Movement of walleye in the Lower Milwaukee River and estuary

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Summary

A radiotelemetry study to examine the movement pattern of adult walleye in the Lower Milwaukee River and the harbor provided valuable information. Based on the experience gained during the 1999 pilot project, we purchased first set of twenty six duty cycle transmitters from the Advanced Telemetry Systems, Inc. (ATS) in 2000 that were programmed to help gather data year around. We continued the effort by implanting fifteen more walleye in 2001. Thus we had 41 walleye in the system with radio transmitters implanted facilitating the data gathering process. The data was collected until November 2003 on a biweekly basis. The average number of days, as a group, from these four implanting dates (spring 2000 and 2001, and fall 2000 and 2001) ranged from 268 days to 611 days. We were able to collect data from a few walleye for more than two years allowing us to track spawning site fidelity.

The analysis of data was conducted using GIS (Geographic Information System, ArcView 3.3) which indicated that there is a distinct seasonal moment pattern in the adult walleye population. The pattern follows a spring upstream migration coinciding potential spawning migration, which reverses later in the summer as they seem to move back to deeper, cooler harbor areas, and eventually spend most of the late fall and winter in the warmer Menomonee River canals. The canal area receives warm water discharge from the We Energies Valley Power Plant, and also there is an abundance of gizzard shad in this area during this time of the year. Upstream spawning migration obtained by analyzing the radiotelemetry data was further reinforced from our annual spring electrofishing survey. One of the walleyes (Frequency 49.281) was recorded once on 3/28/2002 and again on 3/27/2003 near the former North Avenue Dam area suggesting potential spawning site fidelity.

Movement of walleye in the Lower Milwaukee River and estuary

Introduction

Historically, populations of walleye and many other species native to the Milwaukee River declined dramatically due to the effects of dams and other losses of habitat. Since the complete removal of the North Avenue Dam in 1996 (Pictures 1 and 2), the water quality and the habitat have greatly improved in the Lower Milwaukee River enhancing the biodiversity (Hirethota et al 2005). Nearshore fishing opportunities in the Milwaukee harbor area were impacted tremendously in the 1990s due to the decline of yellow perch in Lake Michigan. In order to restore a native walleye population, and to enhance nearshore fishing opportunities, WDNR with the support of local fishing clubs initiated limited stocking of extended growth walleye fingerlings in the Lower Milwaukee River in 1995. About 10,000 extended growth walleye fingerlings have been stocked annually since 1995 in this water as part of walleye restoration efforts (Hirethota and Burzynski 2004). Population assessments conducted annually by WDNR documented that the stocked walleye grew well and attained sexual maturity. However, the information on the movement of adult walleye within the system was lacking, which prompted the initiation of the current study.

Objectives

The first objective was to examine the seasonal movement patterns of these walleyes to determine if refuges exist during the year. The second objective of this study was to understand the timing and occurrence of the spawning migration of stocked walleye.

Study area

The study area included the entire outer and inner harbor of Milwaukee, WI, including McKinley Marina, Menomonee River canals, Menomonee River upstream to the 26th Street Bridge, South Shore Yacht Club, and Lower Milwaukee River upstream to Kletzsch Park (Figure 1). The walleye for implanting transmitters were collected from the same area.

Methods

Fish capture and implanting:

In 1999, a pilot project was initiated to familiarize ourselves with the methods and equipment necessary to conduct a radio telemetry study. A total of seven refurbished transmitters (9.7 g to 20.4 g) and two new duty cycle transmitters (7.8 g and 8.2 g) were used in the study (Table 1, Appendix 1). On May 11, 1999, Wisconsin DNR personnel collected walleye from the Milwaukee River estuary using electrofishing gear. A total of 9 walleye were collected ranging from 1100 to 1700 g. Larger and heavier walleye were selected so that the size of the transmitters would be less than 2% of the body weight of the fish. Once captured, the walleye were transferred to a holding tank on the boat and brought to the dock at the University of Wisconsin WATER Institute where the surgery was performed. The fish were placed in a large, covered tank with recirculating lake water, tempered with a block of pure salt. Another similar

tank was prepared to hold the fish after surgery. Prior to the surgery, fish were anaesthetized using tricaine methanesulfonate (MS-222) solution (1-2 g dissolved in 5 gallons of lake water), weighed and measured. Following the procedure described by Fago (1999), a small incision was made in the belly area using a surgical blade. The transmitter was disinfected and inserted gently into the peritoneal cavity. Using a hollow stainless steel needle, the antenna from the transmitter was pierced through the body cavity and pulled out near the anus in line with the fish body. Using a curved needle and non-dissolvable thread, 4-5 stitches were sutured to close the incision. Care was taken not to damage any internal organ by positioning the transmitter under the suturing area. In order to keep the fish inactive, a dilute solution of MS-222 was flushed over the gills with a turkey baster. After the surgery the fish was dipped for a minute in a 3% salt solution and then transferred to the circulating fresh water recovery tank, where they were held until complete recovery. A few pieces of rock salt were placed in the recovery tank to temper the water to help reduce osmotic stress. When the implanted walleye returned to a normal swimming position (within 1 to 2 hours) they were transported to the respective release locations (Table 1). These locations were selected for two reasons, 1) they are geographically separated, and 2) one is in the harbor and the other is upstream location which would help document direction of movement. The harbor sites included the Summerfest Lagoon, inner harbor at the WATER Institute, and MMSD. The upriver sites included locations immediately downstream of the former North Avenue Dam and under the Van Buren Bridge.

Based on the information and experience gained from the pilot study, we embarked on a larger scale project in spring and fall of 2000 and 2001 (Table 1 and Appendix 1). Funding for the project was from the DNR with additional support for the purchase of new tracking equipment from local fishing clubs. In addition, we acquired new GIS (Geographic Information System) software for data input and analysis (ArcView 3.3), Environmental Systems Research Institute, Inc.). The radio transmitters from Advanced Telemetry Systems, Inc. (ATS) weighed about 8.43 g and were programmed to be active for 12 hours from 9:30 am to 9:30 pm on alternate weeks. With this arrangement the transmitters had an extended expected battery life. In addition, they were programmed to emit a mortality signal if there was no movement of the fish for a continuous 48 hours. The procedure for fish collection and handling, surgical procedure, and data gathering was consistent from year to year.

For the purpose of understanding whether the adult walleye migrate upstream (since these stocked walleye belonged to river running strain) during the spring spawning runs, we complimented our radio-tracking effort with Boomshocking. We used WDNR electroshocker boat to capture adult walleye from downstream of former North Avenue Dam during the first week of April when the water temperature ranged form 40-45 ^{0}F (preferred temperature for walleye spawning). A miniboom shocker was used during the day time upstream of the North Avenue Bridge to capture walleye. Each walleye was examined for sex, maturity condition, and marks.

Since the area receives substantial angling pressure, we posted signs at various places informing the anglers about the study and requesting them to safely release implanted walleye when captured.

Data collection and analysis:

Fish movement data were gathered by tracking tagged fish according to the programmed transmitter using ATS standard equipment – hand held loop antenna and a scanning receiver. Tracking was done using aircraft, boat, canoe and walking along the shoreline. Winter tracking was accomplished by driving and walking the shoreline wherever access was available. The entire study area was covered on two consecutive days each week or once every other week based on how the transmitters were programmed. Data were analyzed using Microsoft Excel and ArcView 3.3 to summarize seasonal and spatial movement of walleye in the Lower Milwaukee River and the estuary.

Results and discussion

Of the nine implanted walleye during the pilot study, five were released just downstream of the former North Avenue Dam and the remaining four were released in the Summerfest Lagoon (Figure 1). Two of the duty cycle transmitters had an expected battery life of 170 days. One of them lasted only two days in the system as the fish may have been caught near the point of release (i.e., former North Avenue Dam site). The second one lasted for 73 days in the Summerfest Lagoon area. One of the implanted walleye was not found over the course of the pilot study, while the remaining six lasted from 29 to 91 days (Appendix 1). One of the five tagged walleye released below the former North Avenue Dam on the Milwaukee River, traveled downstream and was located in the Summerfest Lagoon. Of the other four released in Summerfest Lagoon, two remained in the Lagoon area, and two moved upstream and were found in the Lower Milwaukee River. These nine transmitters averaged about 46 days in the system. Although air tracking would have been useful, we could not effectively track these fish using an aircraft because much of the study area encompassed a highly urbanized environment, and the outside noise interfered with radio signals. The one attempt we made to track along the Milwaukee River upstream from the Milwaukee Harbor to the City of Mequon using an aircraft was largely ineffective. Overall, we learnt many things from the pilot study which helped us improve our study approach. We learnt that the walleye traveled freely between the river and the harbor. We needed to implant enough number of transmitters so that there would be reasonable number of implanted walleye to track even though some would be lost. We learnt that air-tracking was not feasible in this environment, and relayed on other means such as using boat and walking on the shore. We needed to implant transmitters with longer battery life for year-around data collection. The surgical procedure did not cause any incidental mortality and the walleye that were implanted survived well.

In spring 2000, we purchased 20 new radio transmitters from Advanced Telemetry Systems, Inc. which weighed about 8.43 g with a duty cycle of 12 hours ON and 12 hours OFF on alternate weeks. These transmitters had an expected battery life of 200 days. A total of 15 walleye were implanted on April 24, 2000 and May 8, 2000. Eight of these walleye were released just below the former North Avenue Dam and the remaining seven walleye were released at the Summerfest Lagoon (Table 2). A second group of eleven more walleye was implanted on September 27, 2000. These new duty cycle transmitters were larger (weighed 19.5 g) and were expected to last 700 days. This met our objective of studying seasonal movement by tracking continuously for nearly two years. The effort was continued using similar duty cycle transmitters in 2001. We

implanted ten walleye on May 10th and five walleye on October 31st. These fish were released at various locations: by the WATER Institute, under the Van Buren Bridge on the Milwaukee River, just downstream of the former North Avenue Dam and by the Milwaukee Metropolitan Sewage District office (MMSD) near the confluence of the Menomonee River and the Milwaukee River (see Figure 1, Table 1).

Table 1. Number of walleye implanted with radio transmitters and released in the Lower Milwaukee River and harbor from 1999 to 2001, spring and fall seasons.

Year	Season	Location	Number	Battery life	Average days	Range of days
1999	Spring	North Ave. Dam	5	170 d for new; 90 d for refurbished	46	2-91
		Summerfest lagoon	4			
2000	Spring	North Ave.	8	200 d	268	1-1071
		Summerfest lagoon	7			
	Fall	North Ave. dam	7	700 d	429	20-1036
		MMSD	4			
2001	Spring	Van Buren Bridge	2	700 d	477	0-918
		WATER Institute	8			
	Fall	WATER Institute	5	700 d	320	21-708

MMSD – canal behind the Milwaukee Metropolitan Sewerage District office

Fifteen walleye that were implanted in the spring of 2000 averaged about 268 days at large. Of the fifteen, eight implanted walleye released below the former North Avenue Dam averaged about 116 days, and the other seven implanted walleye released at the Summerfest Lagoon averaged about 442 days. One of the walleyes released on 4/24/2000 at the Summerfest lagoon actually lasted for 1,071 days (last found on 3/31/2003 at Burnham Canal) which is five times more than the expected battery life. Another walleye, also released on 4/24/2000 at the same location, reappeared after a long gap of 2 years and 7 months (945 d) at the confluence of Menomonee and Burnham canal. An angler captured one of the walleye implanted on 4/24/2000, and brought the transmitter, which was still active, to WDNR on 11/9/2000. This walleye was released in the Summerfest Lagoon, and captured in the Menomonee canal across from MMSD after 201 days.

Eleven more walleye were implanted in the fall of 2000. These transmitters were programmed to have an expected battery life of 700 days. Of these eleven walleye, four were released in the Menomonee River canal at the MMSD office, and the other seven were released below the former North Avenue Dam. The fish that were released by MMSD averaged 583 days and the others that were released below the dam averaged 341 days. One of the walleyes released in the Menomonee canals across from MMSD on 9/27/2000 was later captured near the north swing

bridge in the inner harbor by an angler on 8/14/2002, a period of 686 days. The battery was still active when the angler returned the transmitter to the WDNR office. Another walleye released on 9/27/2000 below the former North Avenue Dam was last registered on 7/30/2003 at the South Shore Yacht Club (1,036 d).

Ten walleye were implanted in the spring of 2001. Two walleye were released at the Van Buren Bridge on the Milwaukee River, and eight walleye were released into the Milwaukee Harbor at the UWM WATER Institute. The walleye that were released at the Van Buren Bridge averaged 611 days, while the ones released by the WATER Institute averaged 444 days. One of the walleye released near the WATER institute on 5/15/2001 was last detected on 7/02/2003 (778 d).

Five more walleye were implanted in the fall of 2001 and released into the Milwaukee Harbor at the WATER Institute. These transmitters were also programmed with an expected battery life of 700 days, and averaged 320 days. One of the implanted walleye that was released near the WATER Institute on 10/31/2001 was last detected on 10/09/2003 in the McKinley Marina (708 d). This walleye was not encountered between 11/21/2001 and 9/12/2002 during our routine tracking trips.

The average number of days that the fish were tracked varied based on the battery life. However, there were some walleye which were encountered only one time, and a few completely disappeared (Appendix 1). The area receives fair amount of angling pressure. Even though the signs were posted for anglers to return the study fish safely, it is quite possible that some walleye were kept by the anglers. Some may have died due to hocking injury. Movement data were collected until November 2003 which was more than two years beyond the last set of implanting done on October 31, 2001.

Seasonal and spawning movement

We divided the year into four periods to examine movement patterns of walleye – Spring (March-April-May), Summer (June-July-August), Fall (September-October-November) and Winter (December-January-February). Walleye with implanted radio transmitters were released primarily in two general sites – in the harbor and upstream. During the spring of 2000 and 2001 and the fall of 2000 and 2001, a total of 25 and 16 radio tagged walleye were released, respectively. Thus, we had forty-one radio tagged walleye in the system for this study. Of the forty-one walleye, 24 were released at the harbor sites and 17 were released at the upstream sites.

During the study period, 15 of the 24 (63%) harbor released walleye were detected upstream at some point during the study suggesting upriver movement Conversely, of the 17 river released fish, 7 were found in the inner and outer harbor (from the north swing bridge out to the lake and including South Shore Marina). This number comprises 41.2% of the river released fish. The distances from the release location to the areas where the tagged fish were observed were considerably less in this study (Figure 2) compared to fish movements in the Lower Wisconsin River (Pellett et al. 1998 and Fago 1999). However, the data indicated that the walleye moved in both directions and utilized both habitat types.

Results from this study showed patterns of movement during the 4 time periods examined. In spring we recorded 148 observations; 43% of those observations were encountered upstream near the former North Avenue Dam, 35% were encountered in harbor area and the remaining 22% came from the Menomonee River and canal area (Figure 3). Overall, the majority of walleye movement upstream occurred during spring. In the summer, the majority of the observations came from the outer harbor area (46%), followed by upstream water (32%) and Menomonee Canals and inner harbor (22%) (Figure 4). It seems walleye move to cooler and deeper water in the outer harbor and deep upriver pools during the summer months and remain in that area. The Menomonee Canal water remains warmer throughout the year due to warm water discharge from the We Energies Valley Power Plant. Fall and winter months are characterized by walleye congregating in the Menomonee Canal and inner harbor as the majority of the observations came from this area (Figures 5 and 6). Another factor which may influence walleye movement into the Menomonee River and canals is the seasonal presence of large schools of gizzard shad. A combination of abundant prey and warmer temperature may be responsible for greater number of encounters of walleye in the area during fall and winter. In general, a clear seasonal movement pattern of walleye is evident in the study area.

Several radio tagged walleye (16) were encountered beyond 365 days in our study allowing us to collect data for more than one spawning season. We used data from these walleye to compute upstream spawning migration. Five of the implanted walleye (Frequencies 49.065, 49.145, 49.281, 49.311, and 49.352) were found to move upstream during the spring spawning season, probably triggered by spawning activities. One of the walleye (Frequency 49.311) that was released near the WATER institute on 5/15.2001 spent most of the time in the harbor, and it appeared upstream on 3/31/2003. Similarly, another walleye (Frequency 49.281), also released near the WATER institute on 5/15/2001, was recorded upriver near the former North Avenue Dam over two consecutive years (3/28/2002 and 3/27/2003) (Figure 7). In Wisconsin waters, male walleyes mature at the age of 2-5 and females at 5-7 years. Stocking of extended growth walleye began in 1995 and continued each year. Many surviving walleye would have attained sexual maturity during the time the radiotelemetry study was conducted. Our spring spawning assessment conducted during late March and early April near former North Avenue Dam using a boomshocker documented the time when a pulse of adult walleye moved upstream. However, number of mature walleye recorded in the assessment dwindled from year to year. In 2000 survey, we captured 103 walleye of which 27 were mature female, and 20 were mature male. In the following years the proportion of mature female and male walleye was lower than in 2000 (in 2001, 1 male and 3 female out of 51 walleye; in 2002, 2 male and 1 female out of 118 walleye; and in 2003, 7 male and 4 female out of 127 walleye captured). The number of walleye captured during the spring assessment was impacted by the fluctuation in the water temperature, water level, fishing pressure, survival rate of stocked walleye, and flow condition. We were only able to survey a limited section of the river due to unsuitable electroshocking conditions. However, there appeared to be a regular upstream migration pattern of the adult walleye in the system.

In general, walleye movement study in the lower Milwaukee River and the harbor using radiotelemetry indicated that the adult walleye in the lower Milwaukee River exhibit a characteristic seasonal movement pattern as well as upstream spring spawning migration.

Acknowledgements

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Picture 1. Photograph of the former North Avenue Dam area taken in August 2005 after removal of the dam and completion of pedestrian walk bridge. (WDNR photo.)

Picture 2. Photograph of the area immediately downstream of the former North Avenue Dam, showing the upstream release location of implanted walleye. This section was historically dredged for navigation. (WDNR photo.)

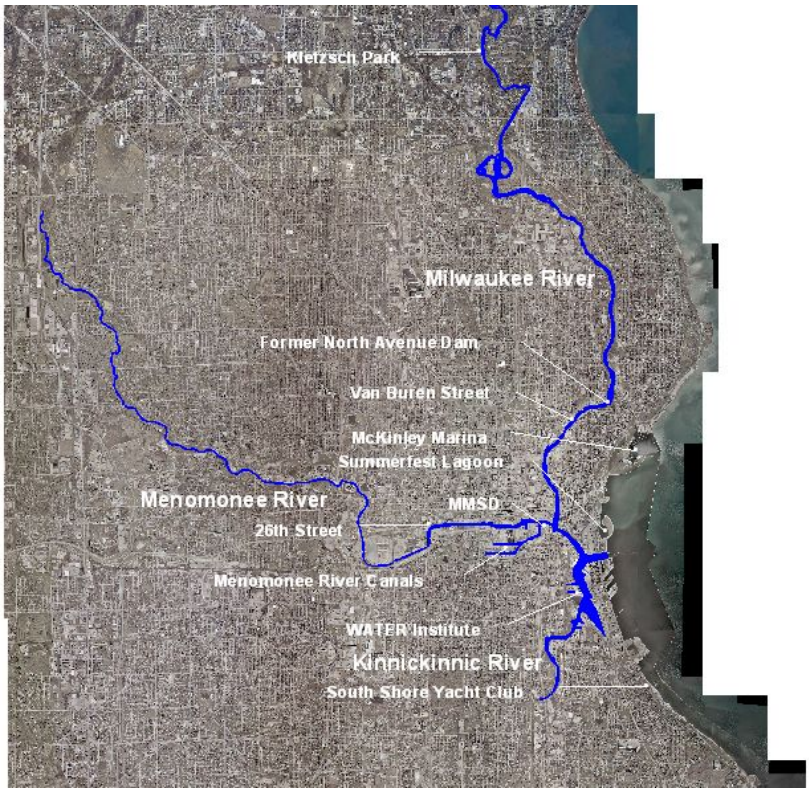

Figure 1. Walleye movement study area in the Lower Milwaukee River and the harbor.

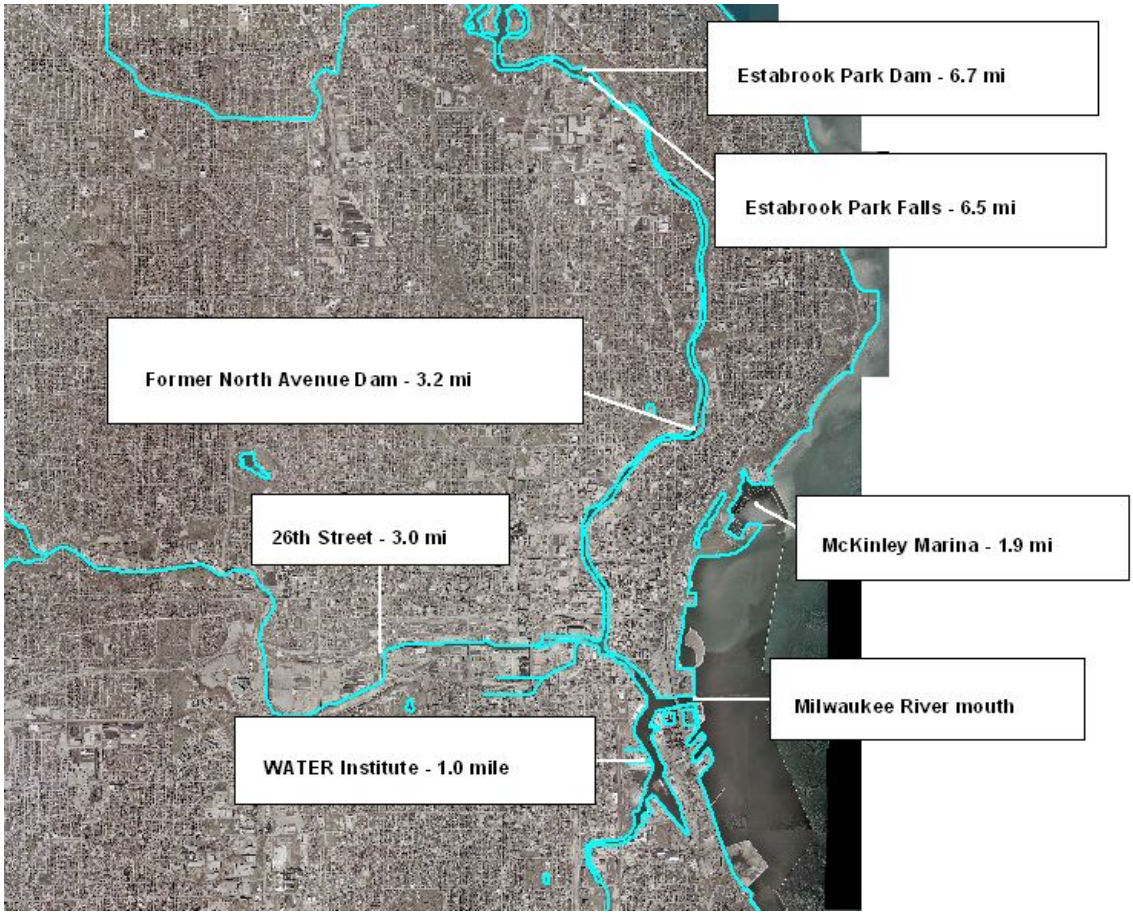

Figure 2. Walleye movement study area – distance from the river mouth.

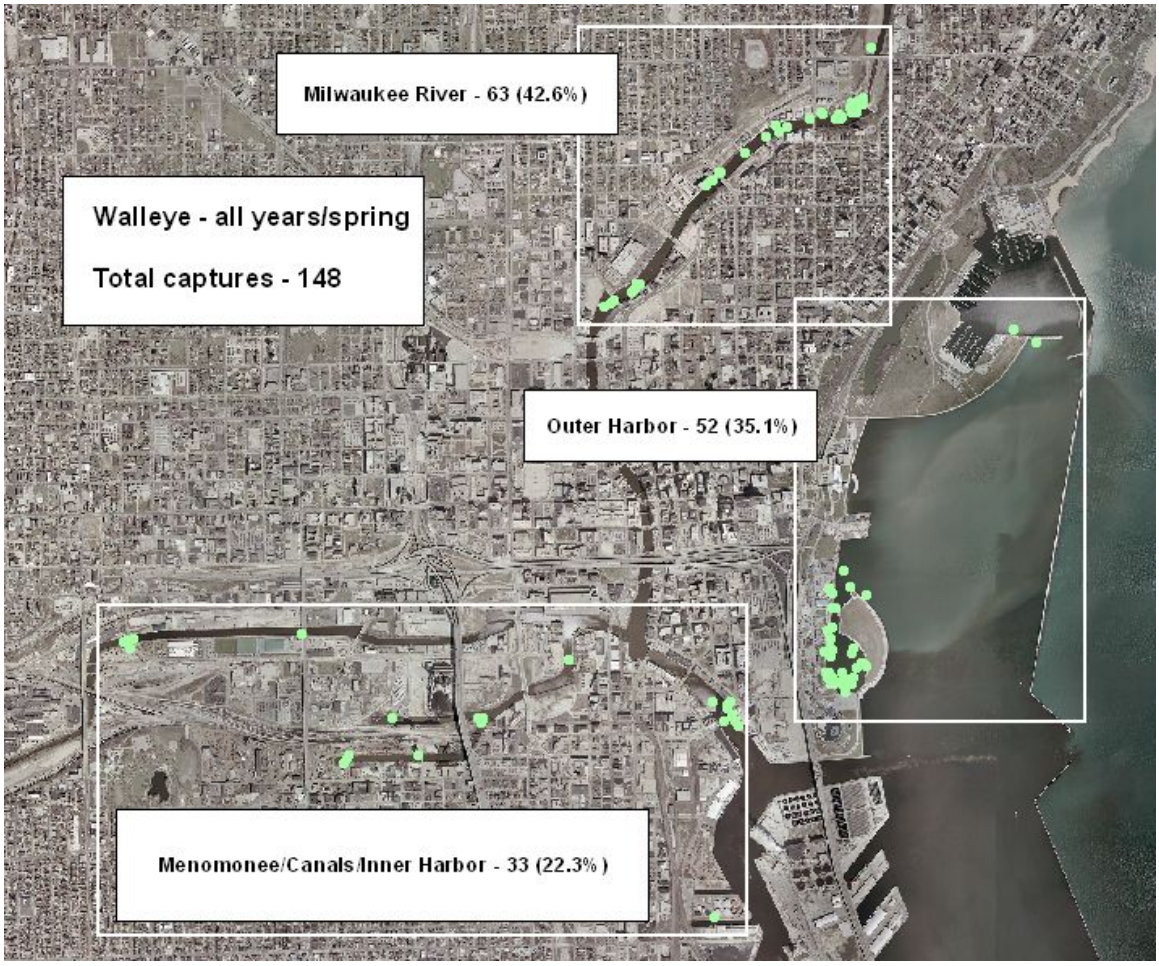

Figure 3. Seasonal movement data – spring.

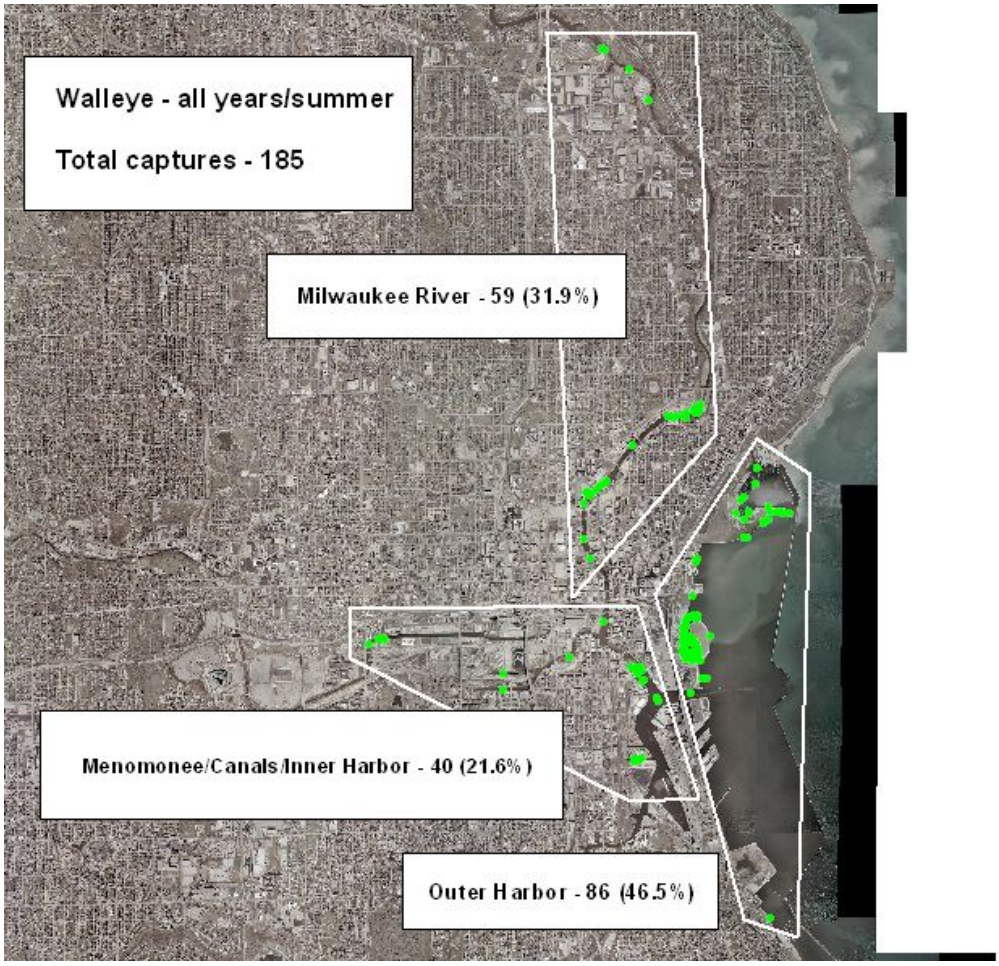

Figure 4. Seasonal movement data – summer.

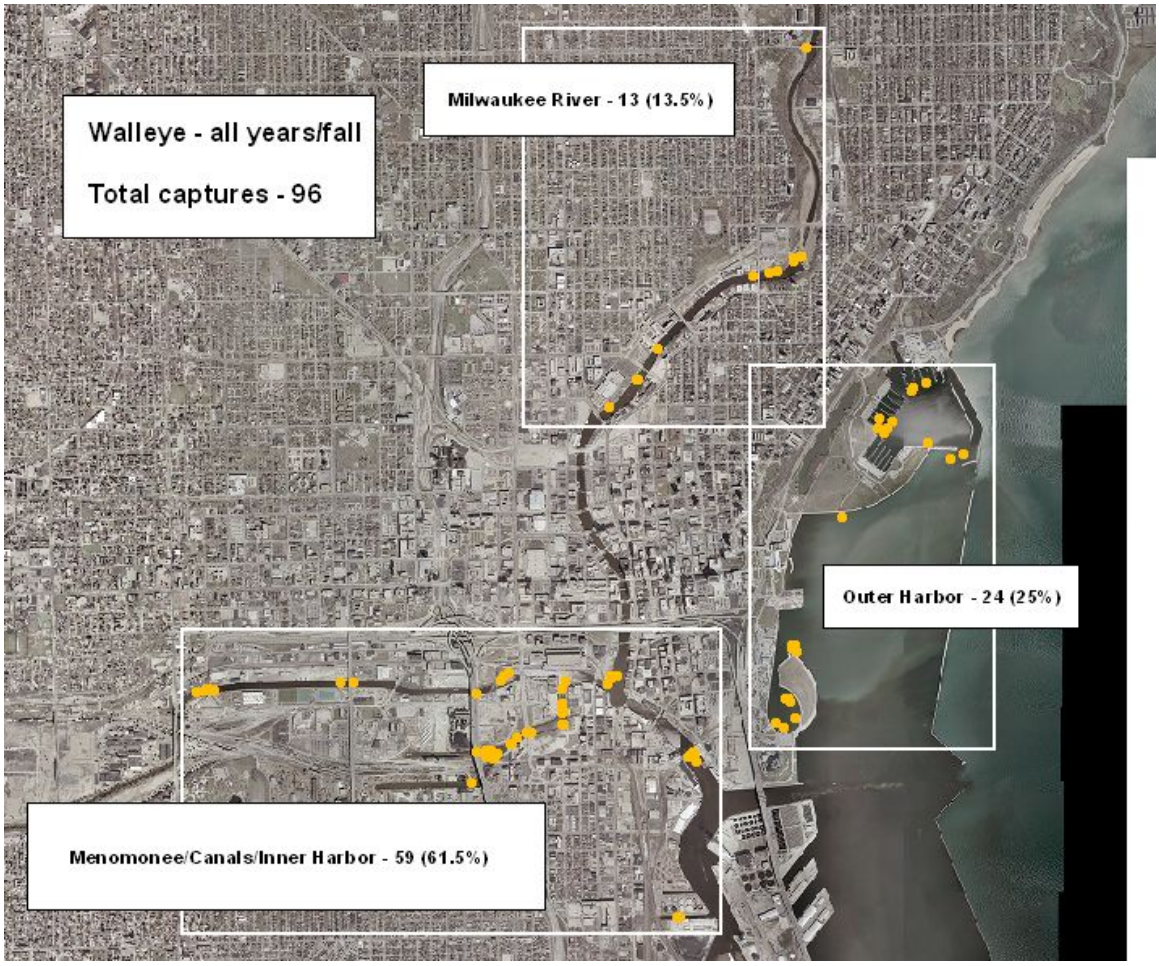

Figure 5. Seasonal movement data – fall.

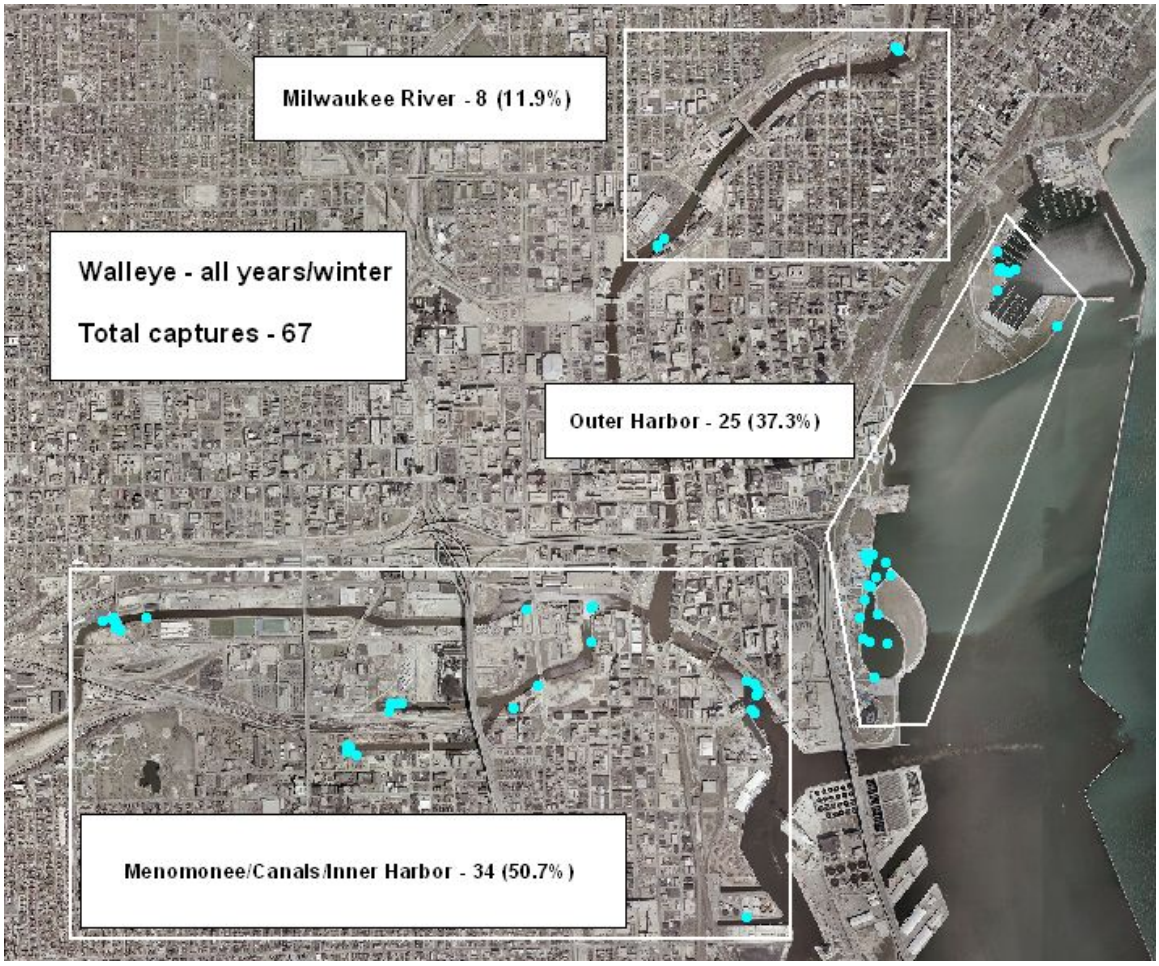

Figure 6. Seasonal movement data – winter.

Figure 7. Spawning movement data – spring.

APPENDIX 1
Summary table of implanted walleye from 5/11/1999 to 10/31/2001 in Milwaukee River and harbor

Frequency	Walleye length	Walleye weight	Date released	Release site	Last date found	Location	Days at liberty	Expected battery life
Pilot study - refurbished transmitters								
49.743	555	1700	05/11/1999	Below N. Ave. Dam	Not found		0	90
49.973	535	1650	05/11/1999	Below N. Ave. Dam	07/14/1999	Milwaukee River upstream of Silver Spring Drive	64	90
50.450	508	1450	05/11/1999	Below N. Ave. Dam	08/10/1999	Milwaukee River below the former North Avenue Dam	91	90
50.434	520	1350	05/11/1999	Below N. Ave. Dam	07/23/1999	Summerfest Lagoon	73	90
49.983	516	1500	05/11/1999	Summerfest Lagoon	06/16/1999	Southeast corner of Summerfest Lagoon	36	90
50.162	503	1450	05/11/1999	Summerfest Lagoon	06/09/1999	Milwaukee River at former North Avenue Dam	29	90
50.583	456	1100	05/11/1999	Summerfest Lagoon	06/28/1999	Milwaukee River at State Street	48	90
Pilot study - New duty cycle transmitters								
49.820	529	1600	05/11/1999	Below N. Ave. Dam	05/13/1999	Milwaukee River at former North Avenue Dam	2	170
49.775	493	1300	05/11/1999	Summerfest Lagoon	07/23/1999	Entrance to Summerfest Lagoon	73	170
Expanded study - New duty cycle transmitters								
49.511	550	na	04/24/2000	Below N. Ave. Dam	04/25/2000	Milwaukee River downstream of Cherry Street	1	200
49.521	493	1150	04/24/2000	Below N. Ave. Dam	03/01/2001	Confluence of South Menomonee and Burnham Canals	311	200
49.531	545	1416	04/24/2000	Below N. Ave. Dam	11/22/2000	South Menomonee Canal at I94	212	200
49.542	550	1835	04/24/2000	Below N. Ave. Dam	07/17/2000	Milwaukee River at Hwy 145 overpass	84	200
49.561	540	na	04/24/2000	Below N. Ave. Dam	04/27/2000	Milwaukee River at Cherry Street	3	200
49.641	500	na	04/24/2000	Below N. Ave. Dam	11/22/2000	Menomonee Canals south of MMSD dock	212	200
49.721	510	na	04/24/2000	Below N. Ave. Dam	04/27/2000	Milwaukee River downstream of Humboldt Avenue	3	200
49.861	540	na	04/24/2000	Below N. Ave. Dam	08/01/2000	Milwaukee River below the former North Avenue Dam	99	200
49.581	603	na	04/24/2000	Summerfest Lagoon	03/01/2001	Confluence of South Menomonee and Burnham Canals	311	200
49.621	585	na	04/24/2000	Summerfest Lagoon	11/09/2000	Menomonee Canals across from MMSD	201	200
49.701	515	na	04/24/2000	Summerfest Lagoon	07/05/2000	Milwaukee River at Humboldt Avenue	72	200
49.801	575	na	04/24/2000	Summerfest Lagoon	11/25/2002	Confluence of South Menomonee and Burnham Canals	945	200
49.921	535	na	04/24/2000	Summerfest Lagoon	02/15/2001	Milwaukee River below the former North Avenue Dam	297	200
49.940	585	na	04/24/2000	Summerfest Lagoon	11/09/2000	Confluence of South Menomonee and Burnham Canals	199	200
49.960	590	na	04/24/2000	Summerfest Lagoon	03/31/2003	West end of the Burnham Canal	1071	200
49.004	572	2105	09/27/2000	MMSD	06/19/2002	Summerfest Lagoon	630	700
49.024	536	1587	09/27/2000	Below N. Ave. Dam	11/22/2000	Confluence of South Menomonee and Burnham Canals	56	700

49.045	565	1694	09/27/2000	Below N. Ave. Dam	11/09/2000	Menomonee River at I94	43	700
49.065	459	1161	09/27/2000	Below N. Ave. Dam	04/13/2001	Milwaukee River below the former North Avenue Dam	198	700
49.085	524	1553	09/27/2000	Below N. Ave. Dam	07/30/2003	South Shore Marina	1036	700
49.105	613	2373	09/27/2000	Below N. Ave. Dam	12/11/2001	Menomonee Canals across from MMSD	440	700
49.124	535	1933	09/27/2000	Below N. Ave. Dam	10/17/2000	McKinley Marina	20	700
49.145	534	1627	09/27/2000	Below N. Ave. Dam	05/13/2002	Inner Milwaukee Harbor at the North swing bridge	593	700
49.165	510	1328	09/27/2000	MMSD	08/14/2002	Inner Milwaukee Harbor at the North swing bridge	686	700
49.184	508	1473	09/27/2000	MMSD	02/03/2003	Menomonee River below the 26th Street bridge	859	700
49.211	560	1723	09/27/2000	MMSD	03/01/2001	Confluence of South Menomonee and Burnham Canals	156	700
49.221	564	1665	05/10/2001	under Van Buren Bridge	06/10/2003	Milwaukee River below the former North Avenue Dam	761	700
49.231	470	1005	05/10/2001	under Van Buren Bridge	08/14/2002	Inner Milwaukee Harbor at the North swing bridge	461	700
49.241	472	1015	05/15/2001	WATER Institute	11/19/2003	Milwaukee River below the former North Avenue Dam	918	700
49.251	469	1026	05/15/2001	WATER Institute	02/04/2002	WATER Institute slip	265	700
49.261	603	2323	05/15/2001	WATER Institute	09/12/2001	WATER Institute slip	120	700
49.271	485	1168	05/15/2001	WATER Institute	08/14/2002	Milwaukee River downstream of St. Paul Avenue	456	700
49.281	485	1251	05/15/2001	WATER Institute	08/19/2003	Milwaukee Harbor off the War Memorial/Art Museum	826	700
49.291	475	1014	05/15/2001	WATER Institute	Not found		0	700
49.301	567	2300	05/15/2001	WATER Institute	11/21/2001	Confluence of South Menomonee and Burnham Canals	190	700
49.311	519	1213	05/15/2001	WATER Institute	07/02/2003	Milwaukee Harbor off Veterans Park near entrance to McKinley Marina	778	700
49.321	535	1589	10/31/2001	WATER Institute	12/11/2001	Burnham Canal at 11th and Bruce Street	41	700
49.331	623	2370	10/31/2001	WATER Institute	10/09/2003	McKinley Marina near Milwaukee Yacht Club	708	700
49.342	638	2700	10/31/2001	WATER Institute	11/21/2001	Menomonee River Canals near MMSD dock	21	700
49.352	539	1591	10/31/2001	WATER Institute	09/12/2002	Milwaukee Harbor at entrance to McKinley Marina	316	700
49.361	480	1154	10/31/2001	WATER Institute	03/27/2003	Menomonee River at 16th Street	512	700

(APPENDIX 1 continued)