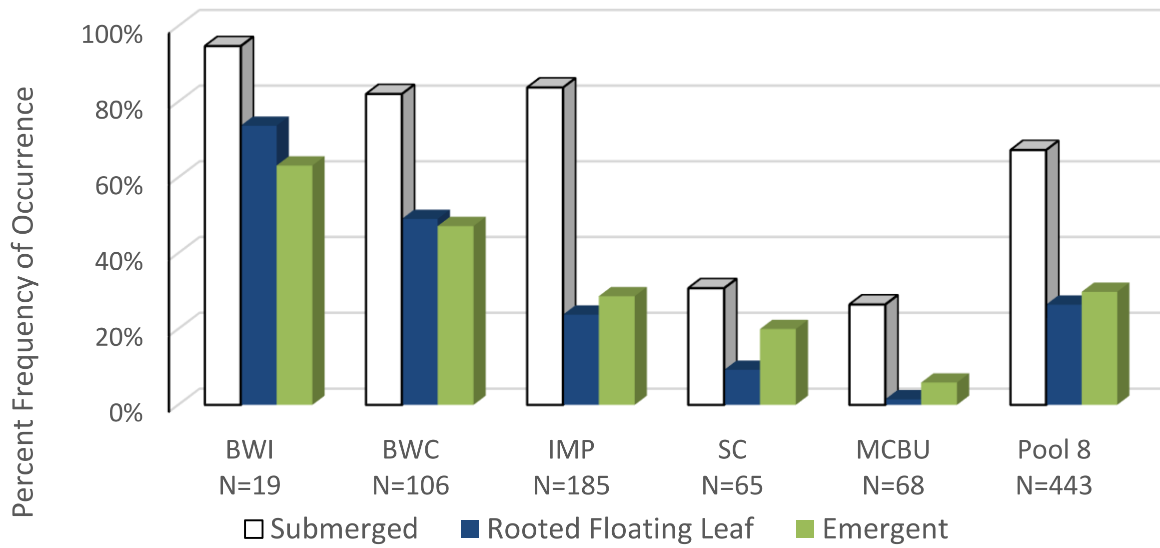


Figure 4. Percent frequency occurrence of vegetation types in each stratum, and the overall averages for Pool 8.

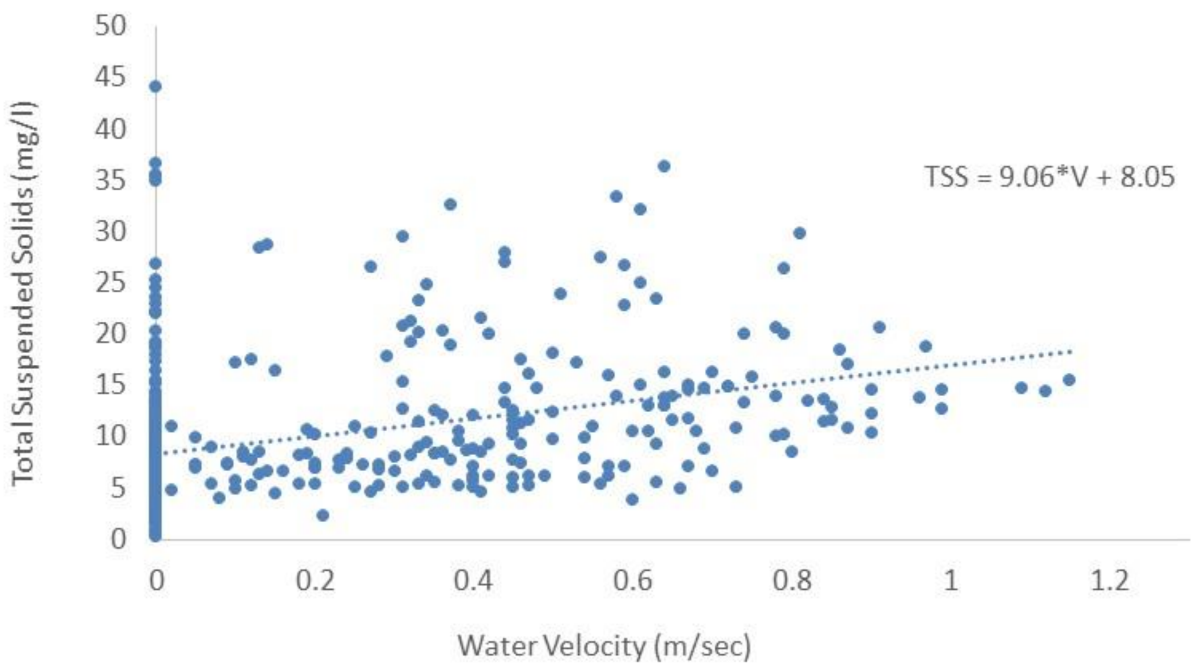


Figure 5. A weak but significant positive correlation ($R^2 = 0.16$, $P < 0.01$) between water velocity (V) and ln-transformed total suspended solids (TSS) measured at 447 water quality sites in spring, summer, and fall stratified random sampling in 2014. This pattern was similar in previous years.

Long-term patterns in vegetation abundance

In 2014, 67.3% of sites supported submersed vegetation, while 26.4% of sites supported rooted, floating-leaf vegetation and 29.8% supported emergent vegetation. Approximately 30% (133) of sites surveyed were unvegetated. These rates of detection are within the range of the previous three years of monitoring (Figure 6), and do not suggest any dramatic changes in overall abundance and distribution or clear effects of the extended high-water periods in 2013 and 2014 (see hydrograph section above).

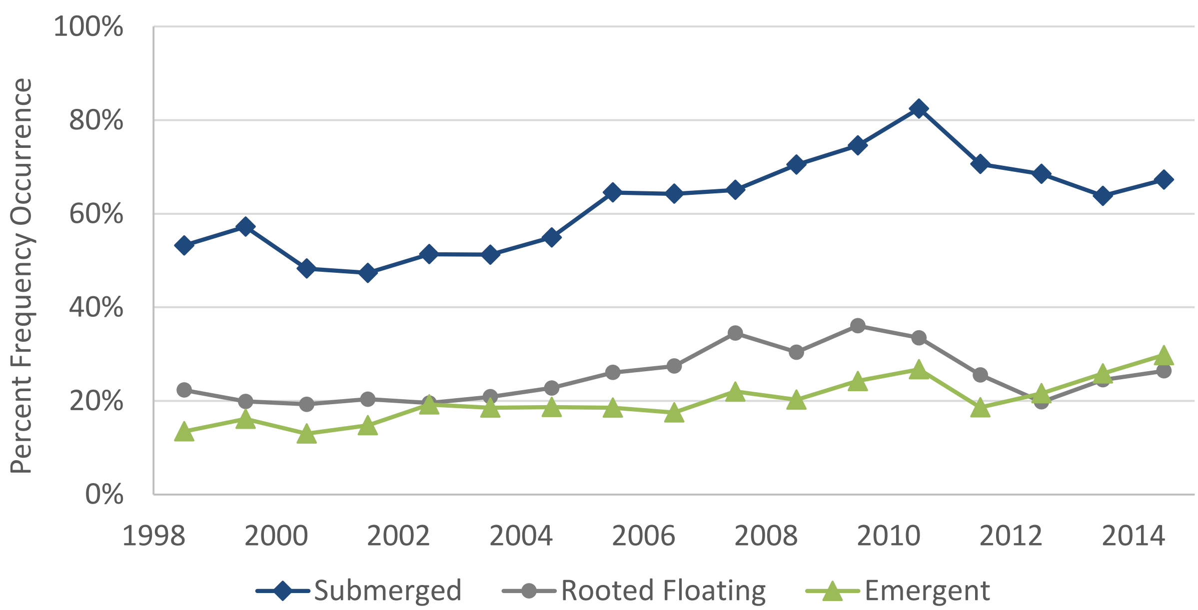
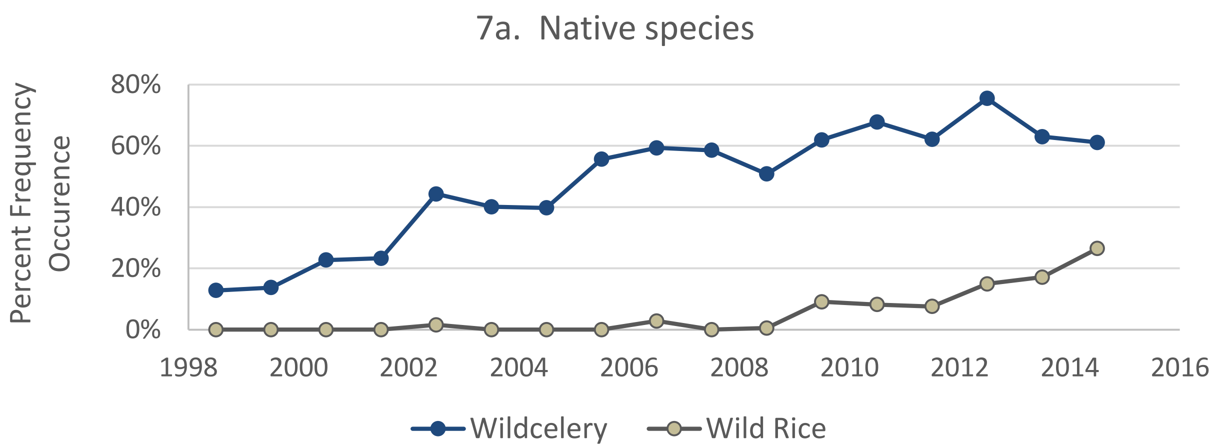


Figure 6. Series of % frequency occurrence of the three main vegetation types over the period of LTRMP monitoring.

Since LTRMP vegetation monitoring began in 1998, all three types of vegetation have increased in abundance in Pool 8. A coarse comparison of composited data from the first part of the record (1998 – 2006) to more recent years (2007-2014) shows an overall increase in the occurrence of vegetation and a decrease in the occurrence of unvegetated sites (Table 3). The highest % frequency vegetation occurrence was seen in 2010 (~82% of sites). Some portion of this increase in vegetation is attributable to two native species of special interest in the ecology of Pool 8. These are wild celery (*Vallisneria americana* Michx.), a predominantly clonal, perennial plant, and wild rice (*Zizania aquatica* L.), an annual. Wild celery tubers have high specific value as forage for canvasback (*Aythya valisineria* Wilson) and other migrating waterfowl, while wild rice can also be an important source of food and cover for wildlife. Long-term data show considerable increases in the abundance of both of these species since 1998 (Figure7a). Prior to 2009, wild rice was only detected occasionally in surveys but since then has increased to be the most frequently detected emergent species in Pool 8.

Table 3. Average % frequency occurrence of vegetation types during the first 11 years and the last 8 years of LTRMP monitoring. Vegetation surveys have been conducted at 440 - 1000 sites annually.

	Submerged	Rooted Floating	Emergent	All vegetation types	Unvegetated
1998-2006	55%	22%	17%	58%	42%
2007-2014	70%	29%	24%	74%	26%
difference	15%	7%	7%	16%	-15%



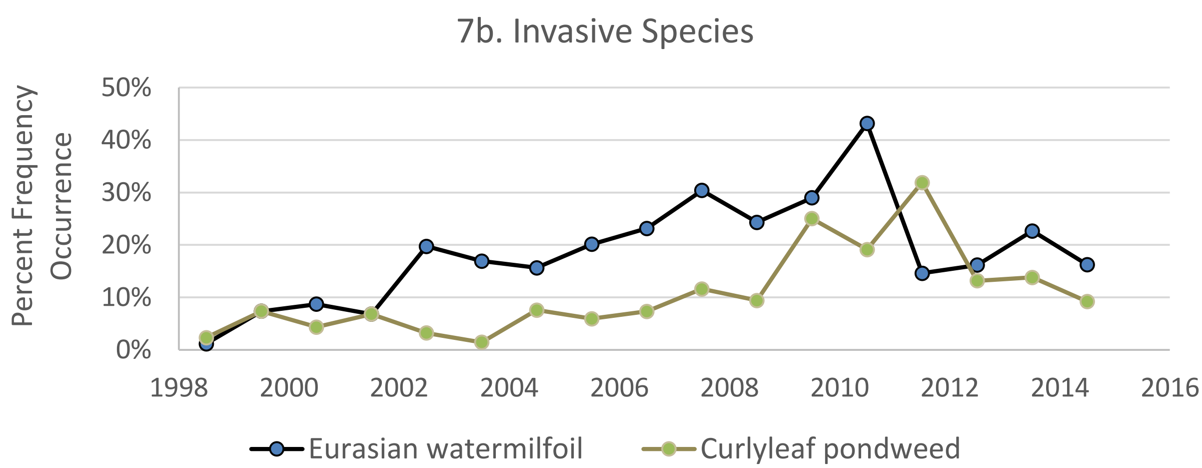


Figure 7a. Positive trends in the detection and abundance of wild celery and wild rice in Pool 8 over the period of LTRMP monitoring, and Figure 7b. Possible cycling abundance of two exotic species over the period of monitoring.

Invasive plants are detected frequently, but do not appear to exclude native vegetation at the site level and are virtually never the sole species detected at a site. Notably, the detection of invasive Eurasian watermilfoil (*Myriophyllum spicatum*) and curlyleaf pondweed (*Potamogeton crispus*) increased from occurrence at < 2% of sites in 1998 to 43% and 32% of sites, respectively, in 2010/2011. Since then, both species appear to have decreased in abundance, with 2014 detection rates at approximately half of the 2010/2011 maxima (Figure 7b).

A total of 35 plant species (including algal mats) have been identified in Pool 8 over the course of LTRM monitoring, but at individual vegetated sites, 4-7 species are generally detected (Table 4).

Table 4. Average native and invasive species richness in the five strata in 2014 surveys. Unvegetated sites were excluded from species richness calculations.

	Number of sites			Species richness - average number of species at vegetated sites	
	Total visited	**Unvegetated**	**Vegetated**	**Natives**	**Invasives**
Backwater Contiguous	106	11	95	7.0	0.7
Backwater Isolated	19	0	19	6.6	0.2
Impounded	185	28	157	4.6	0.4
Side Channel	68	42	26	4.2	0.4
Main Channel Border	65	49	16	5.0	0.5
Overall Average				4.9	0.4

2014 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, 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 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, 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 individuals or larger individuals and stock-sized individuals. Stock and quality size designations vary by species. 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

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.

Results

The fisheries component made 266 fish collections in 2014, falling four collections short of the planned effort. All of sampling period 1 was conducted under high water conditions, and sampling was halted for two weeks when the river went over flood stage. Despite missing significant time, we were able to finish all period 1 collections when the river receded toward the end of period 1. However, in period 2, the high water came at the end of the period and we were unable to electrofish three wingdam sites because of high current velocity. Period 3 sampling went well with the exception of a mini fyke net site in a backwater that was completely destroyed, presumably by a snapping turtle, beaver, or muskrat. We were unable to revisit that site due to time constraints.

The planned sampling allocation among gear types has remained stable for many years. Sampling effort was highest for daytime electrofishing (81 collections), followed by mini fyke nets (65 collections), and fyke nets (48 collections). Effort was greatest in the contiguous backwater stratum (83 collections), with side channel (60 collections) and main channel border (48 collections) also receiving considerable effort.

Total catch in 2014 was 22,548 fish, which is about 30% lower than 2012 and 2013. While the high discharge may have contributed to decreased gear efficiency, we also observed lower catches when discharge was normal. This may reflect reduced fish populations from the harsh previous winter and a number of recent years with unusual water level conditions (see hydrograph and water quality discussions above). Species richness (63), by contrast, remained consistent with the LTRMP period of record and appears to be stable (Figure 8).

The top 5 species, in order of catch, were bluegill – 4415, weed shiner – 2257, mimic shiner – 1917, spotfin shiner – 1458, and emerald shiner – 1179. Other notable species in abundance were largemouth bass, bullhead minnows, and black crappie, while yellow perch slipped into the second tier of common fish along with golden shiner, channel catfish, freshwater drum, and rock bass. The trend toward a more balanced lotic and lentic fishery, that was evident in 2013, continued in 2014.

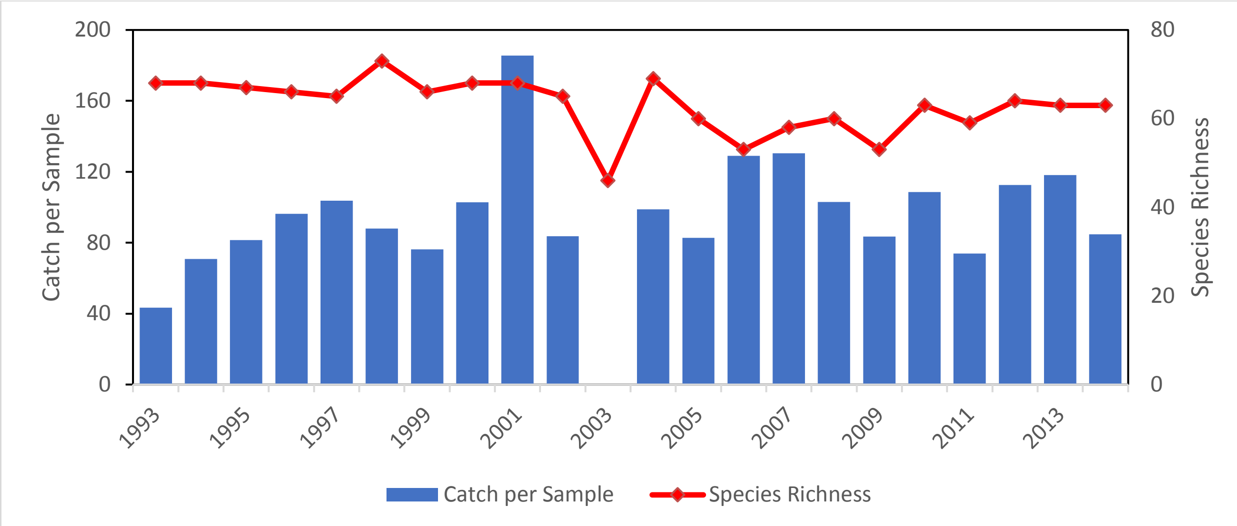


Figure 8. Catch per sample and annual species richness, for Upper Mississippi River Restoration – EMP-LTRMP fish collections in Pool 8 of the Upper Mississippi River. Data represent samples collected with daytime electrofishing, fyke nets, mini fyke nets, large and small hoop nets, and otter trawls. Data are omitted for 2003 due to limited sampling that year.

Single specimens were sampled of the following species in 2014: mooneye, northern hog sucker, orangespotted sunfish, pallid shiner, quillback, and speckled chub. Fewer than 10 individuals were sampled for an additional 19 species. Thus, about 40% of the species detected were very uncommonly encountered. Historically, there are 37 species that have been detected every year since SRS began in 1993, and an additional 27 species have been detected in at least half of the years. There are 26 species that have been detected in 9 or fewer years. Included among that group in the 2014 catch were: pallid shiner (2 of 22 years), lake sturgeon (5 of 22 years), speckled chub and pirate perch (6 of 22 years), northern hog sucker (8 of 22 years) and troutperch (9 of 22 years).

Wisconsin revamped its working list of threatened and endangered species for 2014. Three of these species (blue sucker and river redhorse, threatened, and pallid shiner, endangered) were collected in the Pool 8 LTRMP catch this year.

Thus far no Asian carp (bighead and silver) have been collected in the Pool 8 LTRMP sampling efforts. We caught 221 common carp this year, continuing the long-term trend of decreased carp abundance.

One noteworthy occurrence in the catch was 9 pirate perch, which was more than we had seen in all other years combined. This marks a second year in a row of pirate perch detection after more than a decade of being absent from our catches.

Figure 9 depicts the trend in Shannon-Wiener Diversity Index scores for day electrofishing in Pool 8 LTRMP 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, whereas, many lotic species were in decline, as well. Scores have increased each year since 2011, as the fish community has become less dominated by those few 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.

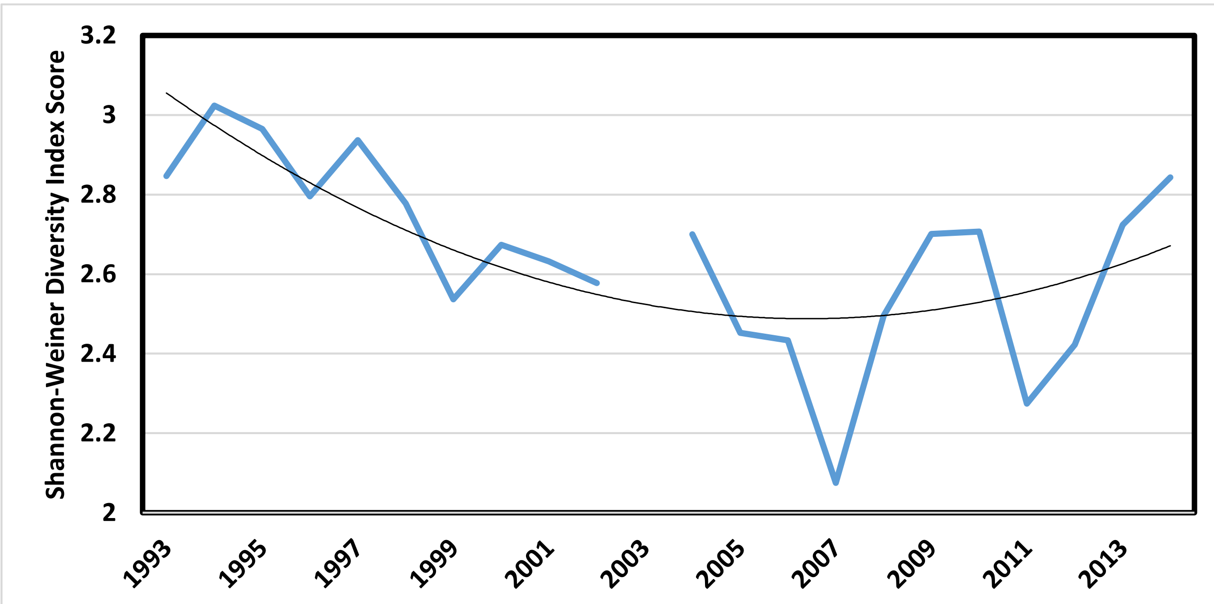


Figure 9. Shannon-Wiener Diversity Index Scores calculated from LTRMP Pool 8 day electrofishing samples from 1993-2014. Data are omitted for 2003 due to limited sampling that year. Trend line is a second-order polynomial representation of the data.

Trend data for 10 species of interest to anglers are briefly discussed on the following pages. In general, over the LTRMP period of record, catch rates for black crappie, channel catfish, and flathead catfish seem stable, catch rates for bluegill, largemouth bass, yellow perch and northern pike have increased, and catch rates for sauger, smallmouth bass, and walleye have decreased. These are cursory examinations, only using daytime electrofishing data, and including all sizes of fish collected. Thus, interpretation of these results is best limited to general characterizations.

Black crappie

Catch rates for black crappie were near the 90th percentile in 2014, rivaling 2008 for the highest over the period of record (Figure 10). This species exhibits high variability in catch rates, but appears to be very stable over time. The PSD score for black crappie in 2014 was over 80, suggesting one or more large year classes of juvenile fish moving into the adult population. It remains to be seen whether these year classes can recruit well enough to sustain high catch rates for more than a few years.

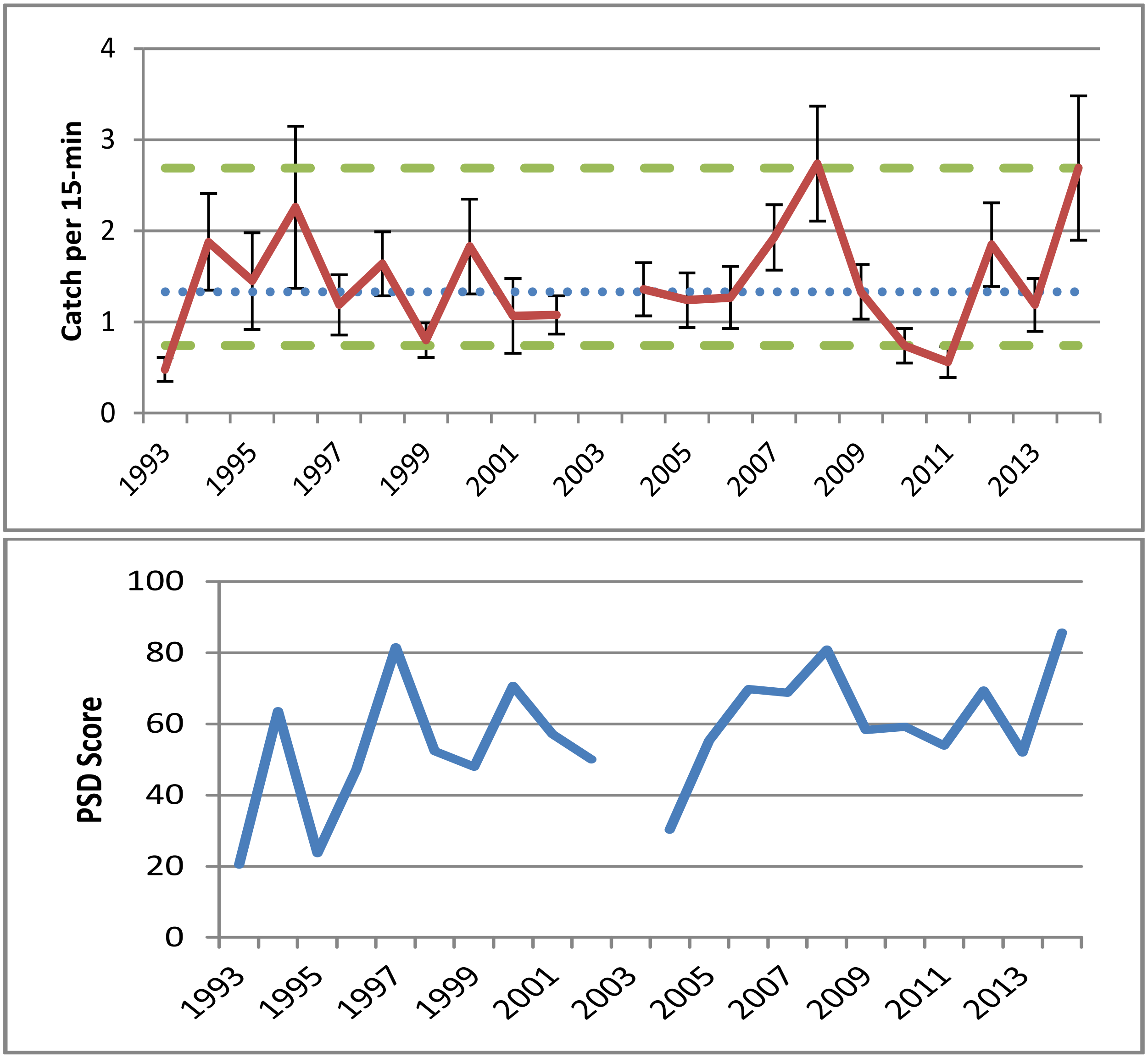


Figure 10. Catch per unit effort (± 1SE) and proportional stock-density of black crappie collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRMP. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2014).

Bluegill

Bluegill CPUE showed a third consecutive year of decline from 2011, and was below the long-term average (Figure 11) in 2014. Catch rates for bluegill have been below their peak for six consecutive years now, seemingly on a downward trajectory. PSD values for bluegill have been remarkably consistent and low for bluegill for most of the LTRMP time frame, coming in at 20 for 2014. The decline in CPUE suggests weak year classes recently. Age-0 bluegills were noted to be very small in late-summer, most likely the result of the very late spring.

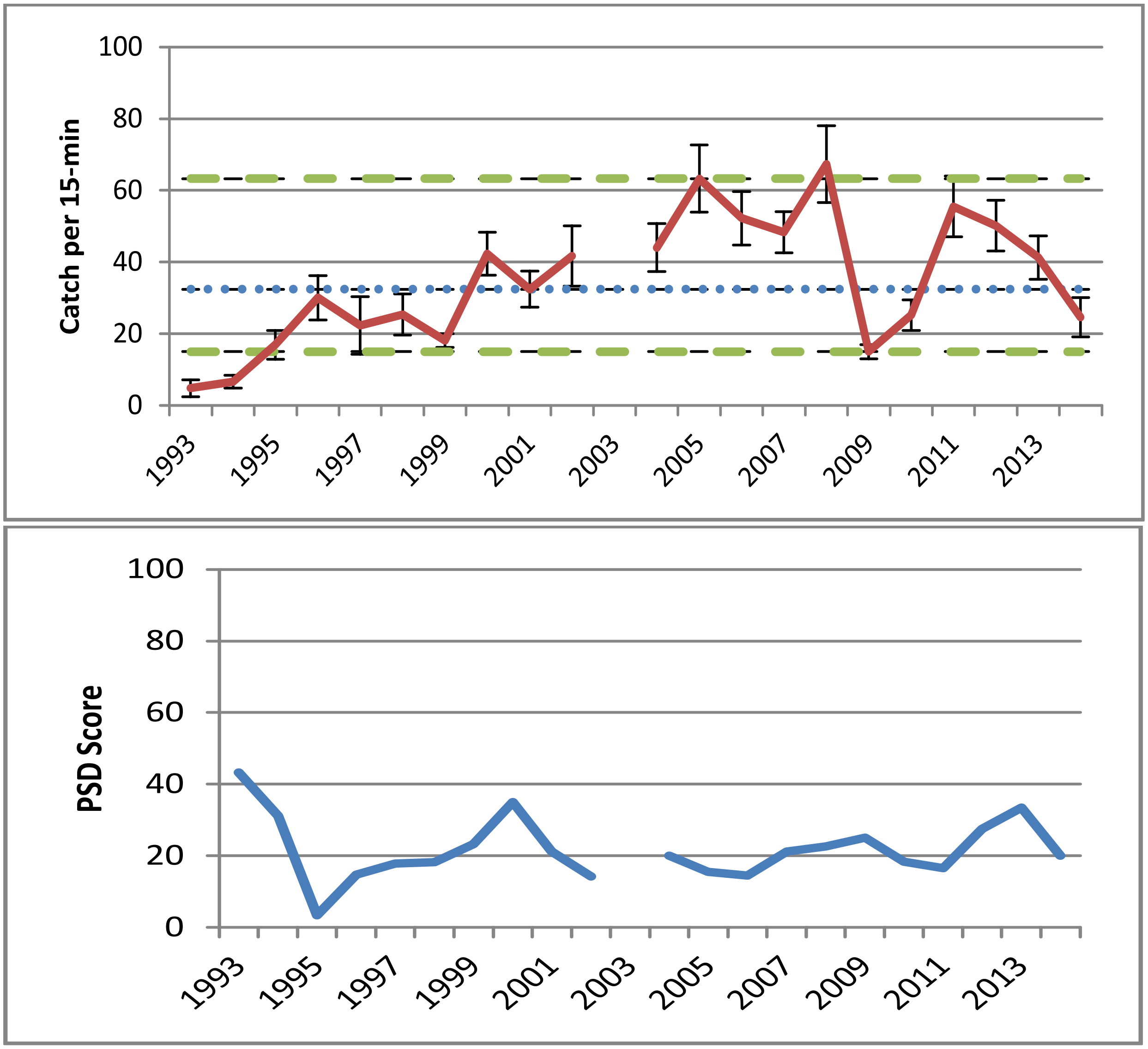
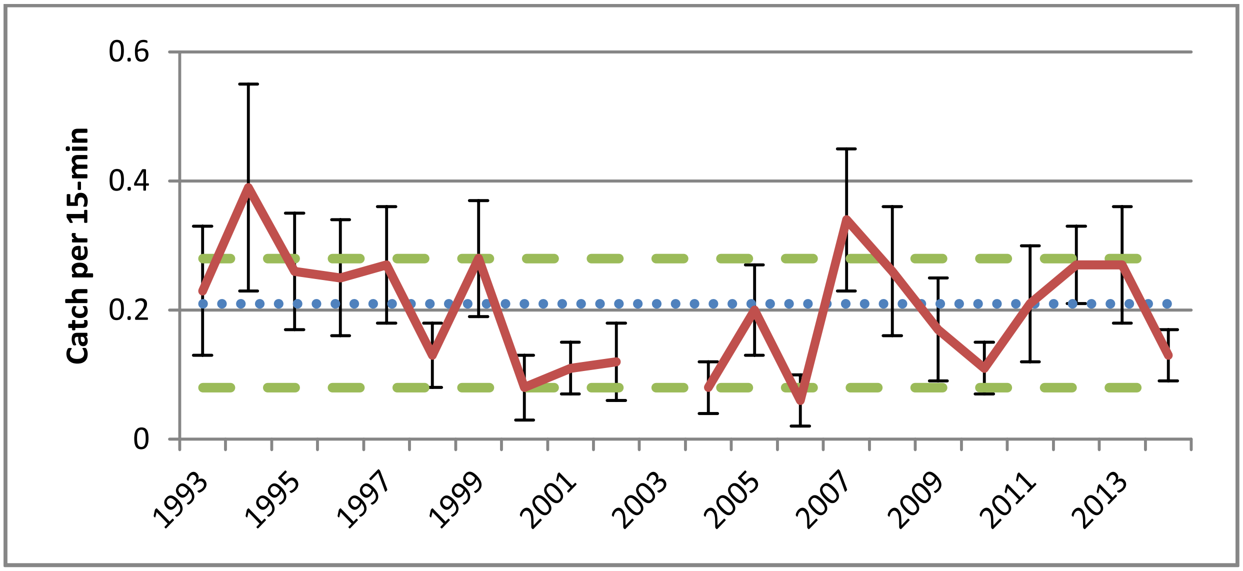


Figure 11. Catch per unit effort (± 1SE) and proportional stock-density of bluegill collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRMP. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2014).

Channel catfish

Catch rates for channel catfish with day electrofishing have been generally low, but stable, over time (Figure 12). CPUE was below the LTRMP average in 2014, after a couple of year near the 90th percentile. The PSD value for channel catfish remained consistent with most years, in the 80-100 range, and suggesting a very mature population with infrequent and small year classes entering the fishery.



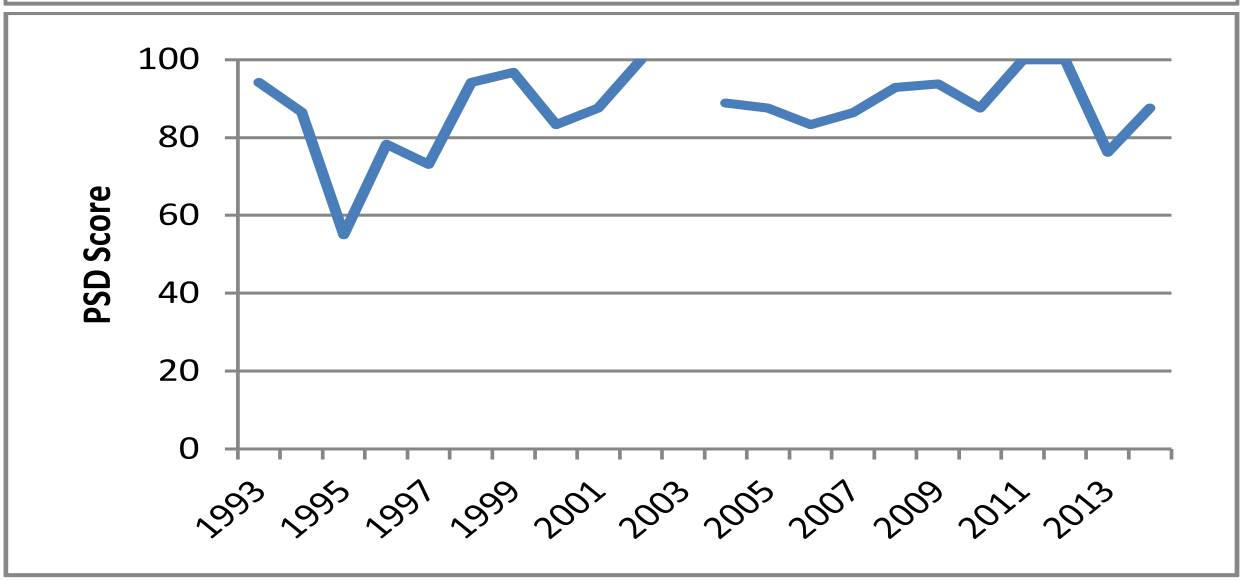


Figure 12. Catch per unit effort (± 1SE) and proportional stock-density of channel catfish collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRMP. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2014).

Flathead catfish

CPUE for flathead catfish declined for a second consecutive year in 2014, but was still above the long-term average (Figure 13). PSD values for flathead catfish seem to be showing a gradual increase, suggesting more adult fish in the population.

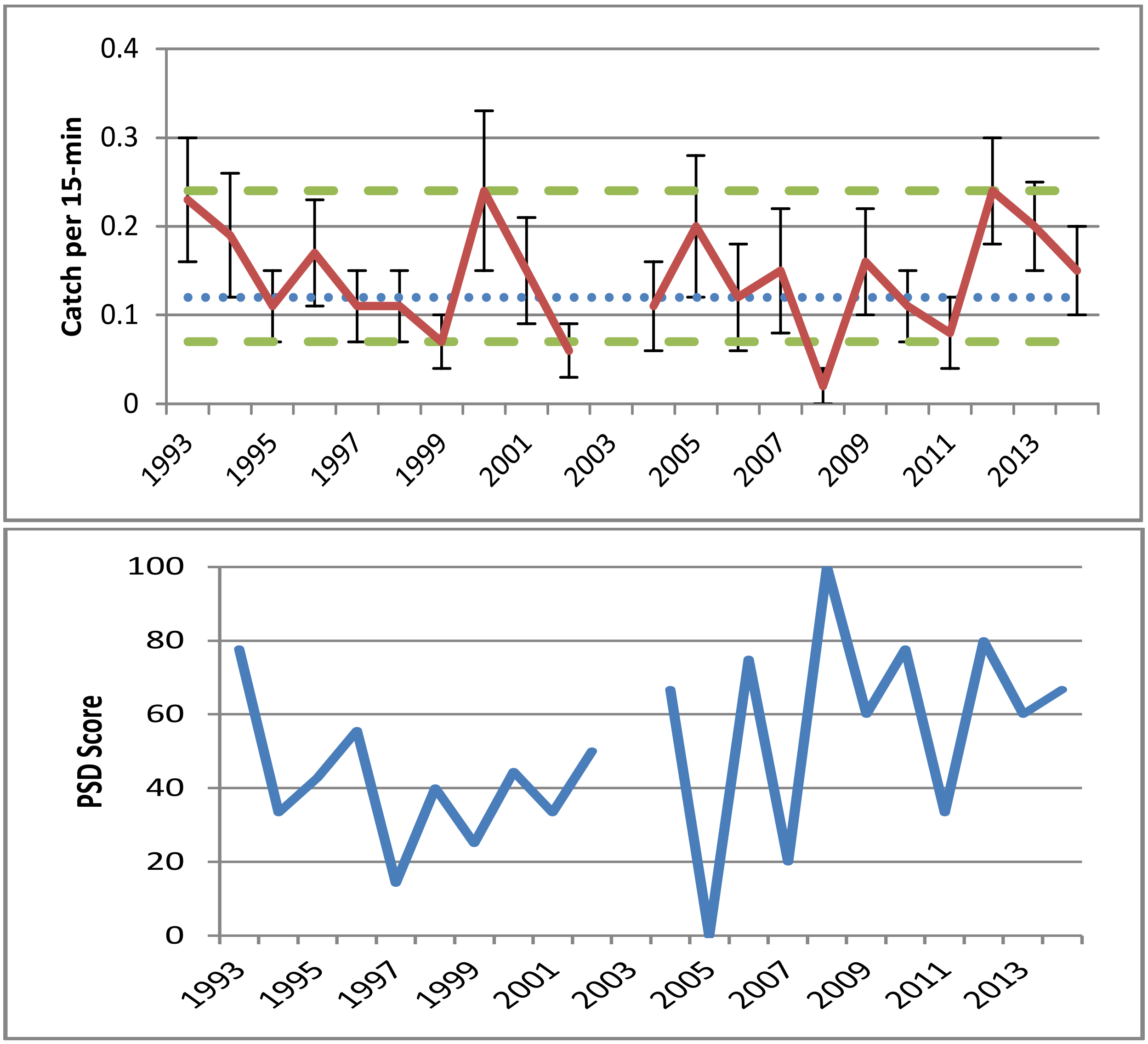


Figure 13. Catch per unit effort (± 1SE) and proportional stock-density of flathead catfish collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRMP. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2014).

Largemouth bass

Largemouth bass CPUE has declined from its peak in 2006-2008, but still near the long-term average in 2014 (Figure 14). 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, as the 2014 value was the second highest in the LTRMP time frame. This suggests large year classes have been lacking.

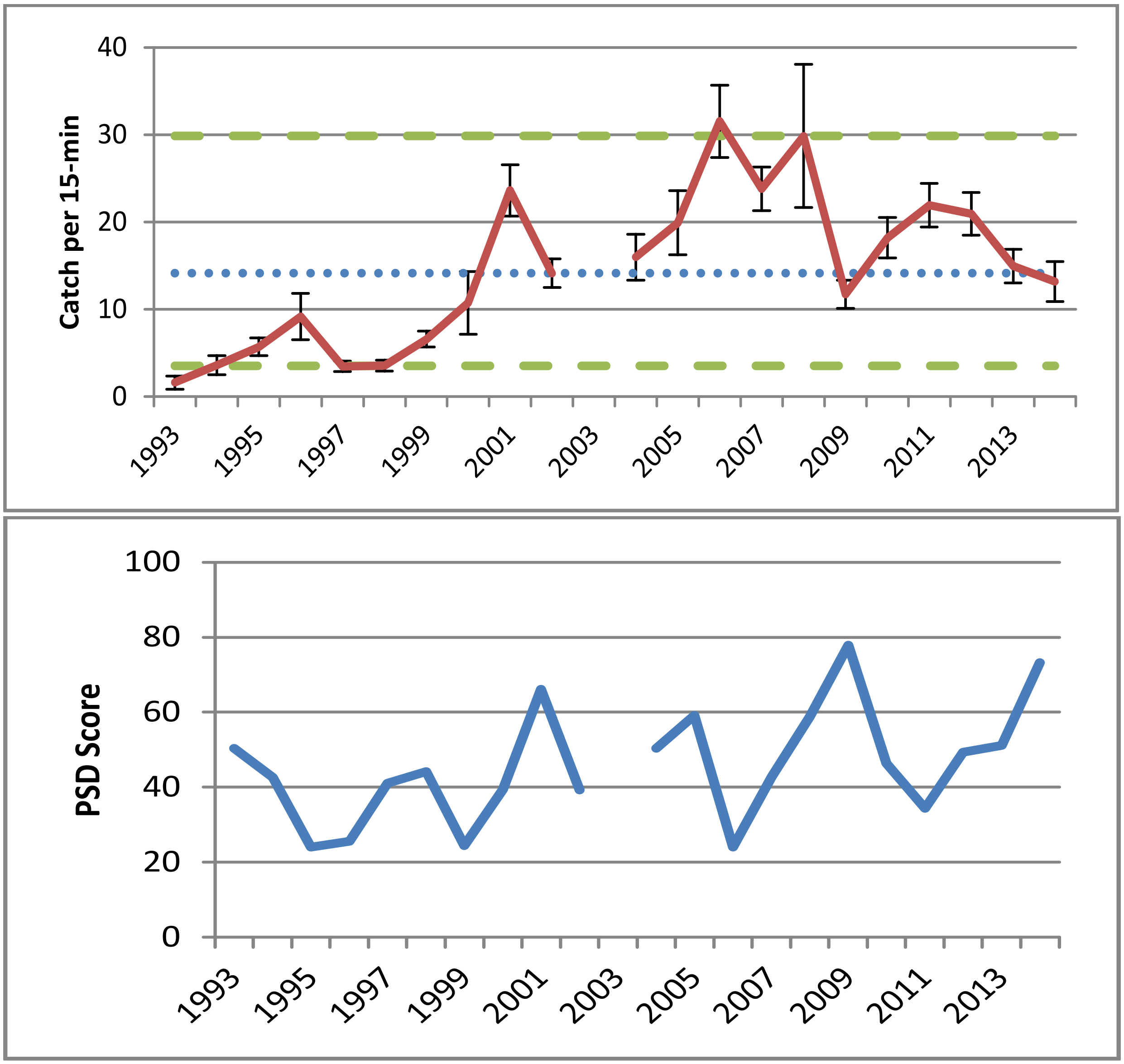


Figure 14. Catch per unit effort (± 1SE) and proportional stock-density of largemouth bass collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRMP. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2014).

Northern pike

Catch rates for northern pike remained near the 90th percentile for a second consecutive year in 2014 (Figure 15). The PSD value for northern pike dipped to 40 in 2014, suggesting strong year classes recently.

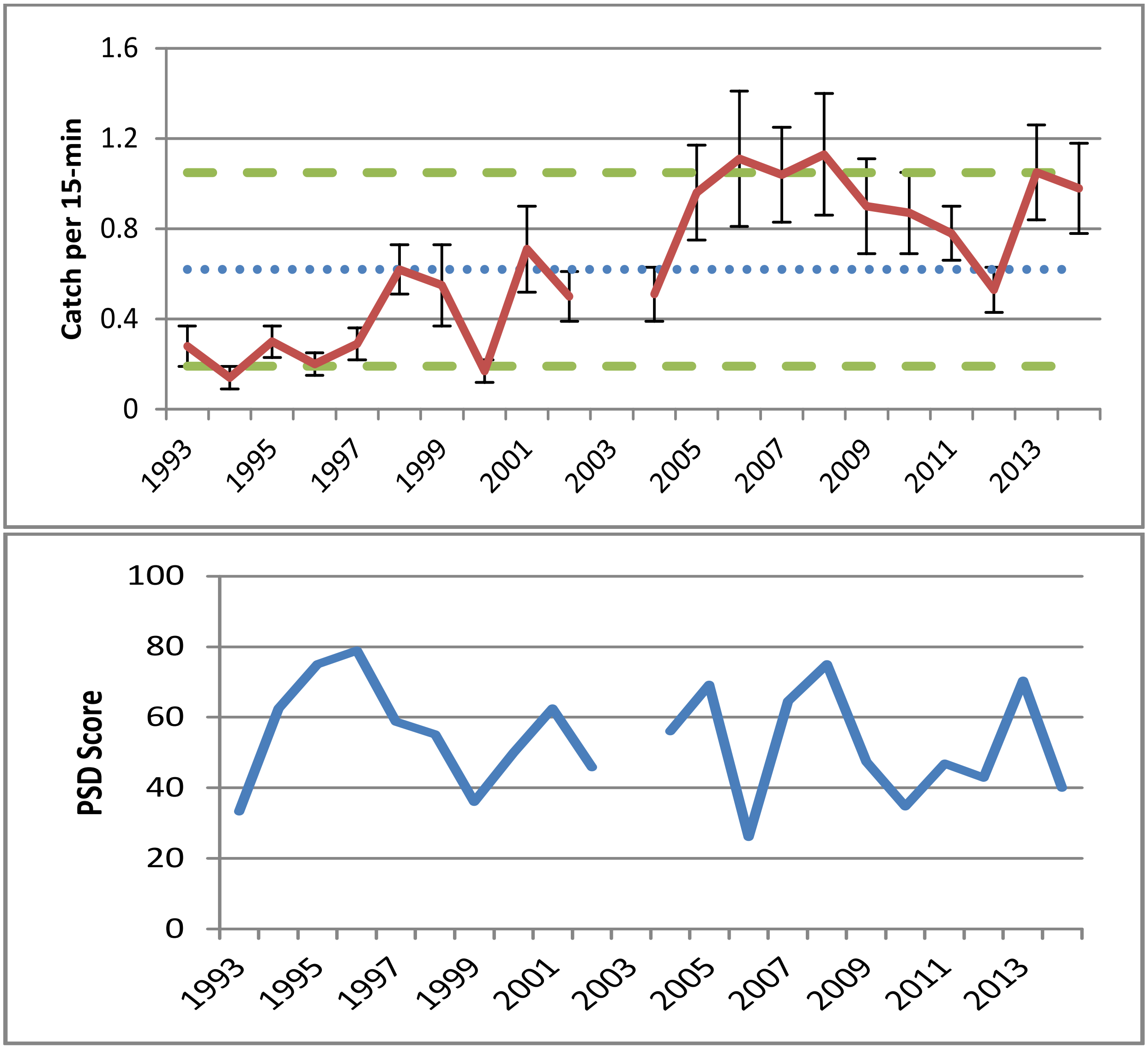


Figure 15. Catch per unit effort(± 1SE) and proportional stock-density of northern pike collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRMP. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2014).

Sauger

Sauger CPUE has indicated a long decline in catch rate, which continued in 2014 (Figure 16). For 2014, CPUE remained low, and represents a string of seven consecutive years below the 20-yr mean. Sauger PSD has fluctuated widely over the past decade, with a general increase observed. The 2014 PSD value crept up to 39, suggesting some younger individuals were recruited into the population, while some adults were also sampled.

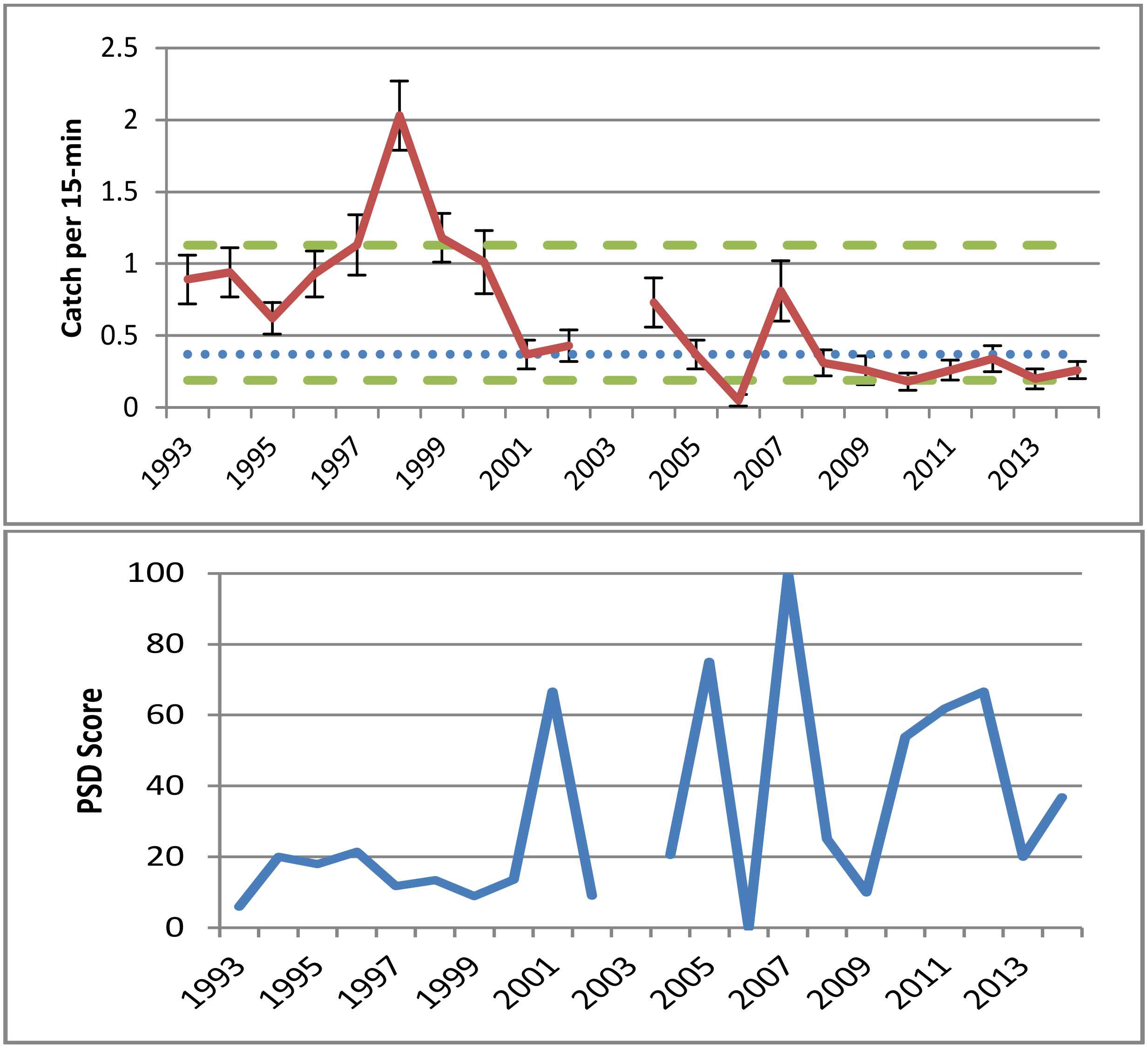


Figure 16. Catch per unit effort (± 1SE) and proportional stock-density of sauger collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRMP. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2014).

Smallmouth bass

Catch rates for smallmouth bass rebounded from 2013, which had the lowest levels since LTRMP began sampling. 2014 CPUE was near the long-term average (Figure 17). A long-term decline in smallmouth bass populations is still suggested by the CPUE trend graph. The PSD graph shows relatively stable size structure over time.

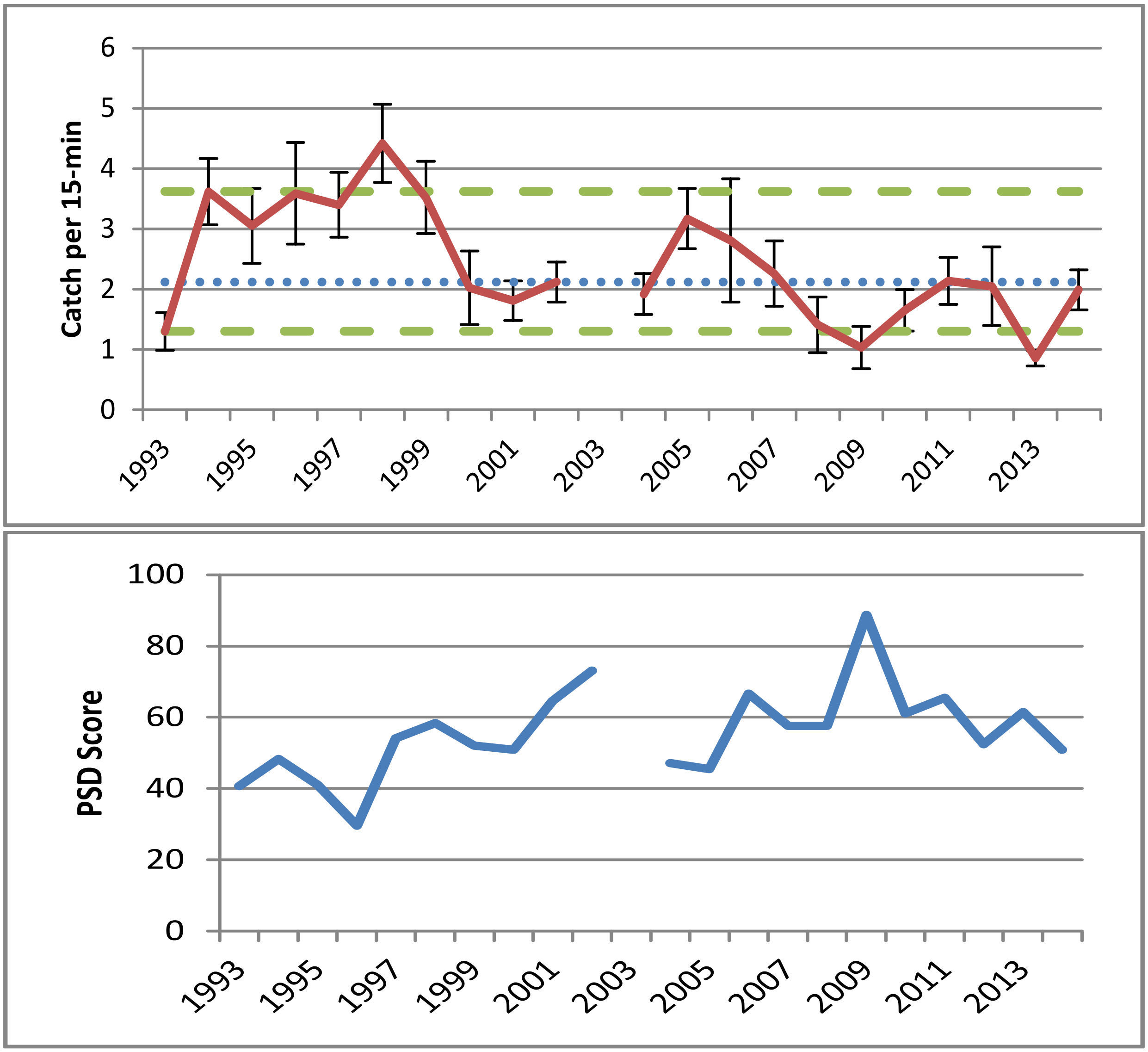


Figure 17. Catch per unit effort (± 1SE) and proportional stock-density of smallmouth bass collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRMP. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2014).

Walleye

Walleye CPUE has remained stable and low for essentially the past fifteen years of LTRMP sampling (Figure 18). High CPUE was observed in 1994, 1997 and 1998, and again in 2007. Walleye PSD values depict a stable pattern over time, with scores ranging from about 40 to 80. In 2014, PSD was 50, perhaps indicating at least a modest hatch, along with some adult fish.

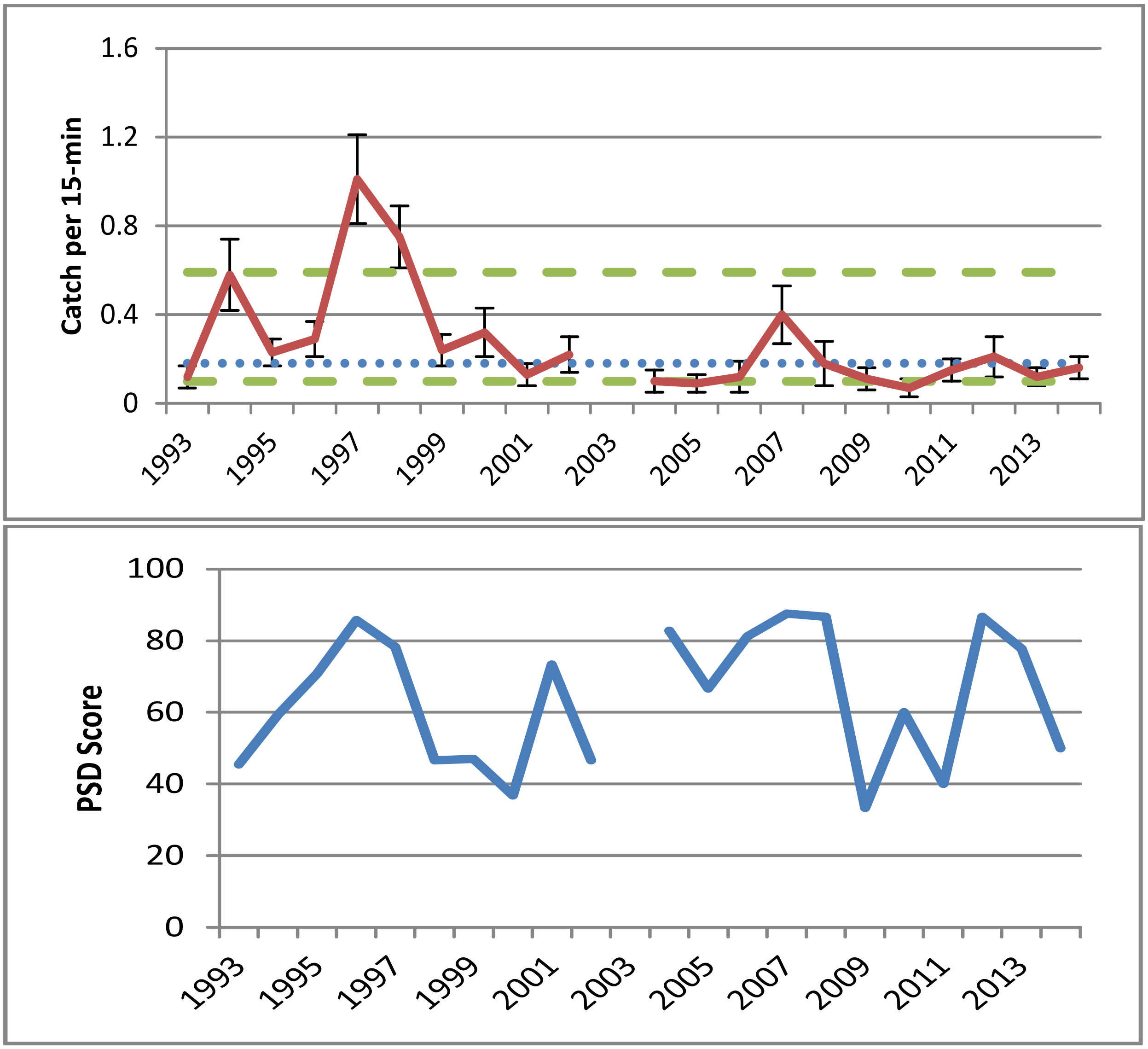
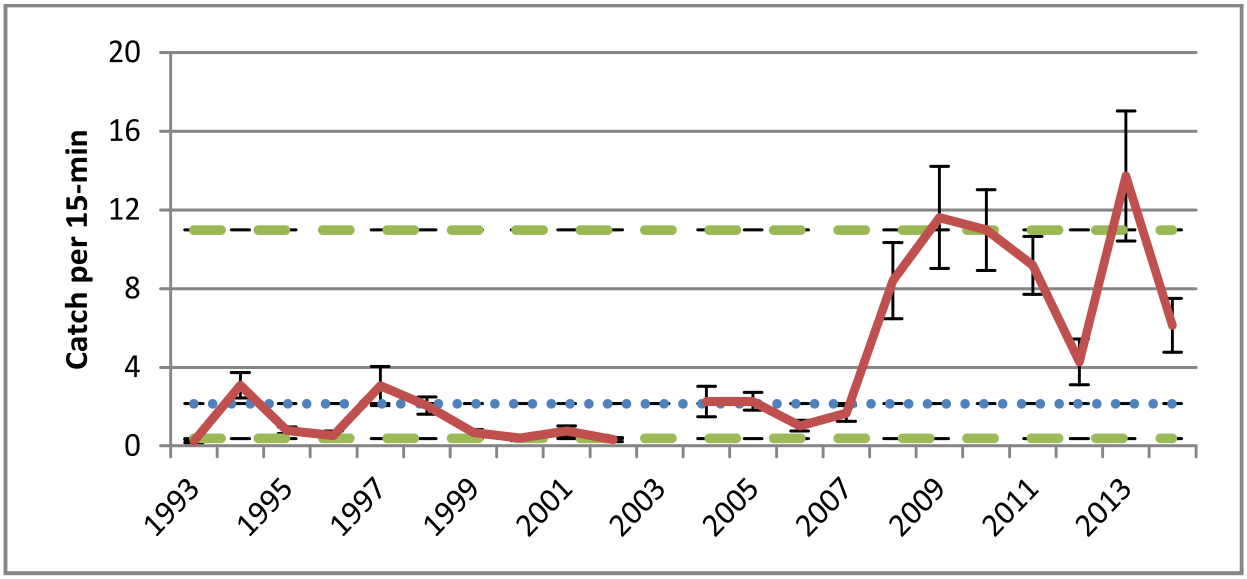


Figure 18. Catch per unit effort(± 1SE) and proportional stock-density of walleye collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRMP. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2014).

Yellow perch

Catch rates for yellow perch have fluctuated widely over the past ten years (Figure 19). 2014 CPUE was down from 2013, which had the highest level for the period of record. Because of the relative scarcity of these fish during the first decade of the program, CPUE was still above average. PSD values also continued to fluctuate, with a low value in 2014 indicating mostly small fish sampled.



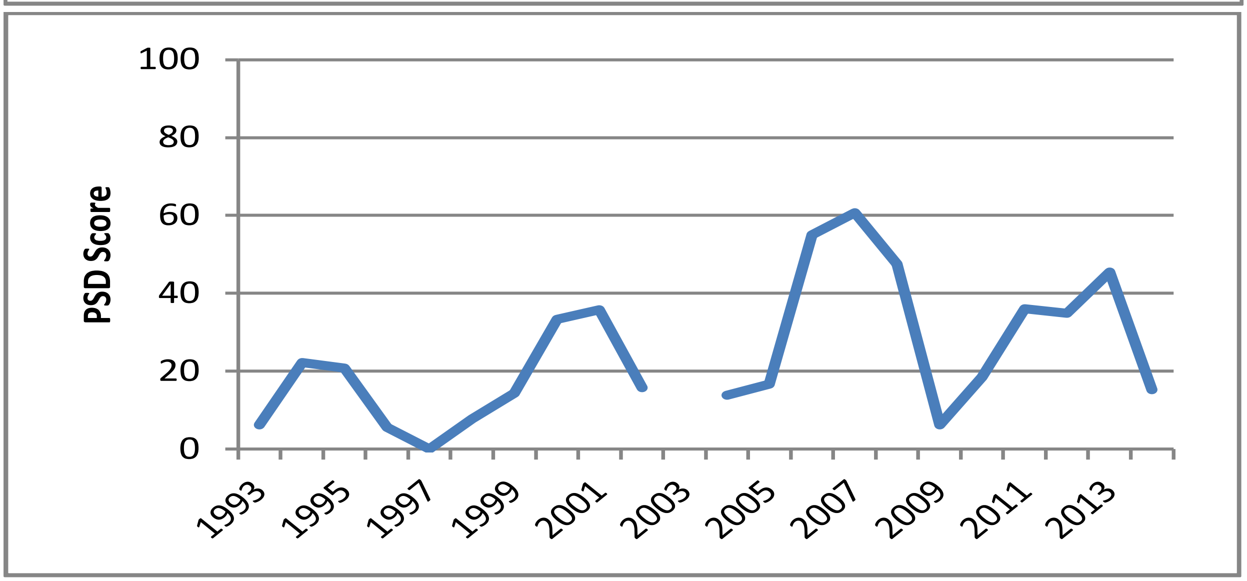


Figure 19. Catch per unit effort (± 1SE) and proportional stock-density of yellow perch collected by day electrofishing in Navigation Pool 8, Upper Mississippi River, by the Upper Mississippi River Restoration – EMP-LTRMP. The long dashed lines represent the 10th and 90th percentiles and the dotted line represents the long-term average for the period of record (1993-2014).

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