

IL DEPT. OF NATURAL RESOURCES

Determine smallmouth bass (*Micropterus dolomieu*) movement patterns
along the southern Illinois shoreline of Lake Michigan

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Objectives

Job #1 – Utilize radio tracking procedures to identify adult smallmouth bass movement patterns along the southern Illinois shoreline of Lake Michigan

Objective:

1. Determine movement patterns of adult smallmouth bass at two primary sites (Jackson Park Harbor and Calumet Park Harbor).

Introduction

The interagency management of Great Lakes fisheries resources has been formalized through consensus and indoctrination of *A Joint Strategic Plan for the Management of Great Lakes Fisheries*. This Strategic Plan is a framework for cooperative fishery management among federal, state, provincial, and tribal agencies under the aegis of the Great Lakes Fishery Commission. Each Lake Committee of the Commission has developed mutually acceptable objectives for the structure of fish communities within each of their respective Great Lakes and the interaction between fish species and their roles as predators, prey, and competing species are incorporated into these objectives.

The fish fauna of Lake Michigan is more diverse in nearshore areas than in its offshore waters, and several warmwater fish species are found only near shore. The most notable fish species of the nearshore fishery are yellow perch which have supported a sport fishery in all four states. In addition to setting annual harvest goals for yellow perch, the Inshore Objective of the Lake Michigan Fish Community Objectives encourages the management of self-sustaining populations of other species such as smallmouth and largemouth bass, esocids, catfish, and panfish. An increasing emphasis for the management of the Lake Michigan fishery as a system of interacting fish communities rather than management under a single-species focus has prompted fishery managers to determine how nearshore fish species interact. To accomplish this, an understanding of smallmouth bass interactions and temporal and spatial overlaps with other species, movements, and population structure is necessary.

Illinois Department of Natural Resources (IDNR) personnel have documented the occurrence of self-sustaining populations of smallmouth bass through collection of juveniles with beach seines and adult and sub-adult smallmouth bass by electrofishing. Savitz et al. (1991) confirmed the existence of a relatively substantial smallmouth bass population near the southern portion of Illinois waters and roving creel surveys were conducted in 1995 and 1996 which showed a high catch per unit effort by sport fishermen (J. Savitz, unpub. data). In addition, population analyses were conducted by mark-recapture in 1997, 1998, and 1999, and an estimate of the population sizes at selected sites was developed as well as an estimate of the percentage of recruitment of juveniles into the adult population (Savitz and Funk 2001). Waters within the Calumet Harbor breakwall are shared with Indiana and fish inhabiting this area are free to cross jurisdictional boundaries (Figure 1). The study area for this project includes Calumet Harbor and Jackson Park Harbor, located 6 km to the north of Calumet Harbor.

Data from annual IDNR surveys have indicated that smallmouth bass inhabit several Illinois harbors and nearshore areas in spring and early summer. By mid-summer however, smallmouth bass are no longer effectively sampled by electrofishing in these areas. Information from creel surveys also has indicated that smallmouth bass are caught less frequently near shore by sport anglers during mid to late summer compared to spring (W. Brofka, Illinois Natural History Survey, pers. comm.). It is unknown whether smallmouth bass leave these harbors or just move to areas that can not be effectively sampled. In addition, no information exists on movement patterns and home ranges of smallmouth bass in southern Lake Michigan.

In 2000, eight smallmouth bass from Calumet Harbor were tracked by using sonic transmitters and a hydrophone to locate transmitter-implanted fish. These smallmouth bass remained in Calumet Harbor throughout the summer and fall of 2000, but moved from the shoreline where they were captured to locations within the shipping channel which runs through the harbor and along the north breakwall of the harbor. These same fish were tracked in 2001 along with an additional twelve smallmouth bass that were caught in Jackson Harbor and implanted with transmitters. The primary objective of this study was to determine where each of these smallmouth bass was on a sampling date.

Study Sites

Jackson Park Harbor is located 6 km north of the Calumet Harbor breakwall and consists of an inner and outer lagoon that are connected by a small boat channel (Figure 2). The inner lagoon where the fish were collected is approximately 0.3 sq km; the outer lagoon is approximately 0.4 sq km. There is no depth greater than 4 m in the inner lagoon, but the outer lagoon has a deep hole in the northwest section which is approximately 5.5 m deep. Surface water temperatures are higher in Jackson Park Harbor than in the open lake or Calumet Harbor. The length of the shoreline in the inner lagoon where the fish were captured was less than 100 m long and located approximately 100 m south of the boat ramp. The mouth of the harbor was approximately 900 m from the boat channel connecting the two lagoons and the boat channel is approximately 100 m SE from where the fish were originally captured. The deep hole in the outer lagoon is approximately 300 m from the mouth of the harbor and 600 m from the connecting channel.

Calumet Harbor, situated on the Illinois-Indiana border, is approximately nine sq km in size, and the area inside of the harbor is almost exclusively within the state boundaries of Indiana (Figure 3). Smallmouth bass were captured along a 800 m portion of rip-rap shoreline north of the

Calumet River in 2000 and implanted with sonic transmitters. The 95th Street launch ramp is approximately 1500 m south of the most southerly portion of that shoreline, which abuts the Calumet River Channel. The channel itself is approximately 2100 m long and is approximately 8 m deep. The north breakwall is located at the north end of the collection site and is situated perpendicular to the shoreline. The portion of the north breakwall where the fish were located is approximately 1300 m long.

Several sites, too numerous to mention, also were surveyed on Lake Michigan for transmitter-implanted fish when all of the fish were not located in the harbors. Surveyed sites included the shoreline, and natural and artificial structures that were likely habitats for smallmouth bass. Included in these sites were the Casino Pier which is the north extension of the Jackson Park Harbor mouth; an artificial reef, constructed in 1999, that is approximately 1.7 km NE of the Jackson Harbor entrance; other natural shoals near the artificial reef; and the South District Water Filtration Plant breakwall which is located approximately 3.3 km SE from the Jackson Harbor entrance.

Methodology

Twelve smallmouth bass were captured by electrofishing in the inner lagoon of Jackson Park Harbor on 4 May 2001. Sonic transmitters (Sonotronics, Inc.) were implanted into the body cavity, using methods similar to Hart and Summerfelt (1975) and Savitz et al. (1993). All smallmouth bass were between 345 and 510 mm in length in 2001 (Table 1). Four of the smallmouth bass (# 76245, 76334, 77244, and 77246) were implanted with transmitters capable of emitting signals for up to four years; the other eight transmitters were expected to emit signals for up to 14 months. Prior to surgery, hands and surgical tools were cleansed in denatured alcohol, transmitters were soaked in betadine, and the fish were anesthetized. Transmitters were inserted through an incision in the wall of the body cavity on the ventral portion of the fish, and the incision was closed using nylon sutures. The implant wound was treated with an acriflavin solution and the fish were held until all fish were swimming upright in an oxygenated cattle trough. Smallmouth bass were then released at the boat ramp in the inner lagoon (Figure 2, location H).

Eight smallmouth bass were previously collected on 27 June 2000 by electrofishing near shore in Calumet Harbor, implanted with transmitters, and released both at the 95th Street launch ramp (Figure 3, location A; 3 fish) and along the rip-rap shoreline to the north of the launch ramp (Figure 3, location B; 5 fish). On each sampling trip, the transmitter-implanted fish occurred only at four sites in 2000. While reporting of fish locations was based on those sites, the actual data was recorded as the latitude and longitude of the fish location as determined by GPS.

Sonotronics™ omnidirectional and directional hydrophones were used to locate the transmitter-implanted smallmouth bass on 19 occasions between 9 May and 15 October in and near Jackson Harbor and on 13 occasions between 7 March and 10 August inside Calumet Harbor. The number of sampling days was primarily restricted by weather as was in some cases the amount of time involved in sampling. On some sampling dates, tracking occurred in the morning, and on other sampling dates tracking occurred in the afternoon. Diurnal measurements were taken for one Jackson Harbor fish (# 77244) on one day, but the primary aim was to locate each fish at least once during the sampling day. During the first year of tracking smallmouth bass at Calumet Harbor, approximately twice as many sampling trips were cancelled as were made. During the

spring sampling (March and April) of 2001, only two out of six scheduled sampling trips were actually made. In addition, a common occurrence was a change of weather during the day so some trips were curtailed.

All transmitters emitted a frequency free pattern of signals, so that each smallmouth bass could be easily identified and separated from any other fish. When a transmitter-implanted smallmouth bass was located, water depth was recorded using a digital depth finder, and location and time were noted. Locations were recorded as latitude and longitude as determined by GPS. Since the smallmouth bass were generally moving when located, locations are presented in this report as distinct features of the shoreline or bathymetry for simplicity.

Results

Job #1 – Utilize radio tracking procedures to identify adult smallmouth bass movement patterns along the southern Illinois shoreline of Lake Michigan.

Jackson Park Harbor

Of the twelve smallmouth bass caught and released on 4 May, only one was never located. Overall, smallmouth bass released in Jackson Harbor were located less frequently than the Calumet Harbor fish (Table 3). On the initial sampling date (9 May 2001), only seven fish were located and all of these were in the inner lagoon at Jackson Harbor (Table 2). All attempts in May to locate the fish that were not in Jackson Harbor failed; additional sampling sites included the shoreline adjacent to Jackson Harbor, Calumet Harbor, a recently constructed artificial reef north of Jackson Harbor, and some natural shoals in the area.

As the summer progressed, fewer of the Jackson Harbor fish were located, but some were found outside of the harbor. On 6 June, smallmouth bass # 74236 was located along the north face of Casino Pier, the north pier at the Jackson Harbor entrance; smallmouth bass # 77246 was located at this site on 9 June. On 6 July, two smallmouth bass (# 77246 and # 72224) were found along the outside of a breakwall at the South District Water Filtration Plant that lies between Jackson Park Harbor and Calumet Harbor (Figure 2, location F). None of the smallmouth bass were located outside of Jackson Harbor following 6 July. None of the smallmouth bass released in Jackson Harbor were ever detected in Calumet Harbor or at the artificial reef or any of the natural shoals in the immediate vicinity at any time during the study.

For the most part, the fish did leave the harbor and move into Lake Michigan, occasionally returning to the 5.5 m deep hole in the outer lagoon. Except when they were in the harbor, they appeared to be continuously moving. Smallmouth bass # 77246 and # 72224, after they were located at the breakwall of the South District Water Filtration Plant, could not be located again within 10 minutes after initially finding them. Smallmouth bass # 77246 was located on many sampling dates, but on different dates was found at each of four sites. Smallmouth bass # 77244 was monitored for several hours on 27 July but did not leave the deep hole in the outer lagoon.

Calumet Harbor

All eight smallmouth bass implanted with transmitters and released within Calumet Harbor in 2000 were located in 2001 (Table 3). As in the previous year, there was no indication that the

fish exited Calumet Harbor. The last sample in 2000 occurred at the end of November and all of the fish were in the harbor. In this year's initial sample (7 March 2001), only two fish were located but they were in the Calumet Harbor along the North Breakwall (Table 4). Seven of the eight fish were located in Calumet Harbor on 19 March; six of these were along the North Breakwall (location E). All of the fish were located along the North Breakwall throughout April and May. From the beginning of sampling it was obvious that the transmitter signals from the Calumet Harbor fish were weak and it was often difficult to find the fish. In June, the signals were very weak and some of the fish could not be located. The last sample in Calumet Harbor occurred on 10 August. Only one fish was located on that date and movement of the boat a few meters in any direction resulted in a loss of signal recognition.

The batteries in these transmitters are believed to be spent for all of the Calumet Harbor smallmouth bass. There is no evidence to suggest that the fish ever moved out of the harbor. Their locations, however, were different from the previous year in that they remained along the North Breakwall as opposed to the river channel (location C) where they were frequently found in 2000. Some of the samples were taken in the morning and some in the afternoon; there were no obvious changes in location with changes in sampling times (Table 4).

Conclusions

These data imply that smallmouth bass do depart from Jackson Harbor during summer. These findings are similar to other studies that have noted that smallmouth bass moved to greater depths during late summer in Lake Michigan (Raffenberg and Dettmers 2000) and other lakes (Cole 1994). Most of the smallmouth bass were located at some point in the outer harbor, following release in the inner harbor; some of these fish were later located in the open lake. Some fish were never located later in the season and may have moved beyond the range of detection.

It is also possible that some fish could have been lost to illegal angler harvest; smallmouth bass # 73335 was never located after transmitter implantation early in the year. Conversely, smallmouth bass # 75256 was located on all sampling trips. Early in the sampling smallmouth bass # 75256 did move between the inner and outer harbors, however it was located in the same spot each sampling trip after 27 June (10 dates) and may either be deceased or may have expelled the transmitter. The precise location of smallmouth bass # 75256 near the connecting channel however could not be determined due to reflection of the signal off the steel sheet pilings that line the connecting channel between the inner and outer harbors.

Since no smallmouth bass released in Calumet Harbor were found outside of that harbor, and no smallmouth bass released in Jackson Harbor were found inside Calumet Harbor, these two groups of fish may be geographically isolated from each other.

Literature Cited

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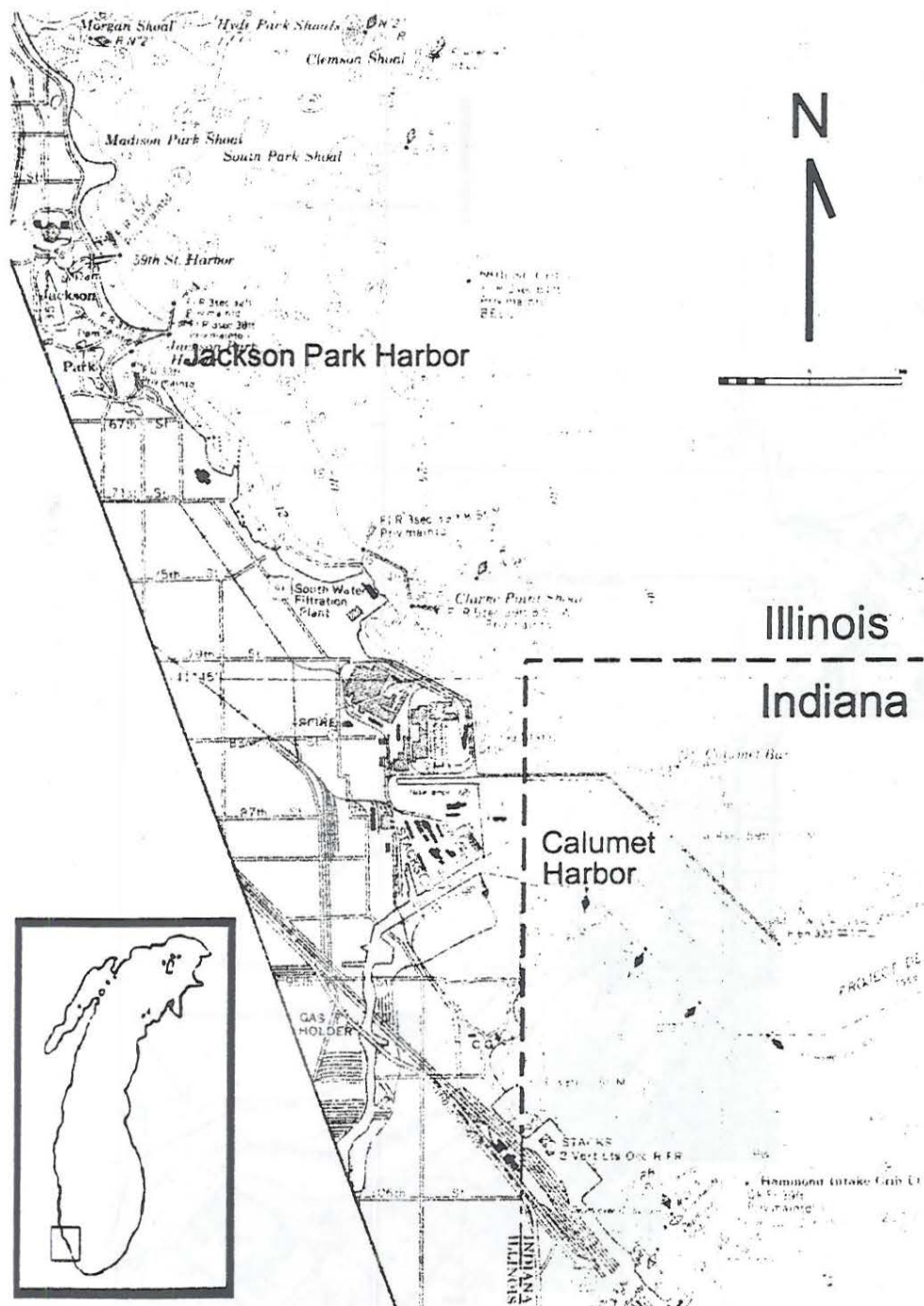


Figure 1. Calumet Harbor and Jackson Park Harbor study sites.

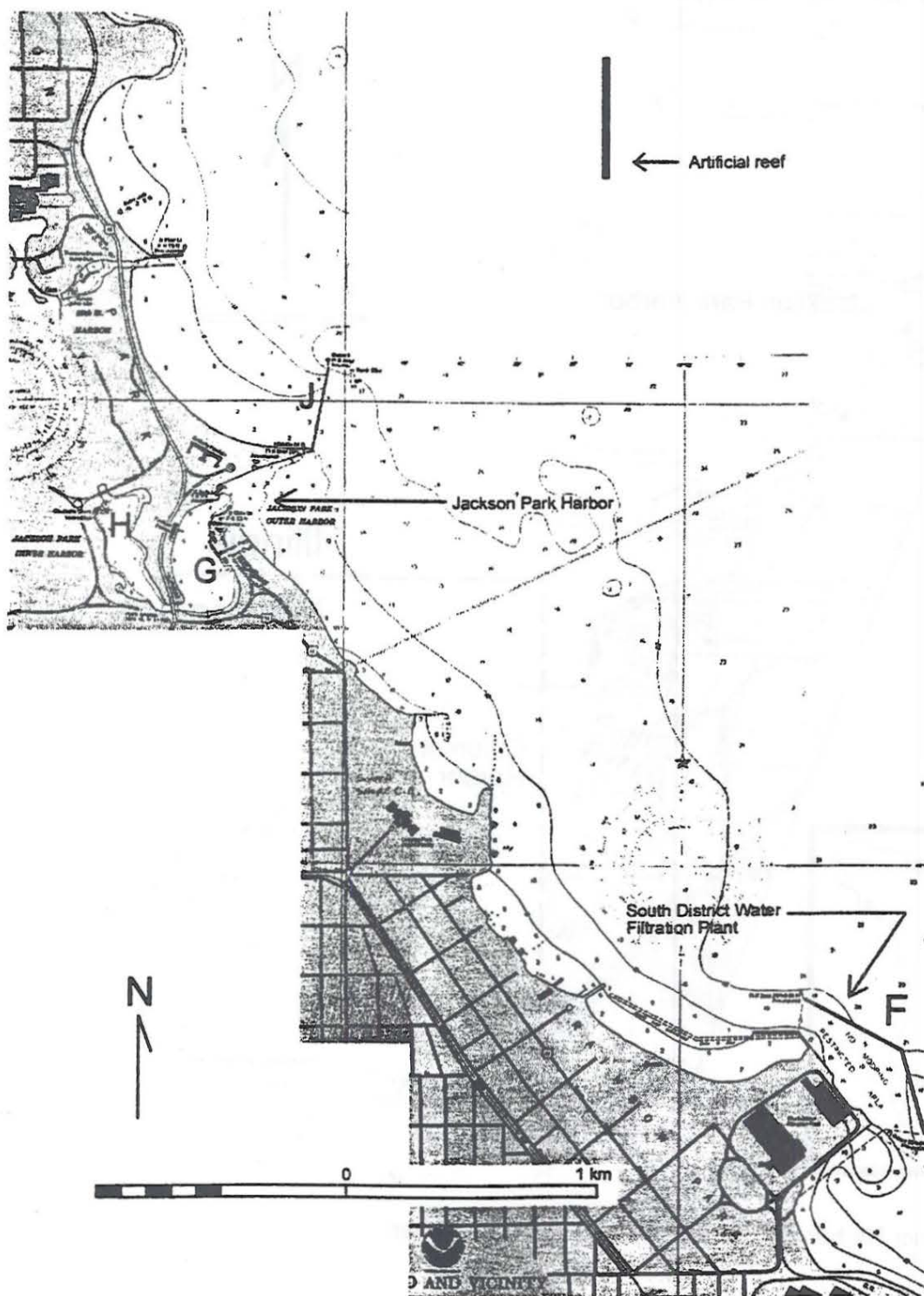


Figure 2. Jackson Park Harbor study area and four sites (F, G, H, and J) where smallmouth bass were detected.

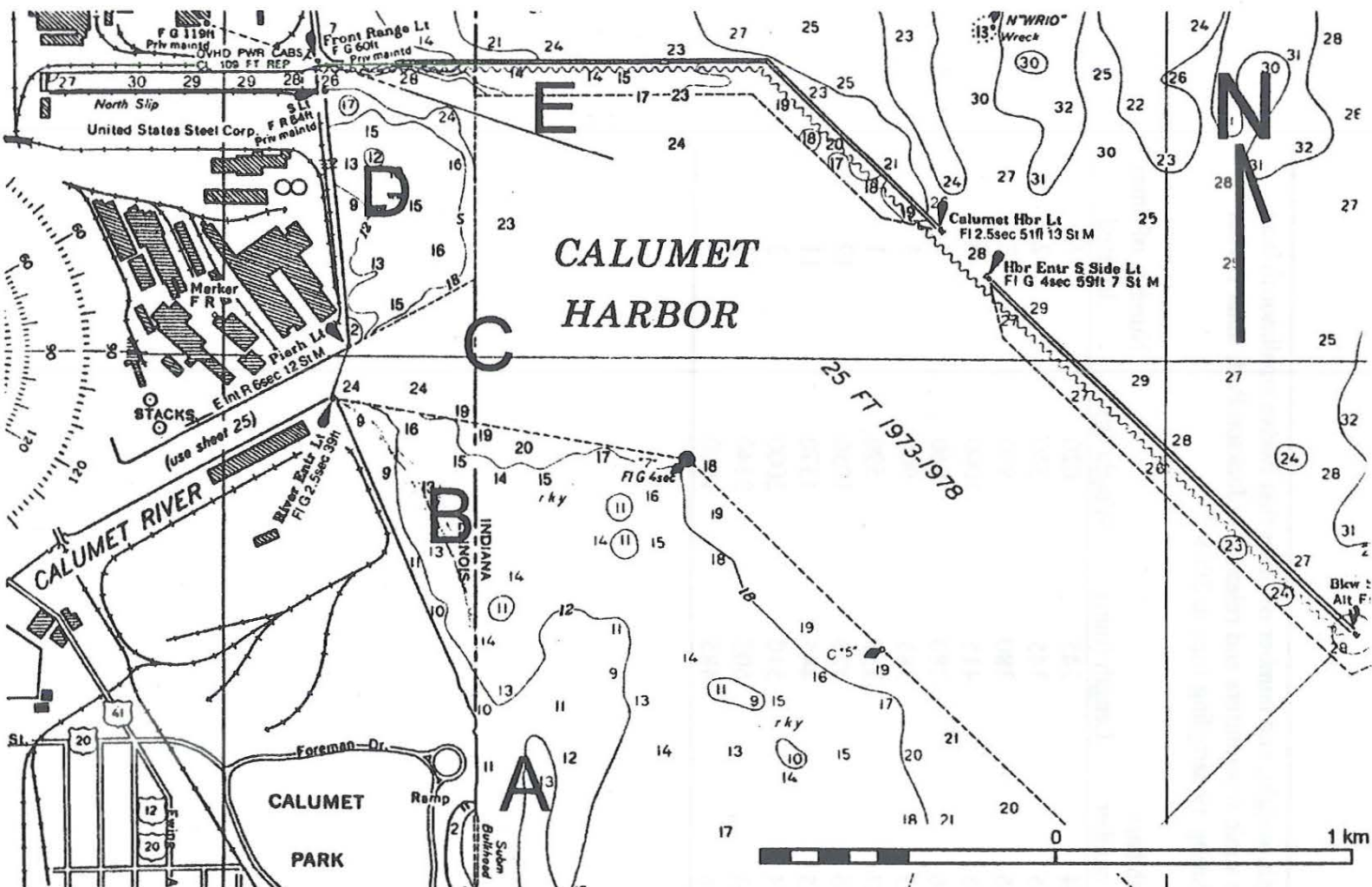


Figure 3. Calumet Harbor study area and five sites (A, B, C, D, and E) where smallmouth bass were detected.

Table 1. Length, weight, and number of times that twelve smallmouth bass implanted with sonic transmitters and released in Jackson Park inner harbor were located during 19 sampling trips in 2001.

Smallmouth bass transmitter number	Length (mm)	Weight (g)	Number of times located
72224	345	620	4
72345	345	560	2
73226	380	930	3
73335	415	1000	0
74236	380	960	4
74425	385	900	5
75227	350	590	1
75256	420	1050	19
76245	445	1370	11
76334	510	2000	3
77244	505	2140	11
77246	485	1600	9

Table 2. Locations of smallmouth bass in 2001. F = South District Water Filtration Plant breakwall; G = Jackson Park inner lagoon; H = Jackson Park outer lagoon; and J = Casino Pier (see Figure 2). Time of day: M (Morning) and A (Afternoon).

		Smallmouth bass											
Date / Time		72224	72345	73226	73335	74236	74425	75227	75256	76245	76334	77244	77246
4 May	M	All smallmouth bass released in the inner harbor (I) at Jackson Harbor											
9 May	M	G	-	G	-	-	G	-	G	G	-	G	G
16 May	M	G	H	G	-	-	G	-	G	G	H	-	G
18 May	A	G	-	G	-	G	G	H	G	G	H	G	-
23 May	M	-	-	-	-	-	-	-	H	G	-	H	H
6 Jun	M	-	H	-	-	J	H	-	G	G	-	H	G
11 Jun	A	-	-	-	-	H	H	-	G	G	-	G	J
13 Jun	M	-	-	-	-	-	-	-	G	-	-	G	G
20 Jun	A	-	-	-	-	G	-	-	H	G	-	-	H
27 Jun	M	-	-	-	-	-	-	-	G	-	-	-	H
6 Jul	M	F	-	-	-	-	-	-	G	G	-	H	F
12 Jul	A	-	-	-	-	-	-	-	G	-	-	G	-
19 Jul	M	-	-	-	-	-	-	-	G	-	-	-	-
20 Jul	M	-	-	-	-	-	-	-	G	G	-	-	-
25 Jul	M	-	-	-	-	-	-	-	G	G	-	-	-
27 Jul	M	-	-	-	-	-	-	-	G	G	-	H	-
24 Aug	A	-	-	-	-	-	-	-	G	-	-	-	-
21 Sep	A	-	-	-	-	-	-	-	G	-	-	H	-
8 Oct	A	-	-	-	-	-	-	-	G	-	-	-	-
15 Oct	A	-	-	-	-	-	-	-	G	-	-	-	-

Table 3. Length, weight, and number of times that eight smallmouth bass implanted with sonic transmitters and released in Calumet Harbor, near 95th Street, were located during 13 sampling trips in 2001. Length and weight values are from the time of transmitter implantation in 2000.

Smallmouth bass transmitter number	Length (mm)	Weight (g)	Number of times located
249	480	1400	11
258	425	1250	10
267	340	580	11
339	355	650	11
348	390	860	10
357	375	780	12
456	375	650	10
555	360	560	11

Table 4. Locations of smallmouth bass in 2001. A = 95th Street launch ramp; B = rip-rap shoreline south of Calumet River; C = Calumet River channel; D = rip-rap shoreline north of Calumet River; E = north Calumet Harbor breakwall (see Figure 3). Time of day: M (Morning) and A (Afternoon).

Date / Time	Smallmouth bass							
	249	258	267	339	348	357	456	555
7 Mar / A	-	-	-	-	-	E	E	-
19 Mar / A	E	E	E	E	E	C	-	E
4 Apr / A	E	E	E	E	E	E	E	E
18 Apr / A	E	E	E	E	E	E	E	E
25 Apr / A	E	E	E	E	E	E	E	E
1 May / M	E	E	E	E	E	E	E	E
9 May / M	E	E	E	E	E	E	E	E
16 May / M	E	E	E	E	E	E	E	E
23 May / M	E	E	E	E	E	E	E	E
6 June / M	E	E	E	E	E	E	-	E
13 June / M	E	E	E	E	E	E	E	E
27 June / M	E	-	E	E	-	-	E	E
10 Aug / A	-	-	-	-	-	E	-	-