

# Smallmouth Bass and Muskellunge Fisheries in Three Northwestern Wisconsin Rivers



## “Guide to the Future” Project Report, 2013

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# **Table of Contents**

Summary of Major Findings.....	3
Introduction and Project Objectives.....	4
General Methods.....	4
Description of Angling Effort.....	7
Effect of Angler Skill on Catch Rates.....	9
Relative Abundance, Size Structure, and Distribution of Smallmouth Bass.....	12
Relative Abundance, Size Structure, and Distribution of Muskellunge.....	14
Muskellunge Encounters vs. Muskellunge Catch.....	16
Abundance and Distribution of Other Species.....	17
Effects of Season and River Discharge on Catch Rates.....	19

## **Acknowledgements**

Scott Braden (WDNR) provided assistance with data entry and management.

## Summary of Major Findings

- Predictable differences in catch rate among anglers with different skill levels were observed for both smallmouth bass and muskellunge. Understanding these differences is necessary to control against biased interpretation. Correction factors may be developed after several years of data provide the requisite sample size, but such corrections have not been applied in this report.
- Angler catch rates of smallmouth bass on the Flambeau River were significantly higher than on the Namekagon or Chippewa rivers for a second straight year. This difference was largely driven by high catch rates of smallmouth bass less than 14 inches long. Catch rates of legal-size smallmouth bass ( $\geq 14$  inches) in the Flambeau River were higher in 2013 than in 2012 and similar to catch rates of larger fish in the other rivers, suggesting that the relatively lower size structure indices in the Flambeau River in 2012 may have been related more to a strong upcoming year class than to slow growth rates as initially hypothesized.
- Anglers fishing these rivers with guides experienced catch rates for both muskellunge and smallmouth bass that were 2-3 times higher than the northern Wisconsin average for unguided anglers on lakes.
- Anglers targeting muskellunge encountered 2-3 muskellunge for every one caught.
- Northern pike were a common incidental catch but their distribution in these three rivers is patchy and appears to be concentrated in areas with more slack water and aquatic vegetation.
- Walleye and largemouth bass were rarely caught on these guided trips.
- Catch rates for smallmouth were highest in August in 2013. The peak for smallmouth catch rates in 2012 was July. The difference between the two years might be related to the warm weather observed early in 2012 and the late spring in 2013. There was no monthly trend in muskellunge catch rates but most effort was exerted in the fall (September-November).
- River discharge had a negative effect on smallmouth bass fishing on the Namekagon River but had no influence on catch rates of muskellunge on the Namekagon. Fishing for smallmouth bass and muskellunge did not appear to be impacted by discharge on the Flambeau or Chippewa rivers.
- Change in water level (rising, falling, or stable over a 3 day period) did not affect muskellunge catch rates on all three rivers combined or smallmouth bass catch rates on the Namekagon or Flambeau. Catch rates for smallmouth bass on the Chippewa River were higher when water was falling compared to when it was stable. In general, water level had less of an impact on fishing success than expected, although it should be noted that days with extreme discharge or change in water level were usually not fished.

## **Introduction and Project Objectives**

Medium and large rivers often hold exceptional and popular recreational sportfish populations. In northern Wisconsin rivers, smallmouth bass and muskellunge are the dominant sportfish, though northern pike are present and walleye can be important seasonally. Due to a variety of factors including current, water clarity, structural complexity, and access, these river fish populations are not easily (or representatively) sampled by traditional fisheries methods such as netting or electrofishing. On an experimental and voluntary basis the Wisconsin Department of Natural Resources (WDNR) enlisted a group of river fishing guides who completed hundreds of fishing trips on these rivers annually with their clients in 2012 and 2013 while targeting smallmouth bass and muskellunge using flyfishing gear. Records of the effort and catch from these fishing trips can provide important information on relative abundance and size structure of river populations of smallmouth bass and muskellunge in a manner that is efficient to the monitoring agency (WDNR) and informative to the guides, their clients, and the general public. In the second year of this project, we enlisted six guides from the Hayward Fly Fishing Company to collect data on the Flambeau, Chippewa, and Namekagon rivers (Price, Sawyer, Rusk, Washburn, and Burnett counties). The data can be used to inform management decisions regarding fishing regulations, access, and fish passage.

## **General Methods**

WDNR personnel and guides met and developed the following protocol for data collection. For each trip, the guide recorded the catch for each client (typically one or two people) separately. Because skill level for each angler was expected to vary, guides discreetly rated their clients as inexperienced beginners, average anglers, or experts. These classifications were used later to standardize and interpret data. Each guide recorded daily water temperature, which was measured in a shaded portion of the river near noon. Guides also recorded “mitigating conditions” (foul weather, challenging water level, off-color water, etc.) that they judged may have negatively impacted fishing success. Fly-fishing gear was used exclusively, and all flies had single barbless hooks (some muskellunge flies had a second, trailing single hook).

There was no set schedule or locations that guides were asked to follow with their fishing activities. However, as a result of the use of logical access points, fishing trips were assigned to “reaches” within each river with set start and end points. In this report these are labeled with the river name (or abbreviation) and a number corresponding to the relative downstream location of the reach within that river (e.g., Chippewa 4 is downstream from Chippewa 3). To protect the proprietary information of these guides, the specific start and end points of each reach are not presented in this report but are known to WDNR personnel. Individual reaches were rarely fished on sequential days. Data collection began in late June during the 2012 pilot season, but in 2013 data were collected during the entire gamefish season beginning on May 4. Three rivers were fished enough to provide useful information for this report – the Flambeau (Price and Sawyer counties), Chippewa (Sawyer and Rusk counties), and Namekagon (Sawyer, Washburn, and Burnett counties).

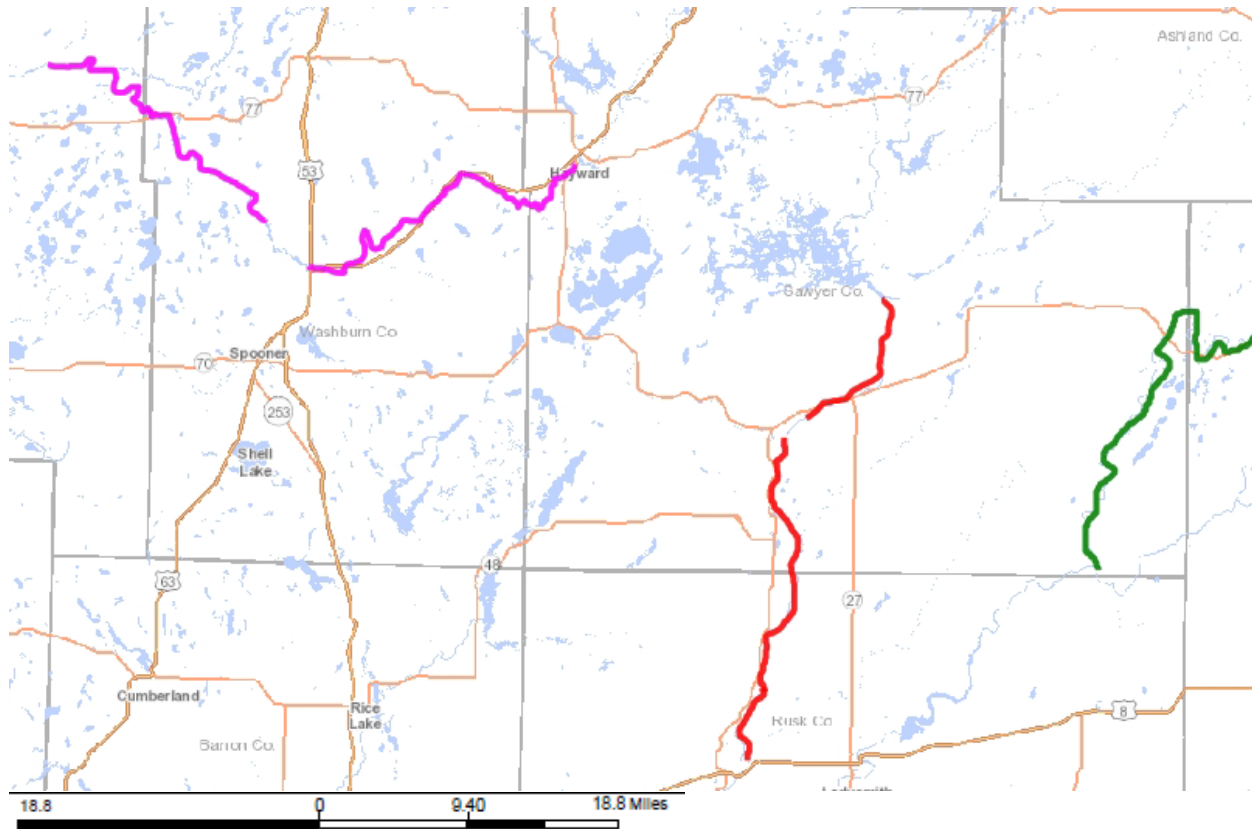


Figure 1. Area fished by guides on the Namekagon (purple), Chippewa (red), and Flambeau (green) rivers in 2012 and 2013.

Each captured fish was recorded on a labeled 12-key mechanical counter (MC-12 counters purchased at <http://store.controlconceptsusa.com> for \$383.00 each) corresponding to the angler that caught the fish. Four sizes of smallmouth bass (7-11, 11-14, 14-17, and >17 inches) and muskellunge (20-30, 30-40, 40-50, and >50 inches) were recorded. Fish were not always measured but were assigned to these bins by guides based on their ability to estimate length. Guides also recorded catches, but not sizes, of northern pike, walleye, and largemouth bass.

Having two weather-resistant mechanical counters in each drift boat greatly facilitated data recording by guides who needed to remain focused on boat control, client safety, and client satisfaction (measuring and photographing fish) rather than spending time recording individual catches or encounters on paper data forms. Guides found it convenient to simply push a button

during moments of peak activity (especially in fast water or bad weather), then complete their data forms carefully after tallying results from the counters at the end of the day.

“Encounters” with muskellunge were recorded whenever a fish followed but did not strike, struck and missed, or was lost after hooking but before landing. Such events are believed to contribute to the quality of fishing for trophy species like muskellunge even when no fish are actually caught. If there were multiple encounters with what was believed to be the same fish, only one encounter was recorded.

Data on river discharge was obtained from USGS gauges on the Namekagon River (Leonard School) and Chippewa River (Bishop’s Bridge), and from a database maintained by Flambeau River Papers at their dam on the Flambeau River (accessed through DNR WAMS database). These gauges were determined to provide the most representative description of conditions that guides encountered on these rivers. Daily discharge (cubic feet per second) was recorded for each day of fishing using the noon measurement from the gauges. Short-term variation in discharge was calculated and expressed as the most recent 3-day change in discharge (noon discharge 3 days prior minus noon discharge on day of fishing). Based on this calculation, river conditions on each day of fishing were classified as either falling ( $\geq 15\%$  drop in discharge over 3-day period), stable ( $< 15\%$  change in discharge over 3 day period), or rising ( $\geq 15\%$  increase in discharge over 3-day period). This classification system was used to determine the effects of river discharge on catch rates for both 2012 and 2013.

All data were entered into an Excel database and analyzed using R software. Trips when guides noted “mitigating conditions” as described above were excluded from all analyses unless specified otherwise. Analysis of variance (ANOVA) with a Tukey means separation technique was used to determine statistical differences in response variables (e.g., catch rate) among levels of class variables (e.g., river). Results of statistical tests were considered significant at  $P$  values less than 0.05 (less than a 5% chance of incorrectly concluding a tested difference was real).

## Description of Angling Effort



In 2013, data were recorded from 323 anglers totaling 1,306 hours of smallmouth bass effort and 1,043 hours of muskellunge effort. Including only days without mitigating conditions, the Flambeau River was fished for 493 hours (152 smallmouth bass and 341 muskellunge), the Chippewa River was fished for 588 hours (279 smallmouth bass and 309 muskellunge), and the Namekagon River was fished for 1,115 hours (747 smallmouth bass and 368 muskellunge). Reaches fished totaled 56 river-miles on the Namekagon, 39 on the Chippewa, and 37 on the Flambeau (Figure 1).

Guides felt that 128 hours of smallmouth bass effort and 40 hours of muskellunge effort occurred on days when conditions mitigated angling success. Guides identified water level fluctuation as the most common mitigating factor in 2013.

The most common angler skill rating assigned by guides was “average” for 126 anglers, while 68 were rated as beginners and 106 were rated as experts. Expert anglers were more interested in targeting muskellunge than average or beginning anglers. Among the three angler skill levels, there were 466 hours fished by inexperienced beginners (321 for smallmouth and 144 for muskellunge), 922 hours fished by average anglers (510 for smallmouth and 412 for muskellunge), and 807 hours fished by expert anglers (345 for smallmouth and 462 for muskellunge). In 2013 there were only minor differences in the guide-rated skill level of anglers among the three rivers (Figure 2).

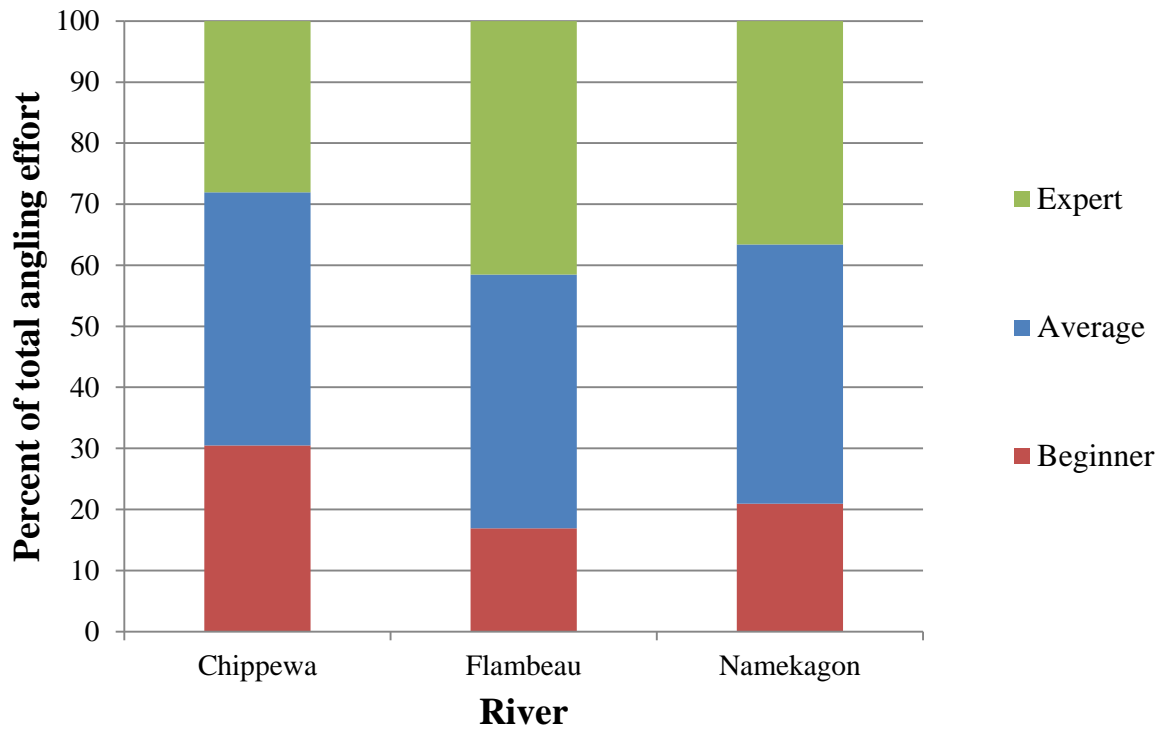


Figure 2. Guide-rated angler skill level, by river, in 2013.



## Effect of Angler Skill on Catch Rates



Angler skill level had a significant effect on catch rates of smallmouth bass (all sizes). As expected, the mean catch rate of experts was significantly higher than that of inexperienced beginners ( $P < 0.01$ , Figure 3). Average anglers were intermediate and did not have significantly higher mean catch rates than inexperienced beginners ( $P = 0.09$ ) or lower catch rates than expert anglers ( $P = 0.16$ ).

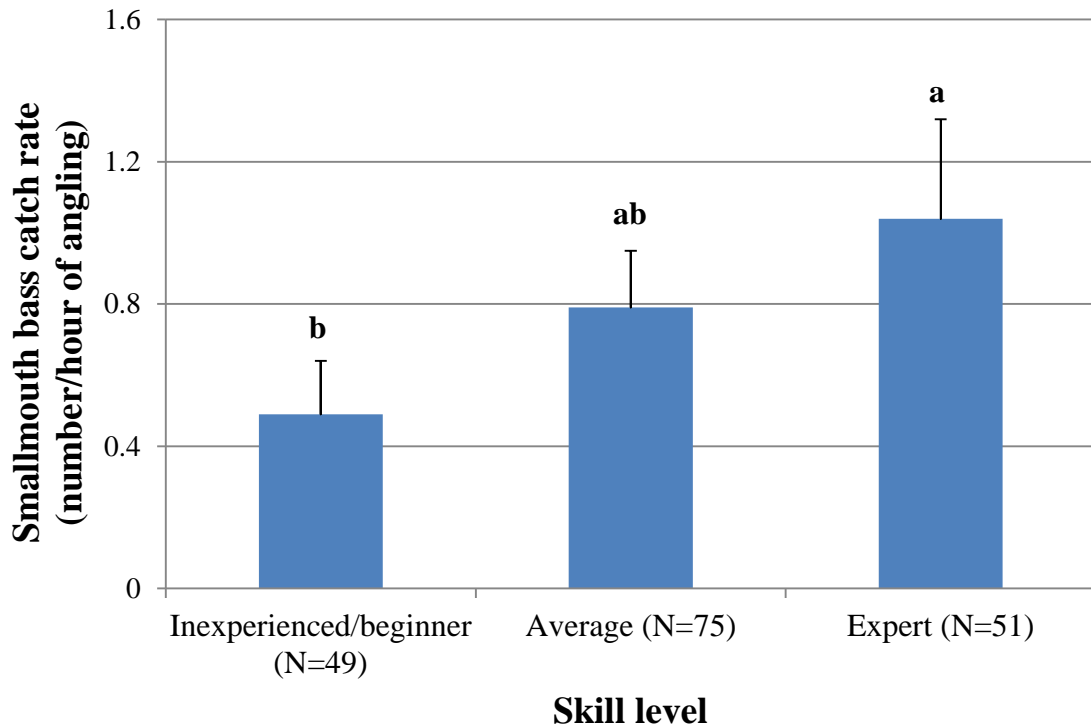


Figure 3. Catch rates of smallmouth bass targeted by guided anglers of different skill levels in three northwestern Wisconsin rivers in 2013. Error bars represent 95% confidence intervals about the mean. Sample size (N) is shown in parenthesis. Significantly different groupings ( $P < 0.05$ ) are denoted with different letters.

Angler skill level had a similar effect on catch rates of muskellunge (all sizes), with expert anglers exhibiting higher catch rates than inexperienced beginners ( $P = 0.04$ , Figure 4). Average-rated anglers had catch rates that were intermediate and not significantly different than the other two skill classes ( $P = 0.70$  compared to beginners and  $0.07$  compared to experts).

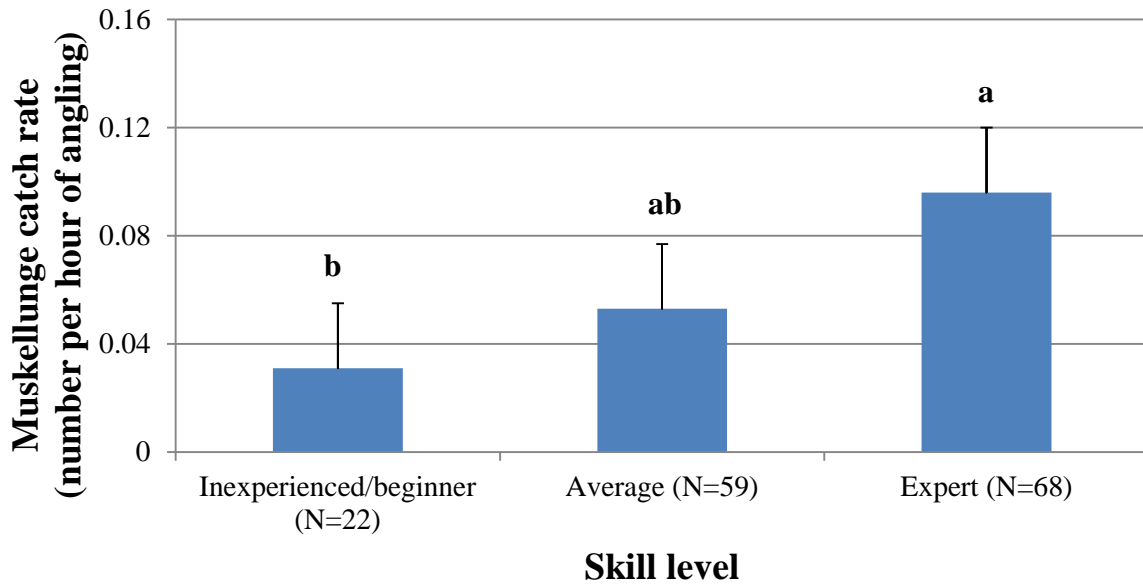


Figure 4. Catch rates of muskellunge targeted by guided anglers of different skill levels in three northwestern Wisconsin rivers in 2013. Error bars represent 95% confidence intervals about the mean. Sample size (N) is shown in parenthesis.

In the future there may be justification for developing a correction factor to this data to account for average angler skill level if significant differences are detected among strata (e.g., if expert anglers fish one river far more than another). Development of such a correction factor should be based on as much data as possible. In 2012, skill ratings were not assigned to a large proportion of trips. We will continue to monitor differences in catch rate among anglers of different skill levels, and we will emphasize that these ratings be assigned to all anglers for which data are collected. This information is critical to understanding and compensating for potential biases in the dataset. In this report, comparisons are made without the application of a correction factor. Our most common comparisons are catch rates among rivers; and because angler skill ratings were within 15% of one another on all rivers in 2013, we do not perceive skill level to have been a major factor influencing comparative results to date.

## Relative Abundance, Size Structure, and Distribution of Smallmouth Bass



Smallmouth bass were the most frequently caught gamefish in most reaches fished by volunteer guides during this project. Average catch rate of smallmouth bass for guided fly fishers in these rivers was close to one fish per hour of angling, far exceeding average angler catch rate of smallmouth bass on northern Wisconsin lakes (~one fish per three hours of directed effort).

We observed significant differences in catch rates of smallmouth bass among the Flambeau, Chippewa, and Namekagon rivers. Average catch rate of smallmouth bass was significantly higher in the Flambeau River than in the Chippewa and Namekagon rivers ( $P < 0.01$ , Table 1). This difference was largely the result of a particularly high catch rate of sublegal smallmouth bass in the Flambeau. Unlike results from the 2012 angling season, catch rates of smallmouth bass greater than 14 inches in length were as high in the Flambeau River as in the other two rivers. These results suggest that the relatively poor size structure observed in the Flambeau River catch in 2012 may not have been indicative of slow growth rates as initially hypothesized. The recent appearance of more smallmouth bass over 14 inches may simply indicate that a large year class of smallmouth bass began to exceed 14 inches in 2013, or that large smallmouth bass were occupying different habitats in 2012 than in 2013.

Table 1. Catch rates (fish per hour) of smallmouth bass targeted by guided anglers, by size class, on three northwestern Wisconsin rivers in 2013. Significantly different groupings ( $P < 0.05$ ) are denoted with different letters.

Smallmouth bass size class	River			P Value
	Chippewa	Flambeau	Namekagon	
7-11 inches	0.26 ( $\pm 0.12$ )b	0.61 ( $\pm 0.22$ )a	0.14 ( $\pm 0.04$ )b	<0.01
11-14 inches	0.19 ( $\pm 0.08$ )b	0.57 ( $\pm 0.21$ )a	0.15 ( $\pm 0.03$ )b	<0.01
14-17 inches	0.20 ( $\pm 0.10$ )	0.31 ( $\pm 0.15$ )	0.24 ( $\pm 0.06$ )	0.46
17+ inches	0.05 ( $\pm 0.03$ )	0.03 ( $\pm 0.05$ )	0.13 ( $\pm 0.06$ )	0.10
<b>All sizes</b>	<b>0.70 (<math>\pm 0.17</math>)b</b>	<b>1.53 (<math>\pm 0.50</math>)a</b>	<b>0.66 (<math>\pm 0.13</math>)b</b>	<b>&lt;0.01</b>

Size structure of angler-caught smallmouth bass was generally similar between the three rivers in 2013 (Figure 5). However, catch rate of memorable-size smallmouths ( $\geq 17$  inches) showed indications of being higher in the Namekagon than in the other rivers for the second straight year, but this difference was not statistically significant in 2013 ( $P = 0.10$ ) at the chosen level of tolerance ( $P = 0.05$ ) for drawing a false conclusion. In the Namekagon, 56% of all smallmouth bass captured by anglers were  $\geq 14$  inches, while only 36% and 22% were of legal size in the Chippewa and Flambeau rivers, respectively. Results from 2012 showed greater differences in size structure among these rivers than was evident in the 2013 data. Further data will be needed to determine whether these patterns mirror actual characteristics or detect actual changes in these bass populations. Estimating growth rate of smallmouth bass in these three river systems would be a worthwhile analysis to complement and inform these results.

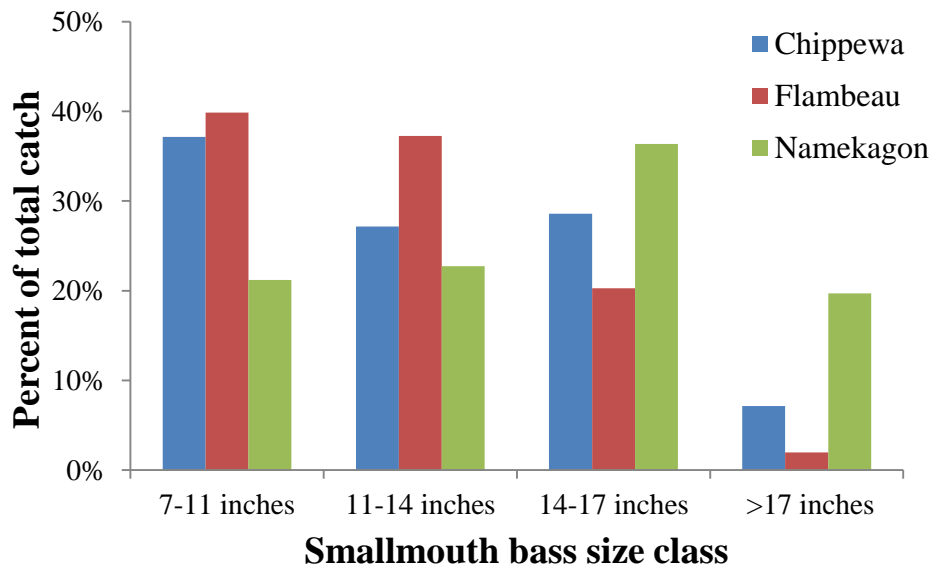


Figure 5. Relative size structure of smallmouth bass caught by guided anglers in three northwestern Wisconsin rivers in 2013.



## Relative Abundance, Size Structure, and Distribution of Muskellunge



Average catch rate of muskellunge in 2013 was significantly higher in the Flambeau River than in the Chippewa and Namekagon rivers ( $P = 0.01$ , Table 2). This difference was driven by high catch rates of muskellunge in the 20-30 inch size class in the Flambeau. There were no other significant differences in catch rate of other size classes among rivers. Overall, muskellunge catch rate averaged 1 fish per 14 hours of angling in 2013, which compares very favorably to the Wisconsin statewide average (1 musky per 34 hours of angling effort) and to many Sawyer County lakes (Chippewa Flowage = 54 hours, Teal Lake = 24 hours, Spider Lake Chain = 13 hours).

Table 2. Catch rates (fish per hour) of muskellunge targeted by guided anglers, by size class, on three northwestern Wisconsin rivers in 2013. A total of 72 muskellunge were caught by guided anglers in 2013.

Muskellunge Size class	River			P Value
	Chippewa	Flambeau	Namekagon	
20-30 inches	0.017 ( $\pm 0.014$ ) <sup>b</sup>	0.072 ( $\pm 0.031$ ) <sup>a</sup>	0.028 ( $\pm 0.023$ ) <sup>b</sup>	0.01
30-40 inches	0.011 ( $\pm 0.011$ )	0.040 ( $\pm 0.021$ )	0.029 ( $\pm 0.018$ )	0.07
40-50 inches	0.003 ( $\pm 0.005$ )	0.005 ( $\pm 0.008$ )	0.005 ( $\pm 0.006$ )	0.84
50+ inches	0.000 ( $\pm 0$ )	0.000 ( $\pm 0$ )	0.000 ( $\pm 0$ )	NA
<b>All sizes</b>	<b>0.031 (<math>\pm 0.016</math>)<sup>b</sup></b>	<b>0.118 (<math>\pm 0.037</math>)<sup>a</sup></b>	<b>0.061 (<math>\pm 0.031</math>)<sup>b</sup></b>	<b>&lt;0.01</b>

Muskellunge between 20 and 40 inches long dominated the catch; and there was no apparent difference in size distribution among the three rivers (Figure 6). Each river produced several fish over 40 inches long. Sampling in 2013 did not produce any 50-inch fish, but angler accounts and prior catch records suggest these rivers certainly have the potential to produce trophy-size fish.

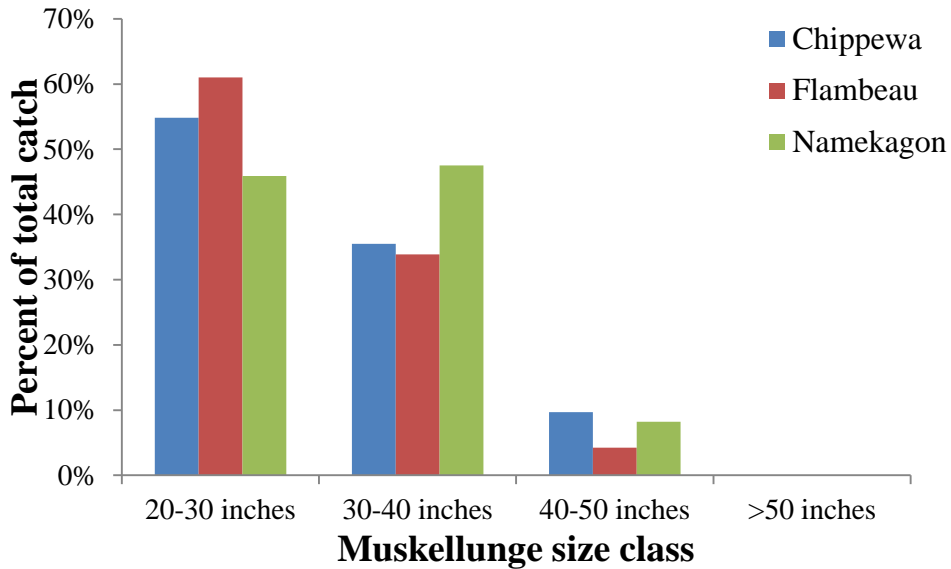


Figure 6. Relative size structure of muskellunge caught by guided anglers in three northwestern Wisconsin rivers in 2013.

## Muskellunge Encounters vs. Muskellunge Catch

Guides recorded encounters with muskellunge that did not result in fish being landed. “Encounters” were defined as follows, strikes, and fish hooked but lost before they could be fully subdued and intentionally released. Stratifying results by angler skill level allowed us to quantify an element of musky fishing quality and proficiency that typically goes undocumented. On average, two to three muskellunge were encountered for every fish caught (see “Capture frequency” column in Table 3). Applying this ratio to the average catch rate of one fish every 14 hours, guided anglers who targeted muskellunge were encountering (and sometimes catching) a fish every 5 hours on these rivers.

In 2013 expert anglers and inexperienced anglers had similar capture frequencies for the muskellunge they encountered. However, the estimate of capture frequency for inexperienced anglers is based on a very low sample size. We hypothesize that expert anglers have better odds than beginners of “moving” fish that are not aggressively feeding. This leads to a higher encounter rate (1 encounter every 3.9 hours for experts and every 13 hours for beginners) but also anchors the overall capture frequency for experts at a level that is similar to beginners. Overall capture success rate across all skill ratings in 2013 was 36%, which is an increase over the observed rate in 2012.

Table 3. Summary of muskellunge catches and encounters among anglers with different skill levels in three northwestern Wisconsin rivers in 2012 and 2013.

Capture frequency = fish caught / total encounters + fish caught x 100.

Year	Skill level	Fish caught	Fish encountered but not caught	Total encounters + fish caught	Capture frequency
2012	Inexperienced	2	7	9	22%
	Average	4	28	32	13%
	Expert	15	44	59	25%
	Not assigned	49	124	173	28%
	Total/Average	70	203	273	26%
2013	Inexperienced	5	6	11	45%
	Average	23	60	83	28%
	Expert	44	61	105	42%
	Not assigned	0	0	0	NA
	Total/Average	72	127	199	36%



## Relative Abundance and Distribution of Other Species



Northern pike were captured at a higher rate in the Namekagon River than in the Chippewa or Flambeau rivers, but unlike in 2012 the difference was not statistically significant ( $P = 0.12$ , Figure 7). The high catch rate observed for Namekagon River pike was largely driven by the catch in Namekagon reaches 3 and 6 (Figure 8), which have an abundance of large-pool habitat and aquatic vegetation compared with other reaches. In general, catch rates for northern pike were similar to that of muskellunge. Monitoring pike over a long time scale will be important as the climate warms. Predictive models suggest that within a few decades northern Wisconsin rivers, such as the ones fished in this project, will be too warm for northern pike to inhabit.

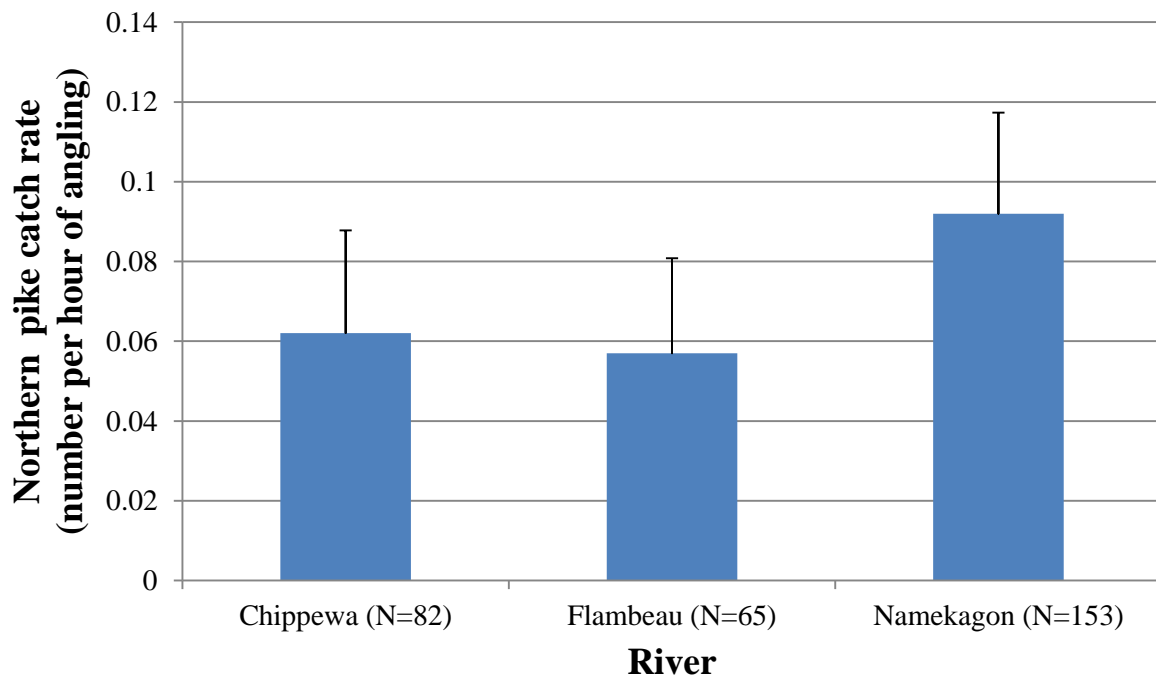


Figure 7. Incidental catch rate of northern pike by guided anglers in three northwestern Wisconsin rivers in 2013. Error bars represent 95% confidence intervals about the mean. Sample size (N angler trips) is shown in parenthesis.

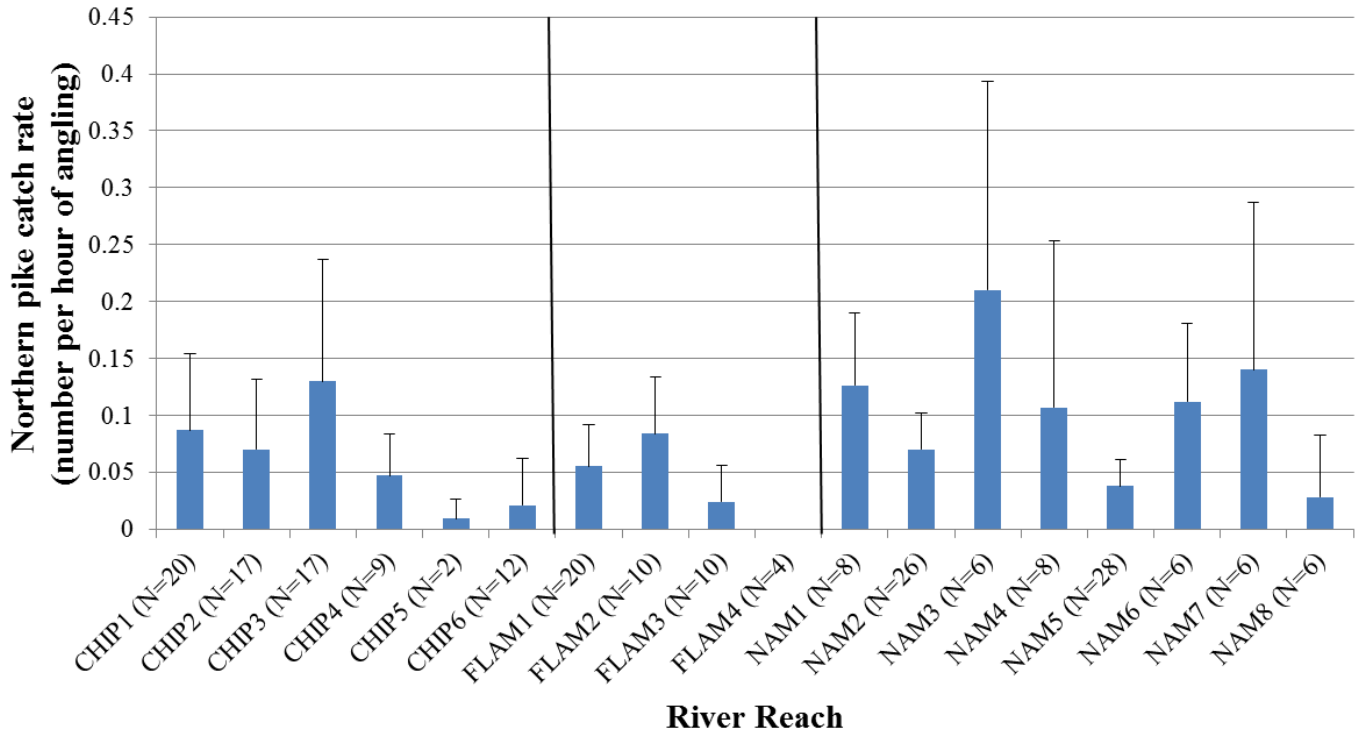


Figure 8. Incidental catch rate of northern pike by guided anglers in different reaches of three northwestern Wisconsin rivers (CHIP = Chippewa, FLAM = Flambeau, NAM = Namekagon) in 2013. Error bars represent 95% confidence intervals about the mean. Sample size (N angler trips) is shown in parenthesis.

Only three walleyes and zero largemouth bass were caught by guided anglers in our 2013 angling season. This probably reflects relatively low abundance of these species during most of the fishing season, but it does not preclude the possibility of high seasonal use of these rivers by walleyes during their early-spring spawning migrations upstream from various flowages. Additional sampling will be needed to determine if assessments of the relative abundance and distribution of these species in rivers will even be possible using guided angler catch data.

## Effects of Season and River Discharge on Catch Rates

Average monthly catch rate of smallmouth bass was highest in August in 2013 (1.3 fish per hour; Figure 9). In 2012 catch rates of smallmouth bass were highest in July. The later peak in catch rate could be the result of the exceptionally late spring in 2013. Surprisingly, catch rates of smallmouth bass in May and June were at or below average, despite the presumed increase in sight-fishing vulnerability of males on nests. Catch rates dropped off significantly in September compared to August. There is increasing evidence that in mid-September smallmouth bass in these reaches move to the nearest flowage or deep hole where they will overwinter.

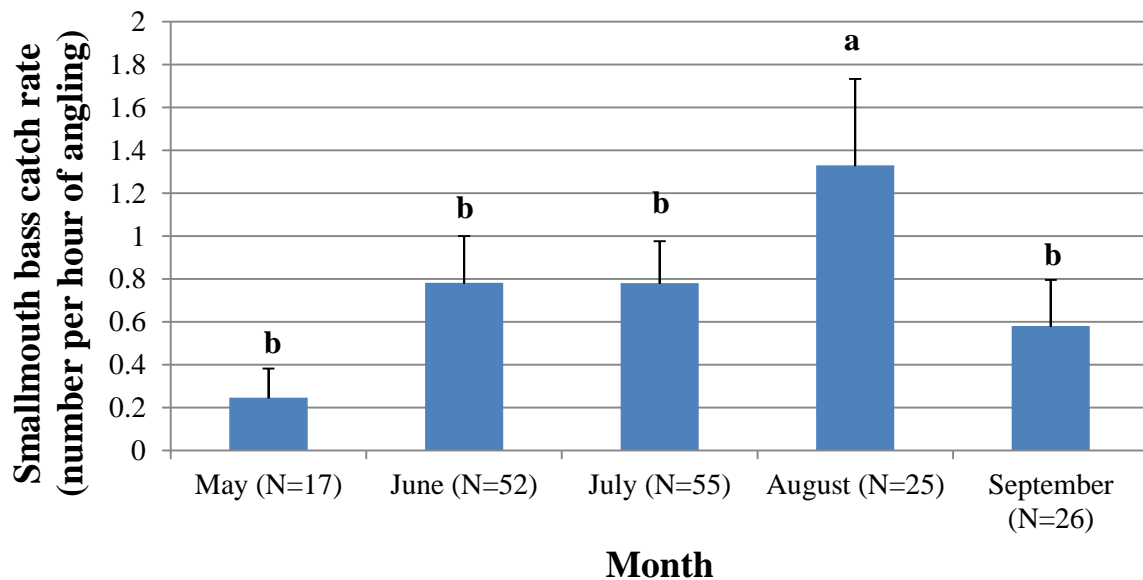


Figure 9. Catch rates of smallmouth bass targeted by guided anglers, by month, in three northwestern Wisconsin rivers in 2013. Error bars represent 95% confidence intervals about the mean. Sample size (N angler trips) is shown in parenthesis. Significantly different groupings ( $P < 0.05$ ) are denoted with different letters.

Average monthly catch rate of muskellunge did not vary significantly, but low sample size (particularly in summer months when guides avoided targeting muskellunge during periods of high water temperature) and high variability in catch rate limited our ability to test for seasonal differences (Figure 10). It was our expectation that muskellunge catch rates would be highest in the fall (September-November) when most of the targeted musky fishing effort occurred, and that pattern was somewhat evident. We will need more summertime musky fishing data in the future in order to determine if there are truly no significant seasonal differences in guided angler catch rates. However, collection of that data is dependant on favorable water temperatures at that time of the year.

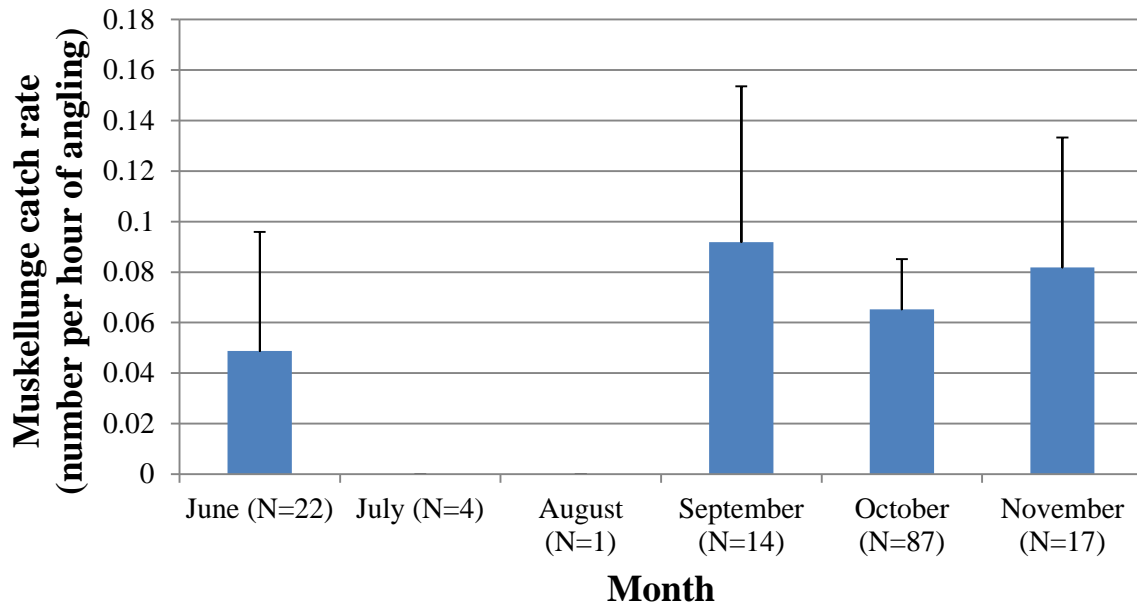


Figure 10. Catch rates of muskellunge targeted by guided anglers, by month, in three northwestern Wisconsin rivers in 2013. Error bars represent 95% confidence intervals about the mean. Sample size (N angler trips) is shown in parenthesis.

### *Catch rates and discharge*

Water level conditions can vary greatly on these river systems from one day to the next. This variation is commonly thought to have a significant influence on fishing success by influencing both fish behavior and gear effectiveness. With two cumulative years of data collection on these three rivers we were able to make some comparisons of fishing quality (measured as catch-per-effort of all sizes of smallmouth bass and muskellunge separately) across different water level and discharge conditions. This analysis included trips when guides noted that water level conditions had the potential to mitigate angling success.

We compared catch rates of smallmouth bass and muskellunge (all sizes for each) to river discharge on all days with fishing recorded in 2012 and 2013 within each individual river.

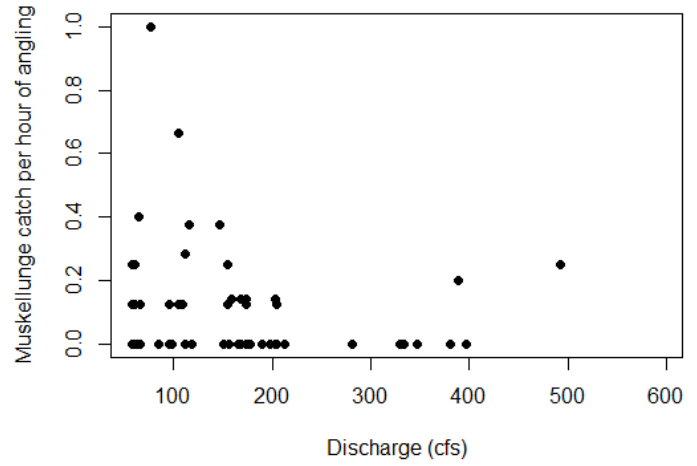
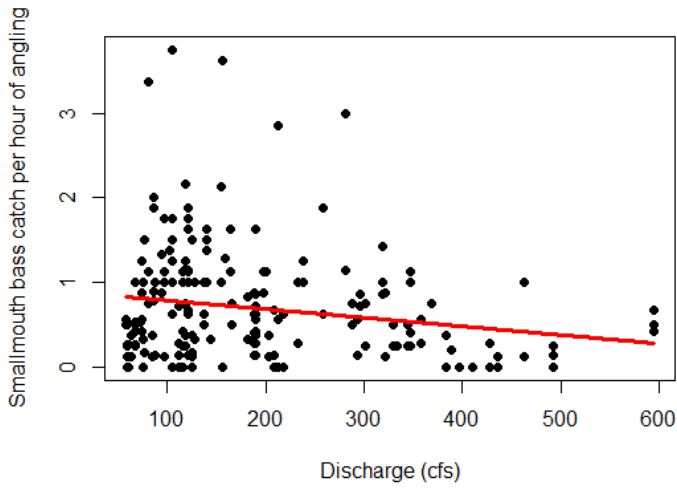
Smallmouth bass catch rates in the Namekagon River were negatively related to river discharge ( $P < 0.01$ , Figure 11). In general, smallmouth bass catch rates were highest at around 100 cfs (measured at the Leonard School Bridge which is roughly 15 miles upstream from the area fished by guides) and declined considerably at flows exceeding 300 cfs. There was no statistically significant relationship between discharge and catch rates of muskellunge ( $P = 0.09$ ).

There was no relationship between river discharge and catch rates of smallmouth bass or muskellunge on the Flambeau River ( $P = 0.50$  and  $0.87$  respectively). Catch rates for both species remained remarkably consistent across a wide range of observed discharges (400-1,600 cfs).

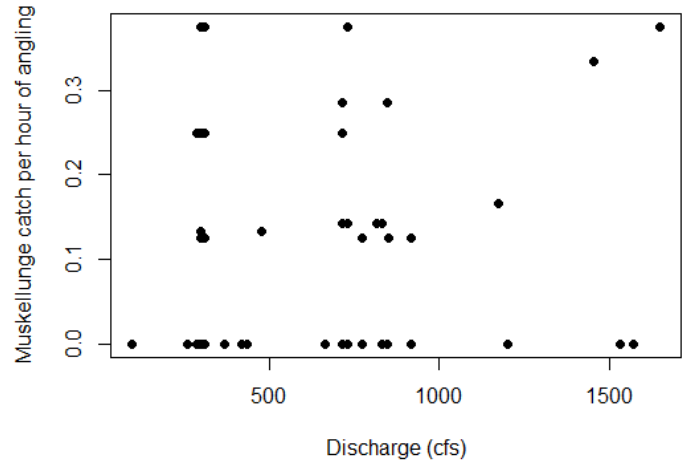
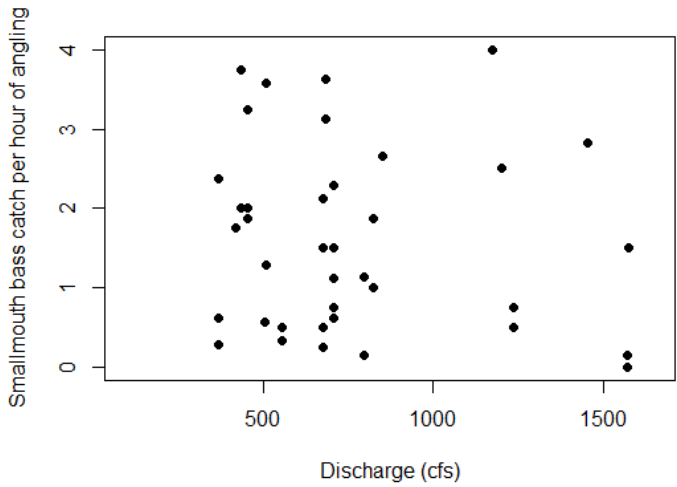
There was no relationship between river discharge and catch rates of smallmouth bass or muskellunge on the Chippewa River ( $P = 0.42$  and  $0.38$  respectively). However, success for muskellunge on the Chippewa River was generally low at discharges exceeding 1,000 cfs.

We are aware that guides avoid fishing these rivers on days with extreme discharge, primarily for safety reasons. But fishing success appears to be unaffected by higher than normal river discharge in most instances. Fishing appears to be affected more by discharge on the Namekagon River than on the Chippewa and Flambeau. Of these three rivers the Namekagon is generally the least regulated by dams, which may provide a clue as to the mechanisms buffering fishing quality on the other two rivers. These patterns should continue to be tracked as more data becomes available. Understanding the relationship between fishing success and river discharge has major implications for water level regulation and dam management practices.

Namekagon



Flambeau



Chippewa

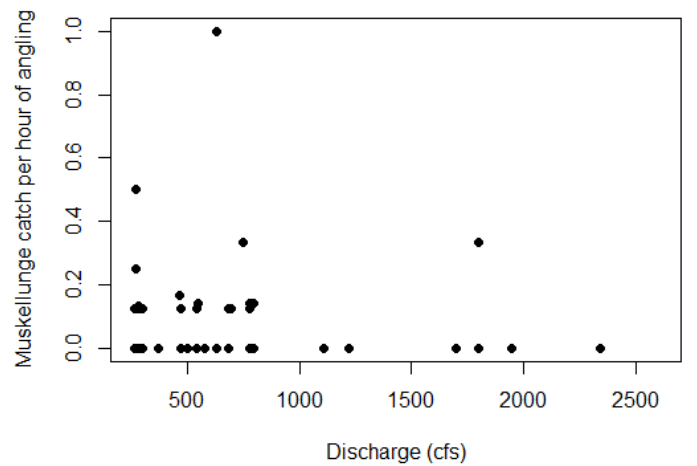
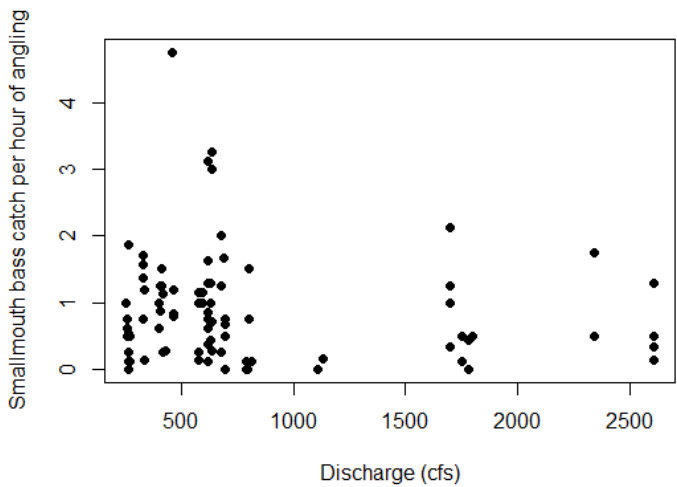
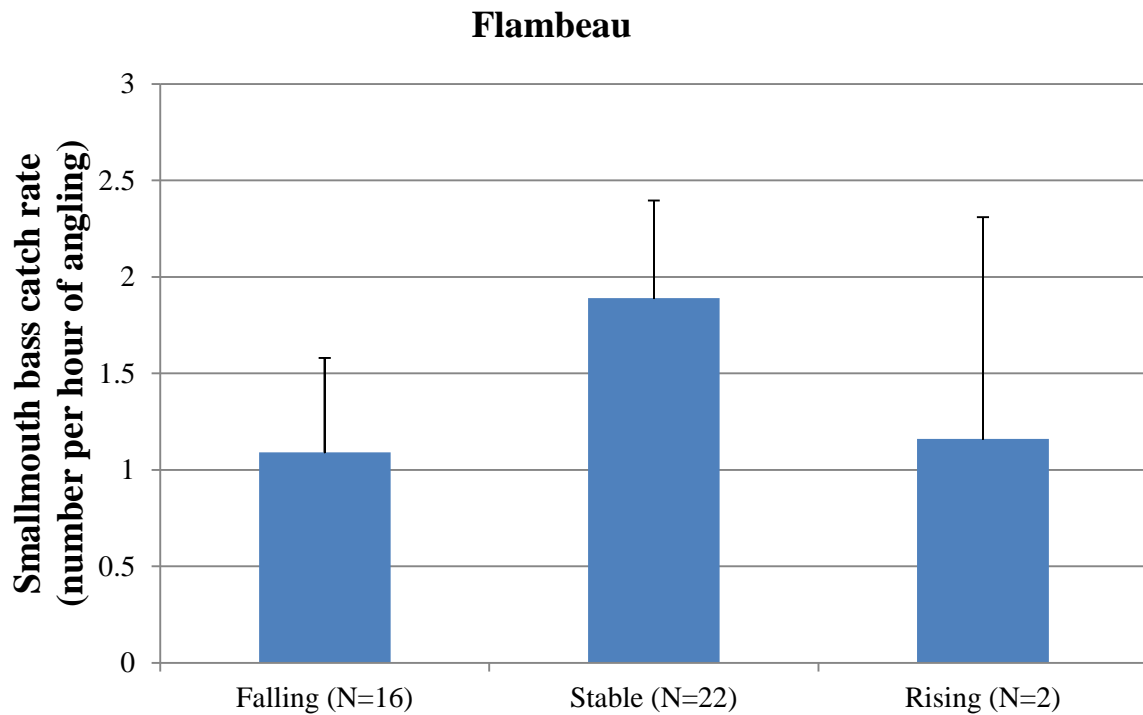


Figure 11. Catch rates of smallmouth bass (left panes) and muskellunge (right panes) across varying levels of river discharge in three northwestern Wisconsin rivers in 2012 and 2013 (combined). A red line indicates a significant trend ( $P < 0.05$ ).

### Changing water levels

Examining two years of data from all three rivers combined, there was no significant difference in angler catch rates of smallmouth bass when water levels were rising, falling, or stable ( $P = 0.70$ ). There were also no statistically significant differences in catch rate among these three water level conditions within the Namekagon or Flambeau rivers individually (Figure 12). In the Chippewa River, however, catch rates were significantly higher during falling water conditions than when water level was stable or rising. Guided trips during rising water levels were rare in all three rivers, which limited this analysis to some extent. In general, participating guides seemed to avoid rising water levels when possible. Our analysis provides some indication that fishing success may not necessarily be altered significantly when water levels are rising by more than 15% over a 3-day span.



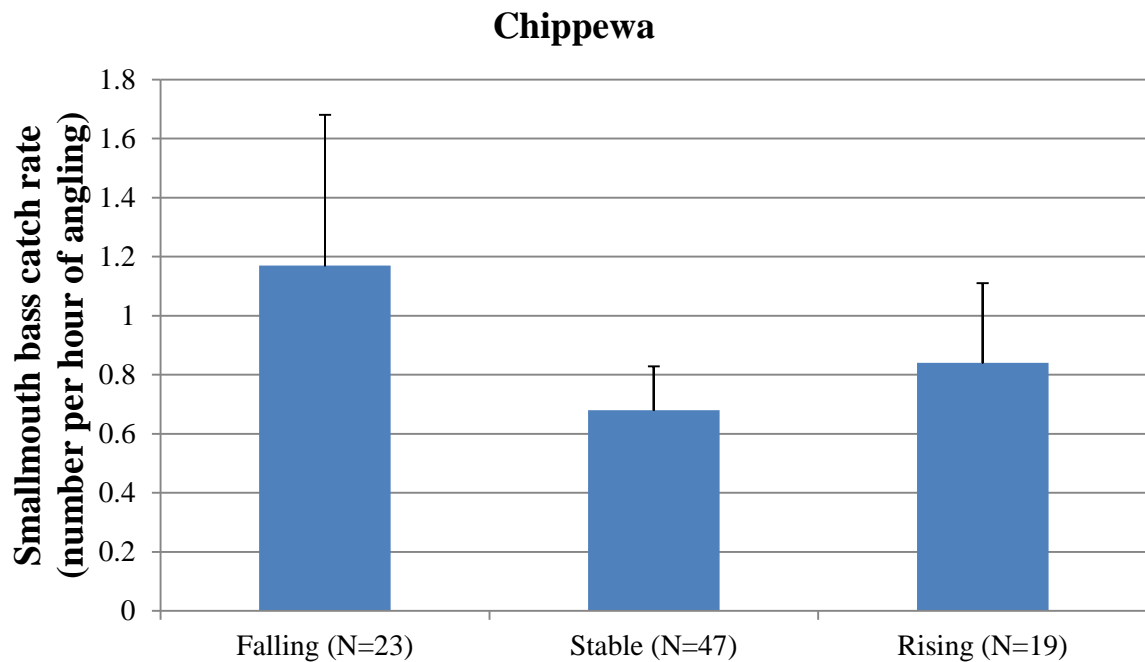
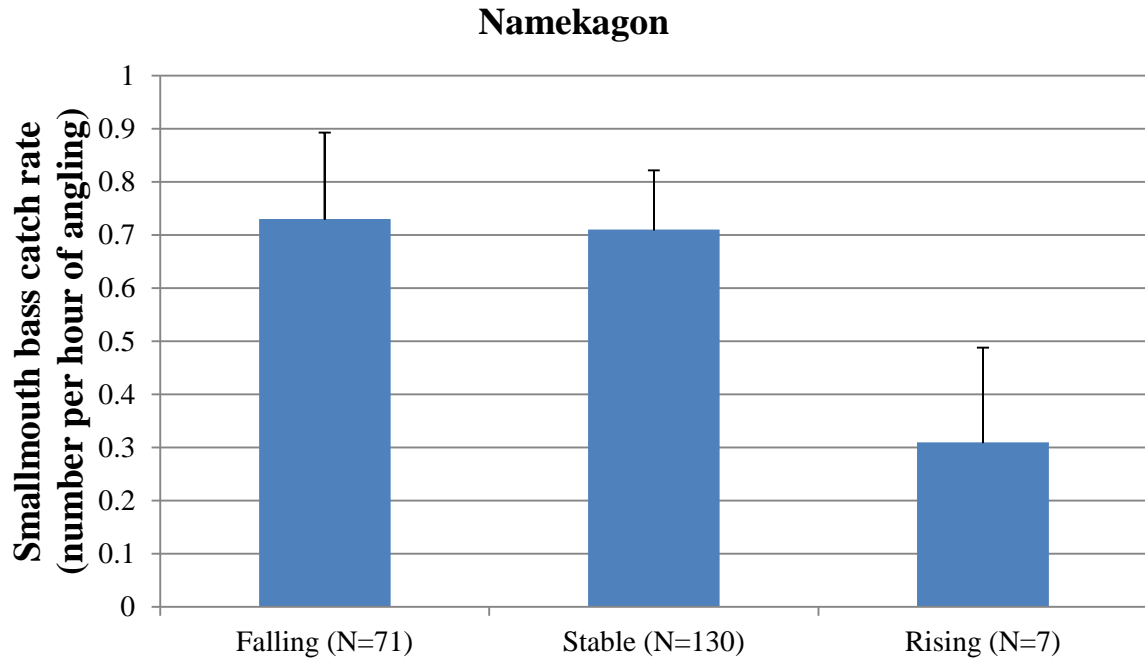


Figure 12. Comparisons of angler catch rates of smallmouth bass on three northwestern Wisconsin Rivers under different water level conditions in 2012 and 2013. Error bars represent 95% confidence intervals about the mean. Sample size (N guided trip days) is shown in parenthesis. Significantly different groupings ( $P < 0.05$ ) are denoted with different letters.



At this time we lack sufficient data to make comparisons of muskellunge catch rate under changing water level conditions within individual rivers. Pooled data from all three rivers revealed that there was no significant difference in catch rate related to water level change ( $P = 0.31$ , Figure 13). It is important to note that a large portion of the muskellunge fishing in this project takes place during a three-month span in the fall, so water level fluctuations are less common in the dataset.

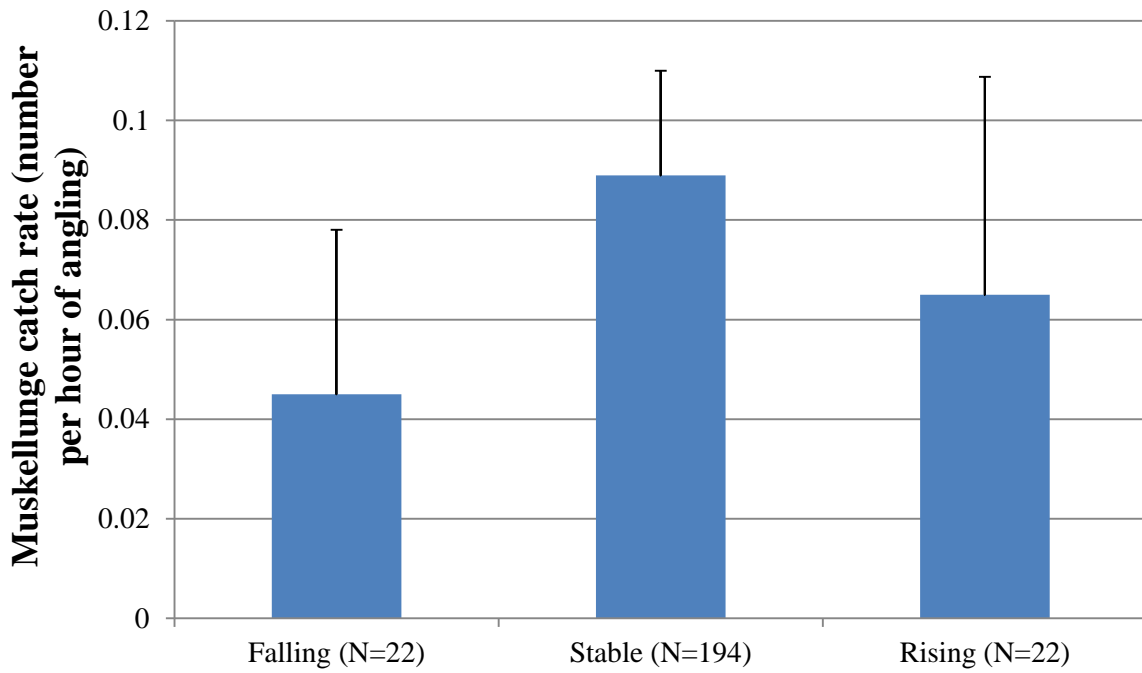


Figure 13. Comparisons of angler catch rates of muskellunge on three northwestern Wisconsin rivers under different water level conditions in 2012 and 2013.