Walleye Movement in the Winnebago System (2011-2013)

Ryan Koenigs, Winnebago Sturgeon Biologist, 16 December 2013

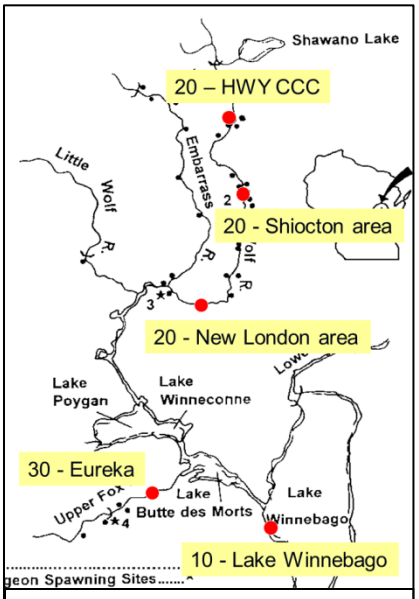
The Winnebago System is home to a nationally recognized walleye fishery that receives substantial angling effort. The general angling public around the system is also heavily engaged in the management program and collaboratively work with DNR fisheries staff to promote, research, and effectively manage the fishery. As part of this collaborative effort, DNR and local fishing clubs conducted a sonic telemetry study to learn more about the movement of adult walleye within the system.

Sonic receiver used to monitor movement of fish implanted with sonic tags.

The project was designed in December of 2010 and included surgical implantation of 100 sonic tags into adult walleye captured throughout the Winnebago System during spring spawning assessments. These tags have a battery life of 900 days and transmit a unique pinging sequence 24 hours a day, 7 days a week. When marked fish swim past one of the 35 stationary receivers (photo insert left) spread throughout the system, the receiver documents the date, time, and tag number (fish number). This technology allows DNR staff to determine the coarse movement patterns of adult walleye in the system, while answering many of the questions that anglers pose about how walleye move throughout the year.

Each acoustic tag carries a cost of $320, meaning that the total price tag of the project was $32,000. Unfortunately our DNR fisheries budget could not cover all of this cost, so fisheries staff inquired to local conservation clubs about contributing to the project. The response was overwhelming and local conservation clubs had donated enough funds to cover the entire cost of the project within one month. This is just one of countless examples of when local stakeholders have stepped up to the plate and provided financial support to the DNR fisheries program. Without this support our crew would not be able to complete nearly as much work as we do.

Due to the financial support, we were able to proceed with the project and all 100 tags were implanted into walleye during spawning assessments conducted in 2011. A total of 60 fish were tagged on the Wolf River, 30 fish on the upper Fox River, and 10 fish from Lake Winnebago (tags were evenly split between males and females at each location). Given the duration of the tags, we were able to monitor the movement of fish from April 2011-October 2013.



Allocation of 100 sonic tags implanted into adult walleye during 2011 spawning assessments.

A project like this provides an exhaustive amount of information that can be difficult to summarize due to each fish exhibiting unique movement patterns. What we can do is summarize how the majority of the fish are moving and acknowledge that there are always going to be outliers. One clear conclusion was that male walleye spend considerable more time in the Wolf and upper Fox Rivers than females (Table 1, Figures 1-4). This should come as no surprise due to the spawning nature of the fish. Male walleye typically move onto spawning marshes well before spawning activity commences and remain there until all spawning has concluded. Females, on the other hand, typically move onto spawning marshes just before they begin ovulating and then leave the marsh to begin their downstream movement shortly after spawning out. Due to this behavior, males remain in the rivers much longer than females, therefore providing the majority of the angling action during the spring spawning runs.

Days in Wolf River (Females)				**Days in upper Fox River (Females)**			
Year	**2011 (27)**	**2012 (17)**	**2013 (13)**	**Year**	**2011 (12)**	**2012 (10)**	**2013 (7)**
Min	11	6	25	Min	4	3	27
Max	62	151	167	Max	71	44	46
Median	18	11	37	Median	14	24	37
Mean	22.8	24.5	46.4	Mean	24.8	22	37.5
Days in Wolf River (Males)				**Days in upper Fox River (Males)**			
Year	**2011 (23)**	**2012 (13)**	**2013 (8)**	**Year**	**2011 (12)**	**2012 (7)**	**2013 (4)**
Min	25	26	52	Min	24	4	33
Max	345	155	133	Max	393	65	53
Median	36	39	78.5	Median	44.5	8	53
Mean	49.4	49.5	86.4	Mean	76.2	17.3	46.3

Table 1. Data demonstrating the number of days (minimum, maximum, median, and mean) that tagged male and female walleye spent in the Wolf and upper Fox Rivers (2011-2013). Numbers in parentheses represent the number of fish included in the analysis for that year.

It was interesting to see where the fish tagged on the upper Fox River spawned following tagging. We intentionally allocated a higher percentage of the tags to the upper Fox River at Eureka than any other location in hope that this tagging effort would provide some insight into where these fish were spawning. For years now, our DNR staff have been able to handle large numbers of fish below the Eureka Dam, but we have been unable to capture many fish in the marshes dispersed between the Eureka and Princeton Dams. The results in 2011 provided some insight, as 6 of the 15 females tagged at Eureka moved upstream of the Princeton Dam and spawned in Lake Puckaway (none of the males exhibited this movement). As Figure 3 indicates, some of these fish remained in Lake Puckaway during the duration of the study. These results demonstrate that fish are able to move upstream of the Princeton Dam in high water years, and that fish are capable of readily moving between Lake Puckaway and the Winnebago System.

The results also showed poor river fidelity across spring spawning runs for fish tagged on the upper Fox River at Eureka. Of the fish marked on the upper Fox River, only one spawned in the Wolf River in 2011. However, river system straying was more prevalent in 2012 and 2013. In fact, of the 12 females initially tagged on the upper Fox River that were still alive in 2012, 3 spawned in the Wolf River and one spawned in the Embarrass River. Further, 2 of the 8 fish still transmitting in 2013 spawned in the Wolf River. Only one male tagged on the upper Fox River spawned in the Wolf River during the study, and none of the fish initially tagged on the Wolf River strayed during any of the spawning runs. Some examples of fish straying between rivers include: fish 44190 spawned in the upper Fox River in 2011, the Embarrass River in 2012, and the Wolf River in 2013; fish 44195 spawned in the upper Fox River in 2011 and 2013, but the Wolf River in 2012; fish 44203 spawned in Lake Puckaway in 2011 and 2012, but spawned in the Berlin area of the upper Fox River in 2013.

Another trend was that a percentage of the fish marked on the Wolf River never moved downstream further than the Upriver Lakes. Females demonstrated this movement more than the males, but fish from both sexes never moved downstream to Lake Winnebago. Fish marked on the upper Fox River were also less likely to remain in the Upriver Lakes than fish marked on the Wolf River.

Overall, females remained in the Upriver Lakes longer than males (Table 2). Two factors contrubute to this trend; 1) females reach the Upriver Lakes earlier because they spend less time in the rivers, and 2) a higher percentage of females remain in the Upriver Lakes throughout the summer. Fish tagged on the upper Fox River also spent less time in the Upriver Lakes than fish marked on the Wolf River, likely due to geographical distribution of the Winnebago System. The Wolf River drains into Lake Poygan and thus fish have to move through all three Upriver Lakes before entering Lake Winnebago. Whereas, the upper Fox River drains to Lake Butte des Morts, meaning that fish only have to move through one Upriver Lake before entering Lake Winnebago.

Days in URL (Females - Wolf)

Year	2011 (18)	2012 (16)
Min	2	1
Max	324	376
Median	16.5	49
Mean	132.3	143.9
NL	8	6

Days in URL (Females - upper Fox)

Year	2011 (12)	2012 (5)
Min	1	1
Max	281	15
Median	3	2
Mean	31.8	4.2
NL	1	0

Days in URL (Males - Wolf)

Year	2011 (23)	2012 (13)
Min	1	2
Max	305	286
Median	12	19
Mean	73.2	68.1
NL	4	2

Days in URL (Males - upper Fox)

Year	2011 (12)	2012 (5)
Min	1	1
Max	304	200
Median	14	32
Mean	59.3	59.4
NL	1	0

Table 2. Data indicating the number of days (minimum, maximum, median, and mean) that tagged male and female walleye spent in the Upriver Lakes (2011-2012). Numbers in parentheses represent the number of fish included in the analysis for that year and NL represents the number of fish that did not move out of Upriver Lakes until the following spring.

Although some fish did remained in the Upriver Lakes throughout the summer, the majority still moved downstream into Lake Winnebago. Most of the walleye that spawned in the Wolf River entered Lake Winnebago during early to mid-May, while the majority of fish that spawned in the Fox River entered Lake Winnebago in mid to late April. Again, this disparity is likely due to where the rivers drain to and that fish from the Wolf River need to move through all three Upriver Lakes to reach Lake Winnebago.

Regardless of when fish reach Lake Winnebago, the telemetry results clearly demonstrate a large upstream movement of adult fish in late-fall. More specifically, fish are moving from Lake Winnebago into the Upriver Lakes to overwinter. This movement, occurring mostly between mid-October and December, was observed in both fall 2011 and 2012 (Figures 1-4). Fish from both the upper Fox and Wolf River exhibited this movement, but there were a number of females from the upper Fox River that remained in Lake Winnebago through the winter months. So in essence, most of the fish enter Lake Winnebago sometime in May and remain there until October-December (Table 3).

Days in Winnebago (Females - Wolf)

Year	2011 (8)	2012 (8)
Min	58	135
Max	284	225
Median	181	202
Mean	179.6	192

Days in Winnebago (Females - upper Fox)

Year	2011 (10)	2012 (7)
Min	175	215
Max	334	356
Median	217.5	273
Mean	245.5	278.9

Days in Winnebago (Males - Wolf)

Year	2011 (12)	2012 (6)
Min	93	141
Max	268	187
Median	157	155.5
Mean	166.8	161.8

Days in Winnebago (Males - upper Fox)

Year	2011 (10)	2012 (3)
Min	12	176
Max	267	206
Median	157	202
Mean	162.6	194.7

Table 3. Data indicating the number of days (minimum, maximum, median, and mean) that tagged male and female walleye spent in Lake Winnebago (2011-2012). Numbers in parentheses represent the number of fish included in the analysis for that year.

These results address a lot of questions about the ice fishing on Lake Winnebago. Walleye, especially larger walleye, do not show up in the harvest of most ice fishermen. Experienced ice anglers can typically catch numbers of late-ice walleye around the mouth of the Fox River in Oshkosh, but walleye can be tough to locate throughout most of the ice fishing season. As the telemetry data indicate, this a product of there not being large numbers of adult walleye remaining in Lake Winnebago during that time. The late ice fishing can be good though because the fish that do remain in the lake through the winter congregate in front of Oshkosh as they begin their upstream spawning migration.

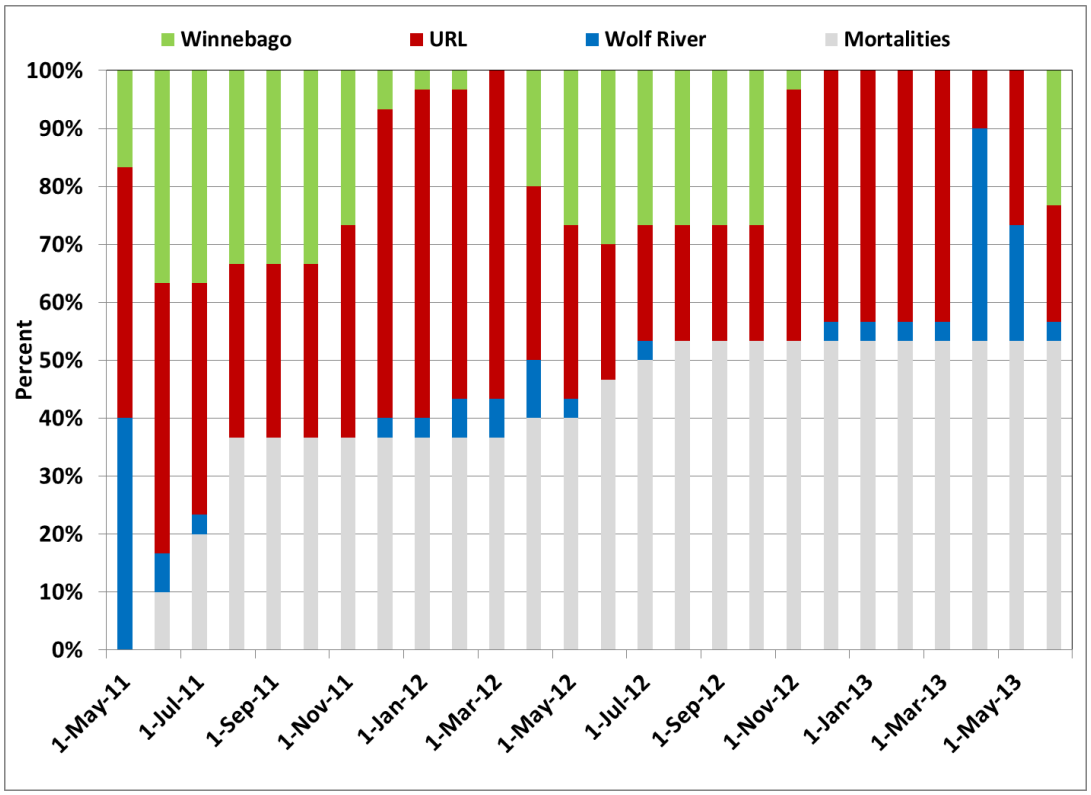


Figure 1. Monthly location of female walleye sonic tagged on the Wolf River.

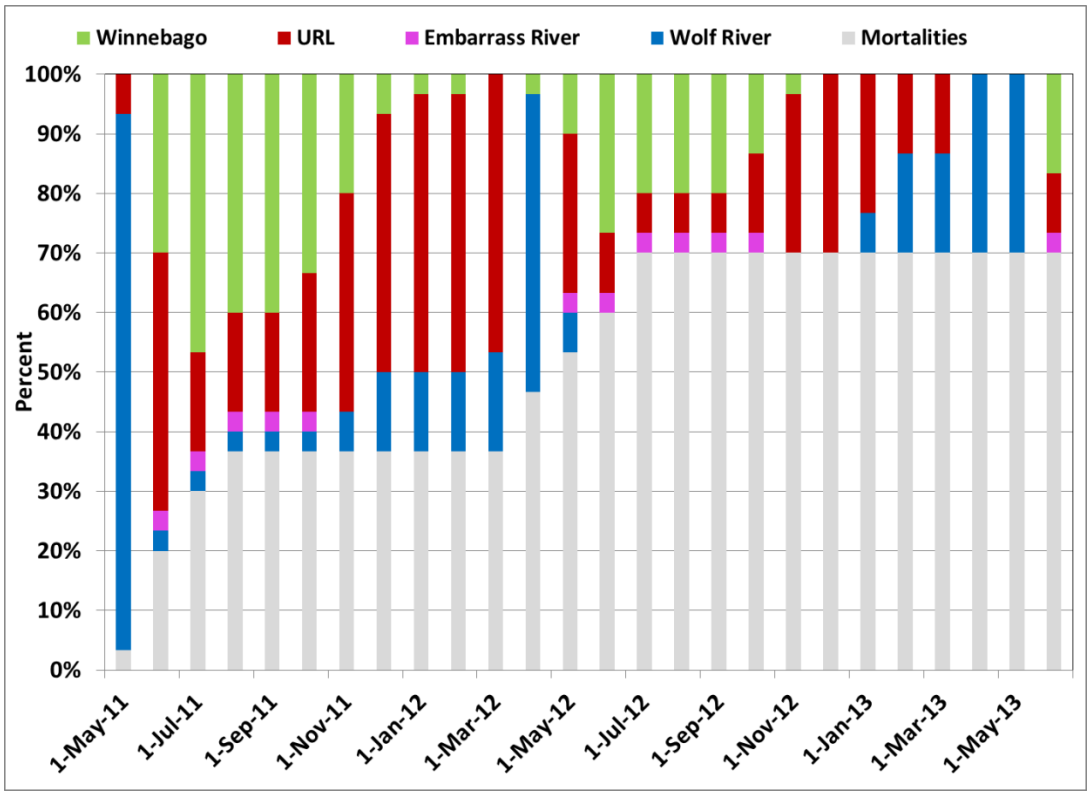


Figure 2. Monthly locations of male walleye sonic tagged on the Wolf River.

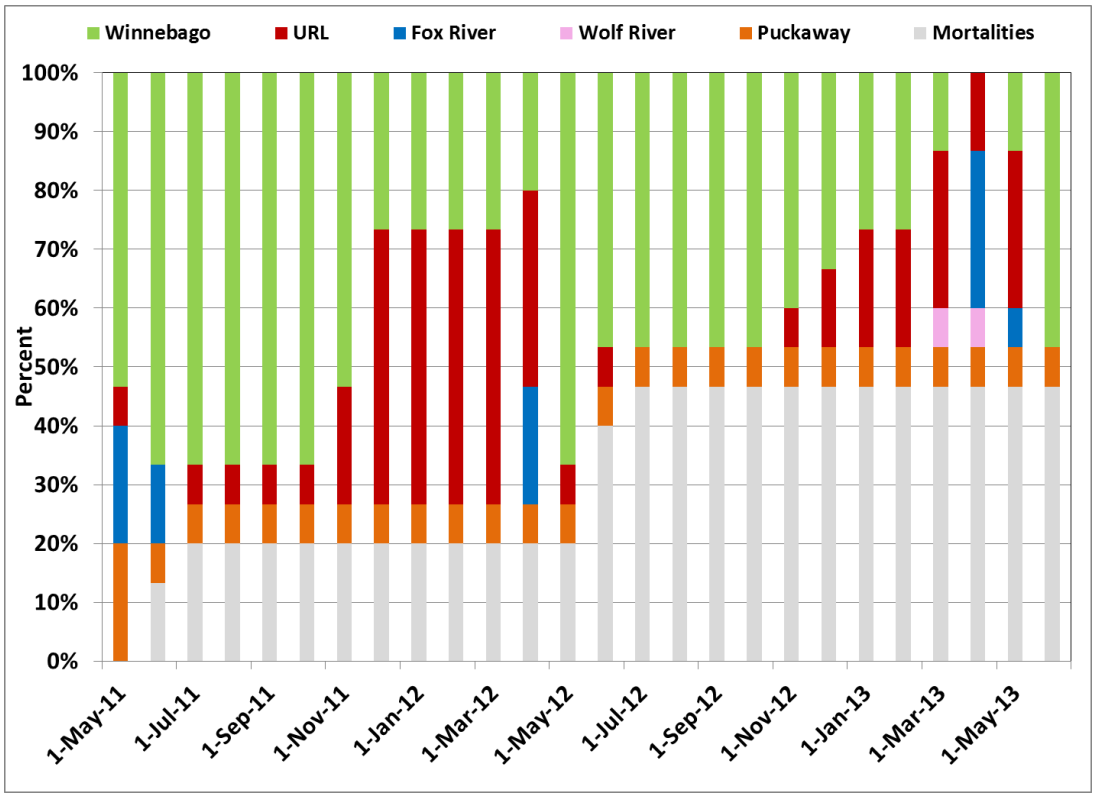


Figure 3. Monthly locations of female walleye sonic tagged on the upper Fox River.

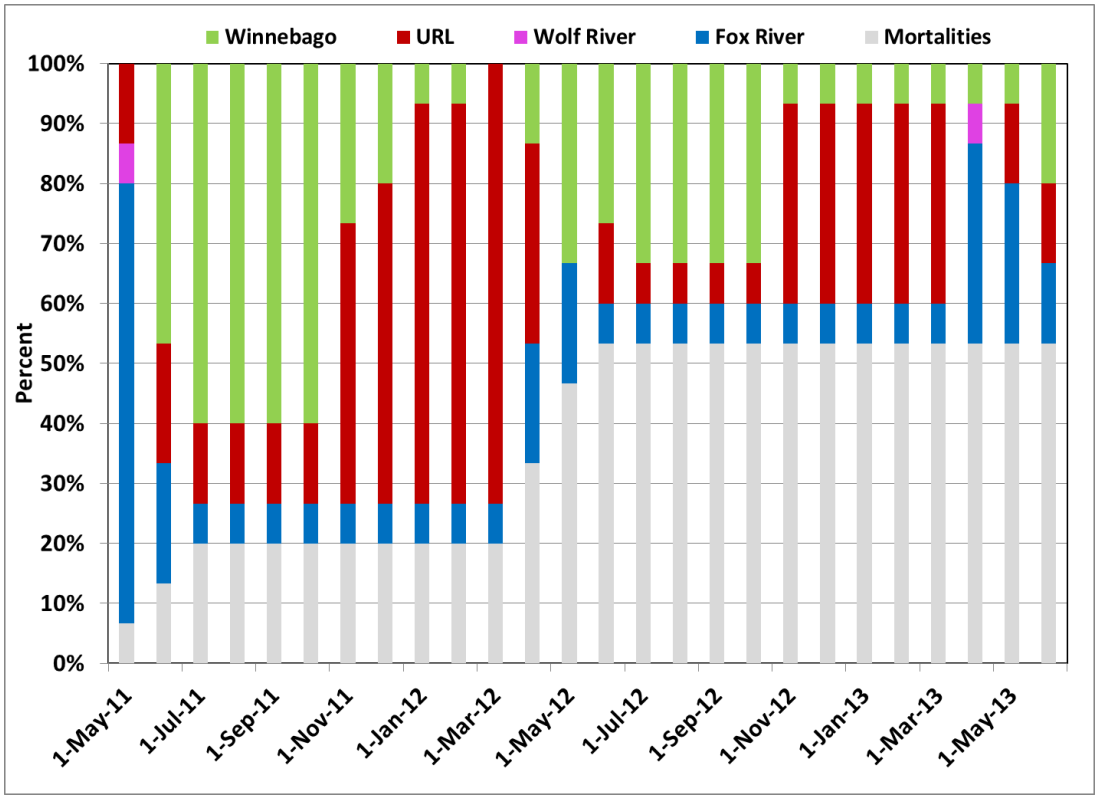


Figure 4. Monthly locations of male walleye sonic tagged on the upper Fox River.

All of the results and trends discussed thus far have described movement of fish marked on the upper Fox and Wolf Rivers. As described earlier, we also implanted tags into 10 fish captured in Lake Winnebago, mostly from west shore reefs just south of the mouth of the Fox River in Oshkosh. The results from these fish were not very clear, thus why they weren't included in most of the analyses. Four of the 10 fish were not contacted at any of our receivers, meaning that they never left Lake Winnebago during the study period, they were harvested or they died of natural causes. Of the remaining six fish, two moved upstream into the Upriver Lakes shortly after tagging and then moved back downstream into Lake Winnebago. Both of these fish were never contacted after May 14, 2011. So that leaves just four fish that provided quality data during the study period. Three of the four fish spawned in Lake Winnebago in 2012, while the fourth spawned in the Wolf River between Weyauwega and New London. 2013 was a different scenario, where two of the fish spawned in the upper Fox River and the remaining two spawned in the Wolf River.

Unfortunately quite a few of the tagged fish succumbed to mortality during the course of the study, as observed in Figures 1-4. Both natural causes and harvest by anglers were sources of this mortality, but there were a few instances where DNR staff were able to re-implant tags from harvested fish into other living fish. Our age and growth data indicate that 30-35% of the adult population succumbs to mortality in an average year, so we were anticipating a high percentage of the tagged fish would no longer be living by the end of the study. That's just part of the game when dealing with a heavily exploited fishery, mortality is going to be a factor.

Even with the mortalities, this was a very beneficial study to both our DNR staff and to the general angling public. Anglers are very interested in how fish move throughout the system and will look to apply these data to their fishing practices in the years ahead. We have already been receiving inquiries about whether we would be looking to raise additional funds to tag more fish. At this time, it doesn't look like something we will be pursuing. The results from the first 100 fish showed some definitive trends, as described in this summary, and we are confident that another 100 fish would yield similar results. There is also a tremendous amount of work that goes into compiling the data into a usable format and then summarizing it. We would consider tagging more fish in the future if a need presented itself.

I hope you enjoyed the summary and find the results as interesting as I did. Once again, this project could not have been completed without the support of local conservation clubs. I immensely enjoy working with the angling stakeholders in the area towards a common goal of making fishing better!

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