

Illinois Department of Natural Resources  
Division of Fisheries

# Salmonid Community of Lake Michigan: 2008 Fall Harbor Assessment

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## Table of Contents

Executive Summary	1
Introduction	2
Methods	3
Results and Discussion	4
Conclusions and Management Recommendations	8
Literature Cited	9
Tables	10-12
Figures	13-16

### List of Tables

Table 1. Annual salmonid stocking plan for the Illinois waters of Lake Michigan and sites where fall harbor assessments were conducted. Numbers of fish are approximate and rounded to the nearest 1,000.	10
Table 2. Amount of electrofishing effort (hrs:min) and water temperature in four Illinois harbors sampled in 2008.	11
Table 3. Total electrofishing effort (hrs:min) and numbers of salmonids sampled in four Illinois harbors in 2008. The double underline indicates species which were not stocked in North Point Marina.	11
Table 4. Number of Chinook salmon with Illinois fin clips sampled in four Illinois harbors in 2008.	12

### List of Figures

Figure 1. Harbors where salmonids were sampled in 2008.	13
Figure 2. Catch-per-unit-effort for all salmonid species combined at four sampling sites, 2001-2008.	14
Figure 3. Length distribution of age-0 through age-4 Chinook salmon sampled in four Illinois harbors in 2008.	15
Figure 4. Length distribution of coho salmon sampled in four Illinois harbors in 2008.	15
Figure 5. Length distribution of rainbow trout sampled in four Illinois harbors in 2008.	16
Figure 6. Length distribution of brown trout sampled in four Illinois harbors in 2008.	16

## EXECUTIVE SUMMARY

Four salmonid species have been stocked annually in the Illinois waters of Lake Michigan at rates of approximately 304,000 Chinook salmon and 300,000 coho salmon, 100,000 rainbow trout and 100,000 brown trout. The number of Chinook salmon stocked in Illinois waters was reduced to approximately 250,500 in 2006 in a lakewide effort to reduce the prey demand placed on the forage base by the number of Chinook salmon in the lake. In fall 2008, we sampled mature salmonids in four Illinois harbors to assess their relative abundance, age and growth, and the homing tendency of marked fish.

Coho salmon and Chinook salmon comprised 97% of the sample. Catch-per-unit-effort (CPUE) of all salmonids combined only declined at Jackson Park inner harbor compared to 2007. Two notable changes for 2008 were a 50% decline in Chinook catches at all four sites and increases in coho salmon catch rates at three of the four harbors. This was the second year that Chinook salmon catch rates declined at all sites.

Similar to previous years, most (39%) of the Chinook salmon we sampled were age-2 however age-3 Chinook salmon comprised a greater portion of the sample in 2002, 2004, and 2006. Fin-clipped Chinook salmon released at Waukegan south harbor were collected at sites other than the stocking location (North Point Marina - 47% of sample; Diversey Harbor - 9% of sample).

Similar to the previous years, 60% of the Chinook salmon sampled in Waukegan south harbor were stocked in that harbor. The abundance of Chinook salmon not stocked in Waukegan south harbor but sampled in that harbor was substantially reduced in 2005 - 2008 compared to previous years.

## INTRODUCTION

The origin of the salmon fishery of Lake Michigan dates back to 1966 when coho salmon were first stocked as a means to utilize and ultimately control the over-abundant alewife population (Keller, *et al.* 1990). Since 1976, approximately 14.7 million salmonids have been stocked annually into Lake Michigan in an attempt to control alewife population growth and also support the world class fishery that had developed. Salmonids were first stocked in Illinois waters in 1976 and salmonid stocking in Illinois currently accounts for approximately 6% of the lakewide stockings. The Illinois stocking plan includes 250,500 Chinook salmon, 300,000 coho salmon, 100,000 rainbow trout, and 100,000 and brown trout that are stocked annually (Table 1).

Since the Illinois shoreline of Lake Michigan lacks permanent flowing tributaries, salmon and trout are stocked in harbors. Adult fish that return to these harbors in the fall are sampled by Lake Michigan Program staff using a DC electrofishing boat. This technique has proven both convenient and effective for collecting information on mature salmon and trout in harbors with relatively low water conductivity (approx. 150  $\mu\text{m}/\text{cm}$ ).

The objectives of the fall salmonid harbor sampling were to: 1) collect fish flesh samples to update the Illinois Fish Consumption Advisory; 2) collect data on returning fin-clipped fish and assess movements and fidelity to stocking sites; and 3) collect information on the condition and abundance of returning fish to address questions regarding health of the fish and the effects on the forage base.

## METHODS

Fish were sampled using a Smith-Root Model 5.0 GPP Pulsed-DC electrofishing unit, operated at 12-14 amps and 120 pulses per second. Total sampling time was based on harbor size, weather conditions, and the amount and type of fish collected. Most sites were sampled for approximately one hour; in some cases however, the entire site was sampled in less than 60 minutes. Selection of sampling sites (Figure 1) was based on harbor configurations that were conducive to electrofishing (i.e., < 3 m in depth) and harbors in which salmonids were stocked. In 2008, we sampled both basins of North Point Marina and the south harbor at Waukegan, Diversey Harbor and adjacent Lincoln Park Lagoon (referred to as only Diversey Harbor in throughout), and Jackson Park inner harbor weekly between mid-September and mid-November (Table 2).

Salmonid species were the target of sampling efforts. Abundance of non-target species (e.g., alewife, gizzard shad, and carp) was usually only noted. Sampled fish were dip-netted and held onboard until biological data were obtained. Fish were measured to the nearest 5 mm (maximum total length) and weighed. In addition, clipped fins, lamprey wounds, sex and maturity, and snag hook wounds were recorded. Otoliths were collected from Chinook salmon and processed as per Robillard and Marsden (1996). Fall harbor assessment catch-per-unit-effort (CPUE) was calculated as the number of fish sampled per 1 hr electrofishing effort.

## RESULTS AND DISCUSSION

A total of 702 salmonids were sampled in four Illinois harbors during 2008. Chinook salmon (190) and coho salmon (494) comprised the greatest numbers of fish sampled; brown trout and rainbow trout numbers were less (Table 3).

Fall assessment CPUE for all salmonids combined was higher in Waukegan south harbor (63.5 fish/hour) than in Diversey Harbor (22.9 fish/hour), North Point Marina (10.9 fish/hour), or Jackson Park inner harbor (9.1 fish/hour). CPUE declined at Jackson Park inner harbor compared to 2007. Three of the four sampling sites are stocked with a full compliment of the four species, however North Point Marina is only stocked with 10,000 brown trout (Table 1). In general, fall harbor assessment catch rates of salmonids have been highest at Waukegan south harbor (Figure 2).

CPUEs vary from year to year at each of the sampling sites depending on the success of capturing particular species during their peak spawning run, water temperatures, growth and survival, and variability in sport angler harvest. For purposes of this assessment, it is generally assumed that CPUEs represent actual returns regardless of variability in electrofishing effort among harbors.

### *Chinook Salmon*

Chinook salmon CPUE was higher in Waukegan south harbor (18.8 fish/hour) than in Diversey Harbor (4.4 fish/hour) Jackson Park inner harbor (1.5 fish/hour), and North Point Marina (3.4 fish/hour). Chinook salmon CPUE declined by 50% at all four sampling locations in 2008. Some of the decline is likely attributable to the 2006 cut in Chinook salmon stocking.

Sampled Chinook salmon ranged in length from 225 to 915 mm and length was directly related to age, however there was far greater overlap of length ranges of the various age groups in 2008 than observed in previous years (Figure 3). The length distribution of Chinook salmon generally has been tri-modal and usually comprised of four age-groups (ages-0 through 3). Six age-0 Chinook salmon (stocked in 2008) were sampled. Twelve age-4 Chinook salmon were sampled in 2008; only one age-4 Chinook salmon was sampled during 2001 through 2004.

Fin clips were evident on 96 of 190 Chinook salmon we sampled in 2008. Since 1999, all Chinook salmon stocked in Waukegan south harbor have been fin-clipped; Chinook salmon stocked in Diversey and Jackson Park Harbors have not (except 10,000 in Jackson in 2006). The majority of Chinook salmon bearing a left pectoral (LP) fin clip (2004), right pectoral left ventral (RPLV) fin clip (2005), left pectoral right ventral (LPRV) fin clip (2006), and right pectoral (RP) fin clip (2007) were sampled in Waukegan harbor in 2008, indicating at least moderate fidelity to stocking site (Table 4). Only 60% (83 of 138) of the Chinook salmon sampled in Waukegan south harbor were fin-clipped however indicating that straying into Waukegan south harbor from other stocking sources does occur; clipped Chinook salmon accounted for between 52 and 73% of the catch in Waukegan south harbor in 2003-2007. Seventeen Chinook salmon were sampled in North Point Marina and approximately half (8 fish) had a fin clip indicating Waukegan south harbor as the origin. No Chinook salmon have been stocked in North Point Marina, so all of those fish strayed to that harbor from other sources. In addition to straying to harbors not stocked or stocked with only marked fish, 6% (3 of 32) of the Chinook salmon we sampled in Diversey Harbor in 2008 had a fin clip indicating Waukegan south harbor as the origin. None of the three Chinook salmon we sampled in Jackson Park inner harbor had a fin clip.

### ***Coho salmon***

Coho salmon CPUE was two times higher at Waukegan south harbor (43.4 fish/hour) compared to Diversey Harbor (18.2 fish/hour). Catch rate for coho salmon has been variable among harbors, with the exception of Waukegan south harbor in 1998-2002, when coho salmon CPUE was consistently near 25 fish/hour. Coho salmon CPUE increased (200-500%) at all harbors from 2006 and 2007 CPUEs except at Jackson Park inner harbor. CPUEs in 2006 and 2007 were the lowest CPUEs since before 1998.

Sampled coho salmon ranged in length from 240 to 680 mm (Figure 4). Previous sampling has indicated that the typical length distribution contains of single mode and is skewed toward smaller sizes. The mean length of coho salmon we sampled in 2008 (525 mm) was similar to previous years.

No fin-clipped coho salmon have been stocked in Illinois harbors since 1998. Previous information on returns of fin-clipped coho salmon has indicated that coho salmon generally return to Illinois harbors to spawn following two summers in the lake. Two of the 494 coho salmon sampled in 2008 had a fin clip. The origin of the clipped fish was the state of Michigan.

### ***Rainbow Trout***

Only Arlee-strain rainbow trout were stocked in Illinois harbors in 1999 – 2001, and approximately 50,000 Arlee-strain and 60,000 Skamania-strain rainbow trout have been stocked each year since 2002. In general, relatively few rainbow trout are sampled during the fall in comparison to coho and Chinook salmon. The time-series of relatively low CPUEs provides little meaningful information on whether a trend in the data exists or not. The majority of

rainbow trout sampled had a adipose right-pectoral fin clip indicating Illinois origin (Skamania strain).

An attempt to mark all rainbow trout stocked in Lake Michigan has been less than successful. In Illinois and Michigan, all rainbow trout have been fin-clipped prior to stocking since 1996. Less than half of the 500,000 rainbow trout stocked in Wisconsin waters are usually marked however, and less than 10% of the 500,000 rainbow trout stocked by Indiana are marked. Fin clips were evident on all seven rainbow trout. Only one of those fin clips corresponded to rainbow trout stocked in Illinois waters (4 AdRP). The average length of rainbow trout we sampled in 2008 was 660 mm (Figure 5).

### ***Brown trout***

The number of brown trout that we have sampled in any particular year has been highly variable and most strongly influenced by the number sampled at North Point Marina. Brown trout CPUEs have been variable among harbors and years although the recent trend has been declining CPUEs. Given that the number of brown trout stocked in Illinois waters has been consistent, it is likely that the variability in sport angler harvest and fall returns of brown trout is driven by stocking in other states (e.g., 1.2 million stocked in Wisconsin waters annually), the closing of a primary shore fishing site (Midwest Generation in Waukegan), and weather patterns, rather than the strain (Plymouth Rock) of brown trout stocked in Illinois.

Fins typically are not clipped on brown trout stocked in Illinois waters because significant regeneration of the fins and the naturally-occurring curving of the fins by this species make identification difficult. None of the brown trout we sampled had fin clips. The length distribution of brown trout that we sampled in 2008 was similar to previous years (Figure 6).

## CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

The number of Chinook salmon stocked in Lake Michigan was reduced in 1999 in an effort to minimize stress on the limited forage base and lessen the possibility of another epizootic outbreak which resulted in mass die-offs of Chinook salmon in the past. Large numbers of age-0 Chinook salmon (stocked in 1999) were collected in the 1999 fall harbor assessment and that cohort was well represented as age-1 in 2000 and age-2 in 2001. This cohort accounted for 56% of the Chinook salmon we sampled in 2002. Virtually no age-0 Chinook salmon however were collected in 2000 – 2008. Chinook salmon numbers were reduced again in 2006 and the effect of that reduction has yet to be fully realized but may have accounted for decreases in CPUEs of age-2 Chinook salmon in our survey.

*Recommendation: Work with Salmonid Task Group of the Lake Michigan Committee to continue development of an assessment of the effects of reduced Chinook salmon stocking on a lakewide basis and add data to the Red Flags evaluation table.*

A high return rate of stocked salmon to Illinois harbors is not likely to be realized since Illinois lacks tributary streams in which fish may imprint and return to at maturity and relatively few fish are stocked compared to other jurisdictions. In an attempt to identify stocking site fidelity and track mortality rates, all fin-clipped Chinook salmon stocked in Illinois waters have been stocked in Waukegan south harbor since 1999. Similar percentages of fin-clipped Chinook salmon were found each year in both Waukegan south harbor (53 and 52%) and North Point Marina (25 and 24%) in 2003 and 2004. Percentages increased at both locations in 2005 and 2006 and were similar in 2007. The decline to 61% clipped fish in Waukegan south harbor and to 50% in North

Point Marina in 2008 may indicate a stabilization of these return rates which is a critical key to understanding movement patterns and fidelity.

*Recommendation: Continue to stock Waukegan south harbor with clipped Chinook salmon for at least two additional years to determine if the percentage of fish that stray into Waukegan harbor from other stocking sites is consistent among years. Provide double-marked fish for the lakewide assessment of Chinook salmon natural recruits through 2011.*

#### **LITERATURE CITED**

- Keller, M., K. D. Smith, and R. W. Rybicki. 1990. Review of Salmon and Trout Management in Lake Michigan. Report to the Michigan Department of Natural Resources. 254pp.
- Robillard, S. R., and J. E. Marsden. 1996. Comparison of otolith and scale ages for yellow perch from Lake Michigan. *Journal of Great Lakes Research* 22(2):429-435.

Table 1. Annual salmonid stocking plan for the Illinois waters of Lake Michigan and sites where fall harbor assessments are conducted. Numbers of fish are approximate and rounded to the nearest 1,000.

Location	Fall harbor assessment site	Number of fish stocked				
		Coho salmon	Chinook salmon	Rainbow trout (Arlee)	Rainbow trout (Skamania)	Brown trout
North Point Marina	X					10,000
Waukegan south harbor	X	100,000	83,500		25,000	10,000
Highland Park				10,000		10,000
Dawes Park				10,000		10,000
Belmont Harbor						10,000
Montrose Harbor				10,000		10,000
Diversey Harbor	X	100,000	83,500		25,000	10,000
Burnham Harbor				10,000		10,000
Jackson inner harbor	X	100,000	83,500	10,000		10,000
Calumet Harbor						10,000
Totals		300,000	250,500	50,000	50,000	100,000

Table 2. Amount of electrofishing effort (min) and water temperature in four Illinois harbors sampled in 2008.

Dates	Location			
	North Point Marina	Waukegan south harbor	Diversey Harbor	Jackson Park inner harbor
22, 24 September	35 / 68 F	40 / 70 F	60 / 72 F	25 / 72 F
30 Sept, 2 Oct	30 / 62 F	52 / 64 F	52 / 69 F	26 / 70 F
7, 9 October	44 / 60 F	60 / 61 F	49 / 62 F	25 / 64 F
16, 17 October	45 / 59 F	60 / 60 F	48 / 62 F	23 / 62 F
20, 21 October	45 / 57 F	56 / 58 F	52 / 58 F	20 / 57 F
28, 29 October	60 / 49 F	60 / 49 F	60 / 49 F	25 / 48 F
3, 6, 7 November	60 / 51 F	49 / 52 F	57 / 54 F	
10, 13 November	55 / 47 F	60 / 46 F	49 / 48 F	
19 November		60 / 41 F	65 / 41 F	

Table 3. Total electrofishing effort (hrs:min) and numbers of salmonids sampled in four Illinois harbors in 2008. The double underline indicates species which were not stocked in North Point Marina.

Harbor	Effort (hrs)	Species				All Salmonids
		Coho Salmon	Chinook Salmon	Rainbow Trout	Brown Trout	
North Point Marina	5.23	<u>32</u>	<u>18</u>	<u>1</u>	6	57
Waukegan south harbor	7.28	316	137	5	4	462
Diversey Harbor	7.20	131	32	1	1	165
Jackson Park inner harbor	1.98	15	3	0	0	18
All harbors	21.7	494	190	7	11	702

Table 4. Number of Chinook salmon with Illinois fin clips sampled in four Illinois Harbors in 2008.

Fin Clip	Year Stocked	Location Stocked	Sample Location (2008)			
			North Point Marina	Waukegan south harbor	Diversey Harbor	Jackson Park inner harbor
LP	2004	Waukegan south harbor	0	2	1	0
RPLV	2005	Waukegan south harbor	1	28	1	0
LPRV	2006	Waukegan / Jackson	4	36	0	0
RP	2007	Waukegan south harbor	3	17	1	0

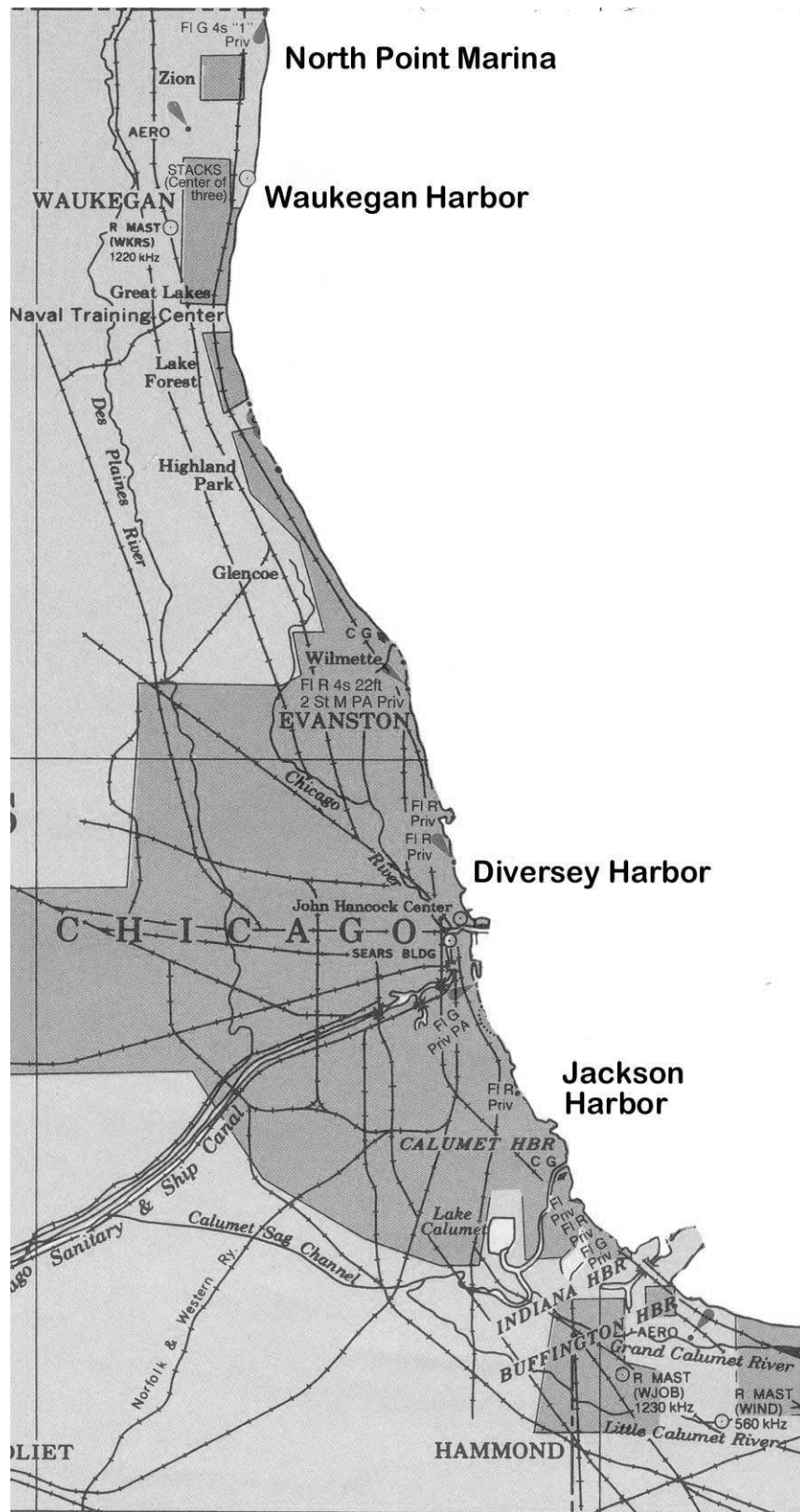


Figure 1. Harbors where salmonids were sampled in 2008.

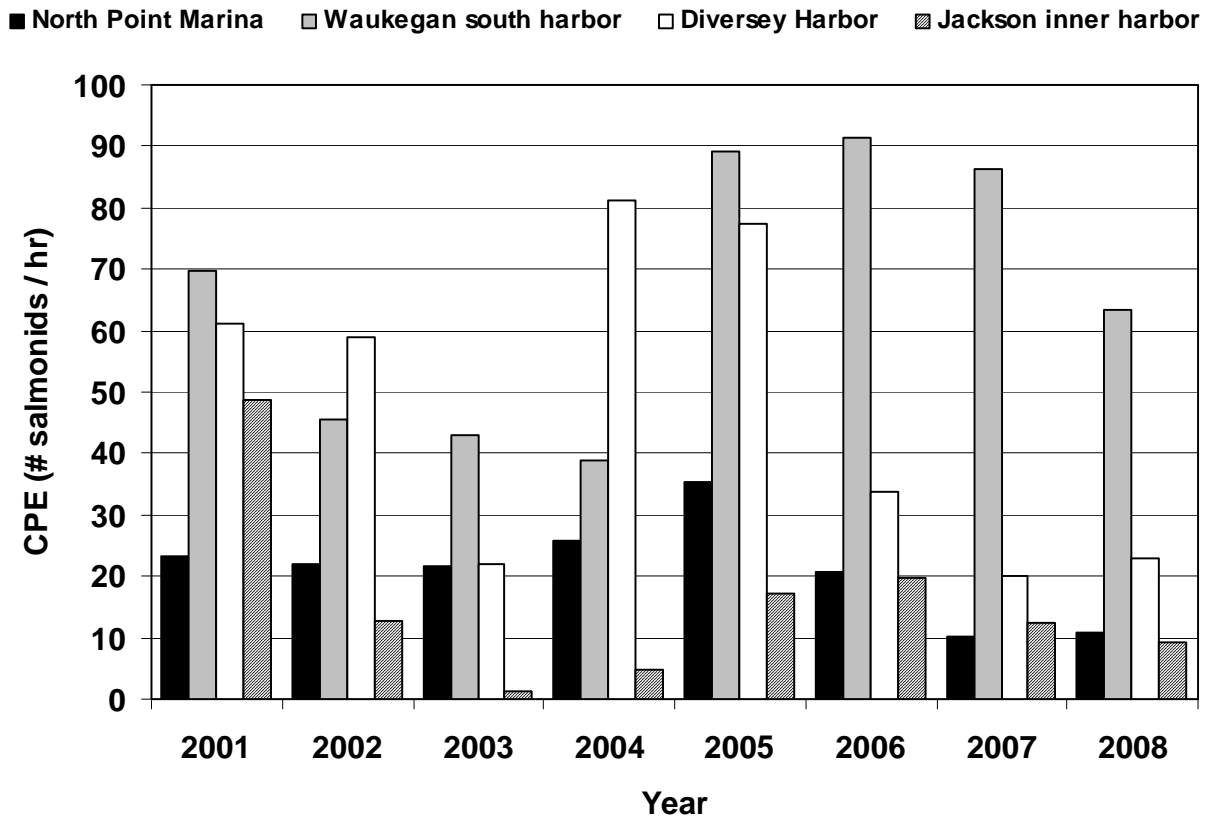


Figure 2. Catch-per-unit-effort for all salmonid species combined at four sampling sites, 2001-2008.

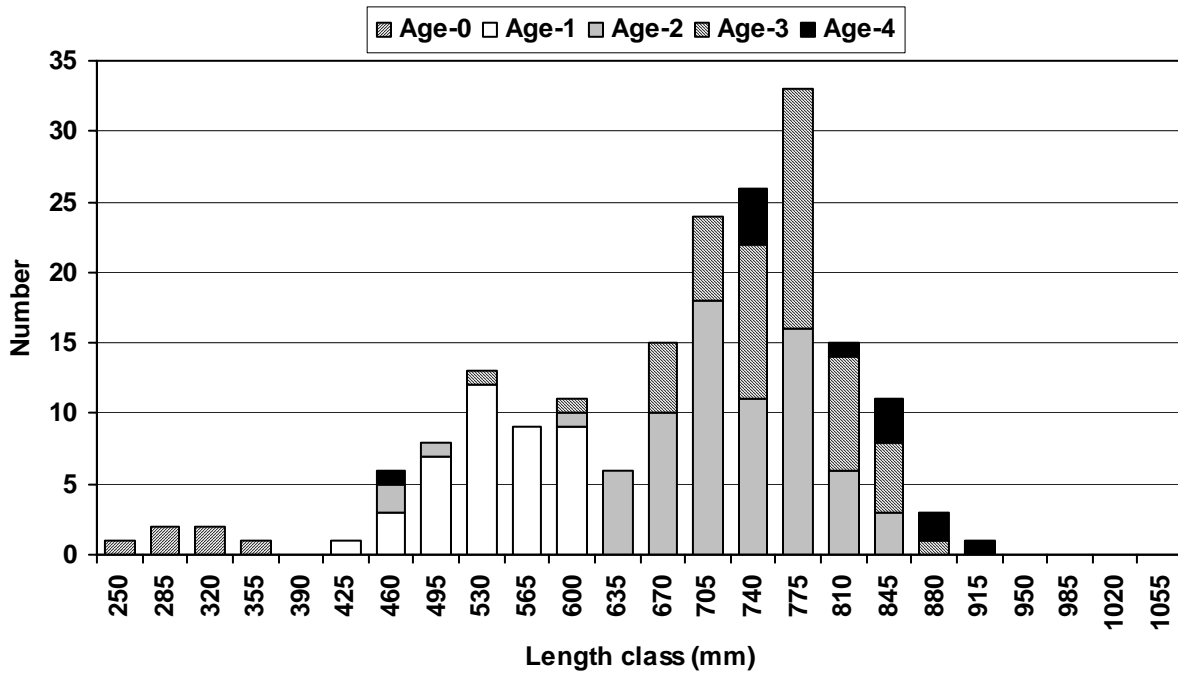


Figure 3. Length distribution of age-0 through age-4 Chinook salmon sampled in four Illinois harbors in 2008.

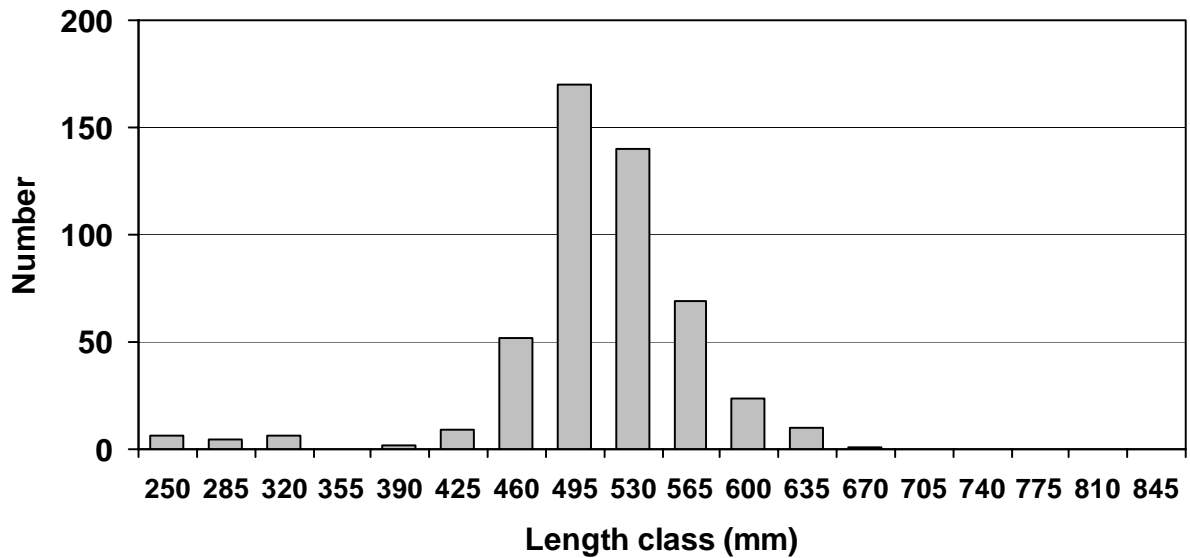


Figure 4. Length distribution of coho salmon sampled in four Illinois harbors in 2008.

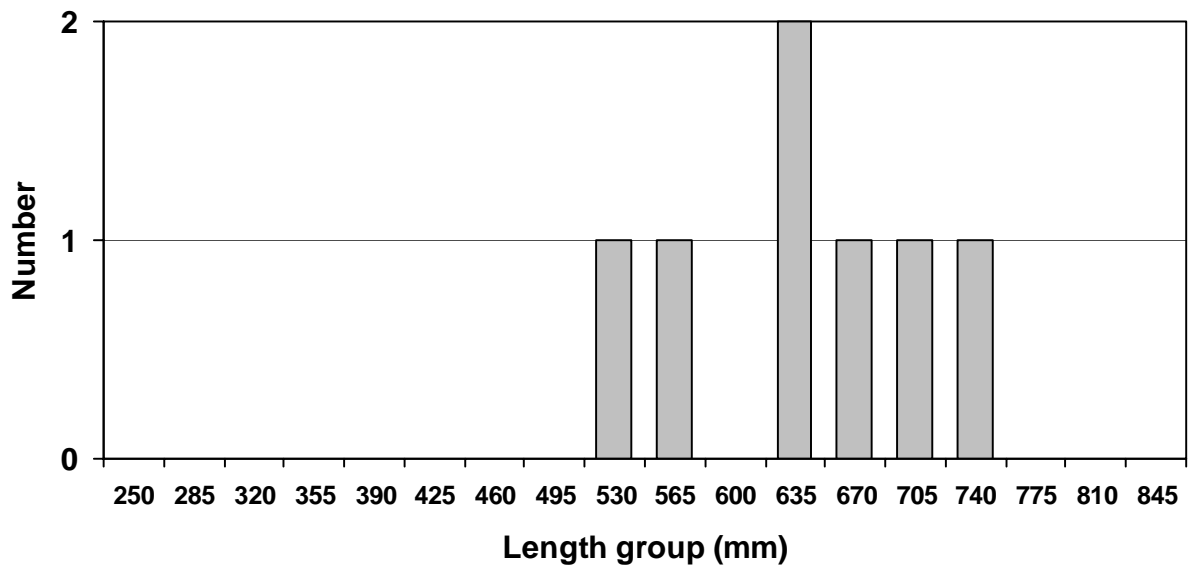


Figure 5. Length distribution of rainbow trout sampled in four Illinois harbors in 2008.

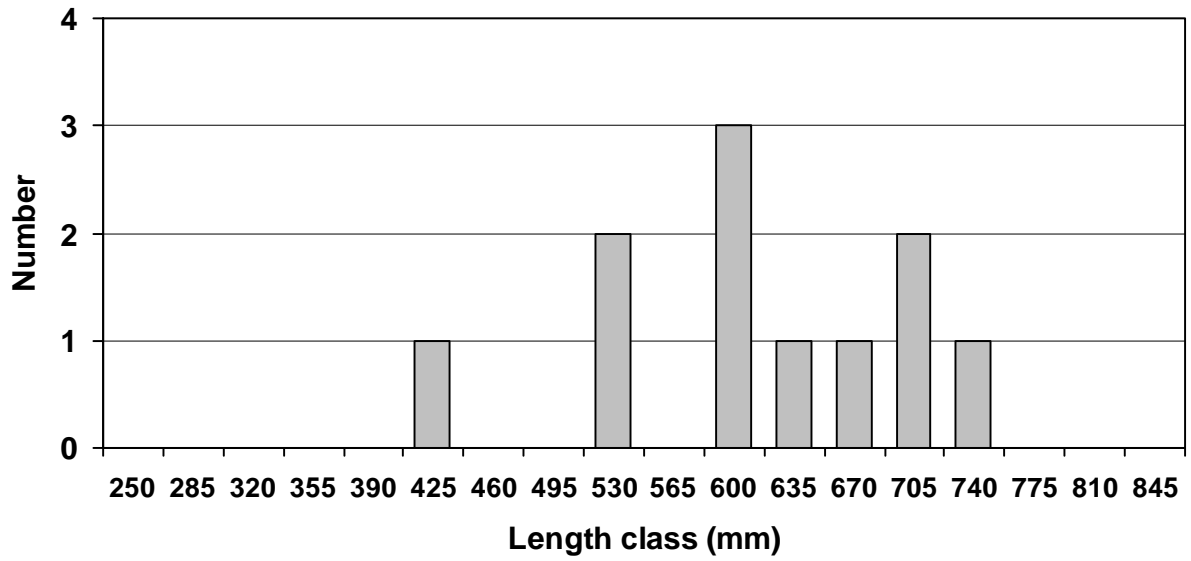


Figure 6. Length distribution of brown trout sampled in four Illinois harbors in 2008.