CHAPTER 3
PRIMARY DATA COLLECTION

3.1 INTRODUCTION

The principal objective of our assessment is to cost-effectively develop estimates of the value of services lost (damages) as a result of FCAs in the waters of Green Bay. For cost-effectiveness we limited our target population, and therefore our sample, for the primary damage assessment to anglers who purchased Wisconsin fishing licenses in eight Wisconsin counties near Green Bay and who were active in open-water fishing in the Wisconsin waters of Green Bay in 1998. In Chapter 8 we conduct a benefits transfer [43 CFR § 11.83(c)(2)(vi)] to estimate ice-fishing damages in the Wisconsin waters of Green Bay, and to estimate damages for all lost recreational fishing in the Michigan waters of Green Bay. The assessment does not address the value of recreational fishing services lost for anglers who do not fish Green Bay because of FCAs.

By sampling anglers who actively fish Green Bay, we measure damages for those individuals familiar with the site and for whom PCBs and the resultant FCAs are most relevant, which aids in the accuracy of the assessment. We focus on anglers active in the Wisconsin waters of Green Bay where the majority of damages can be expected to occur because the days of recreational fishing in these waters is about double that in the Michigan waters (Chapter 2), and because the PCB concentrations and severity of FCAs are higher in the Wisconsin waters of Green Bay (Chapter 2). We focus on anglers who purchase licenses in eight nearby counties because they can be expected to account for the majority of fishing activities in the Wisconsin waters of Green Bay (Section 3.2). We focus on open-water fishing because it accounts for 85% or more of all fishing on the waters of Green Bay.

A three-step procedure is used to collect data from a sample of anglers in the target population. First, a random sample of anglers was drawn from 1997 license holders in the county courthouses in the eight targeted counties. Second, using the license holder list, a telephone survey was conducted to identify and recruit Green Bay anglers for a followup mail survey and to collect data from a cross-section of anglers. Third, a mail survey was conducted with anglers active in open-water fishing in the waters of Green Bay. The mail survey asked more questions and more complicated questions that would not be desirable to ask by telephone.

In this chapter we address the selection of the target population for the primary assessment and the sampling procedures (Section 3.2), discuss the telephone and mail survey instruments and their implementation (Sections 3.3 and 3.4), and evaluate the sampling plan (Section 3.5).

Throughout this chapter, Green Bay refers to the Wisconsin waters of Green Bay, unless specifically identified otherwise.

3.2 SAMPLING PLAN

3.2.1 Selection of Target Population

The target population for the primary assessment is all resident and nonresident anglers who are active in fishing in the Wisconsin waters of Green Bay in 1998 and who purchased their Wisconsin fishing license in one of eight Wisconsin counties near to the waters of Green Bay. The eight counties include five with shorelines on the waters of Green Bay: Marinette, Oconto, Brown, Kewaunee, and Door; and three nearby counties with relatively large numbers of potential Green Bay anglers: Manitowoc, Outagamie, and Winnebago (Figure 3-1). We limited our target population and sampling to these eight counties because anglers purchasing licenses in these eight counties can be expected to account for most of the fishing activity in the Wisconsin waters of Green Bay, and thus the sample will provide a cost-effective means of data collection. Several pieces of evidence support these conclusions.

The 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. DOI, 1992) indicates that fishing in general tends to be a fairly localized activity. The average one-way distance by in-state residents for a fishing trip is about 34 miles. For Great Lakes fishing, the average one-way distance traveled by in-state residents is about 60 miles. Thus, we expect that a large fraction of fishing trips to the waters of Green Bay and the Lower Fox River originate in the counties around the waters of Green Bay.

A WDNR study of recreational boating patterns in Wisconsin suggests that a large percentage of the fishing effort on Green Bay originates in the counties near Green Bay (Penaloza, 1991, 1992). This is important because boating accounts for as much as 80% of fishing activity on the Wisconsin waters of Green Bay.[1] The Penaloza study explores the origination and destination patterns for boating trips in the state of Wisconsin. For Wisconsin locations, the study finds that the median one-way distance traveled by boaters is 10 miles, while the average one-way distance is 42 miles, again indicating that most boat fishing trips originate from nearby counties.

Penaloza identifies a “Lake Michigan” district, which includes 14 counties adjacent to, or near, Green Bay (Figure 3-2). This district includes the eight counties we include in our sample, plus Florence, Menominee, Shawano, Waupaca, Waushara, and Calumet counties. More than 80% of the respondents residing in the Lake Michigan District (LMD) specify the LMD as a destination

1. WDNR open-water creel surveys 1990-1998. Data provided by Brad Eggold, Senior Fisheries Biologist, Plymouth Field Station.

Figure 3-1
The Eight Targeted Counties

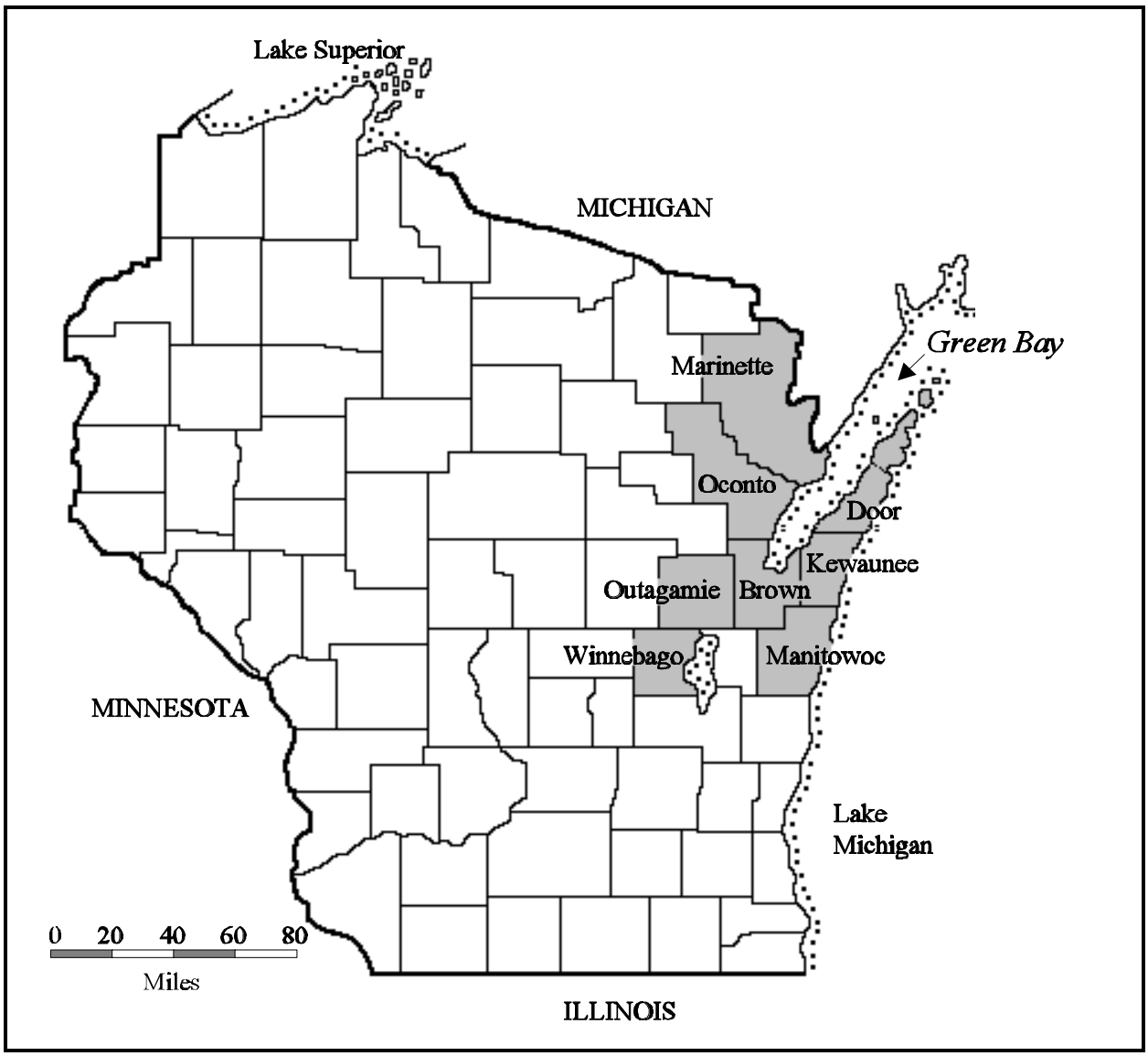
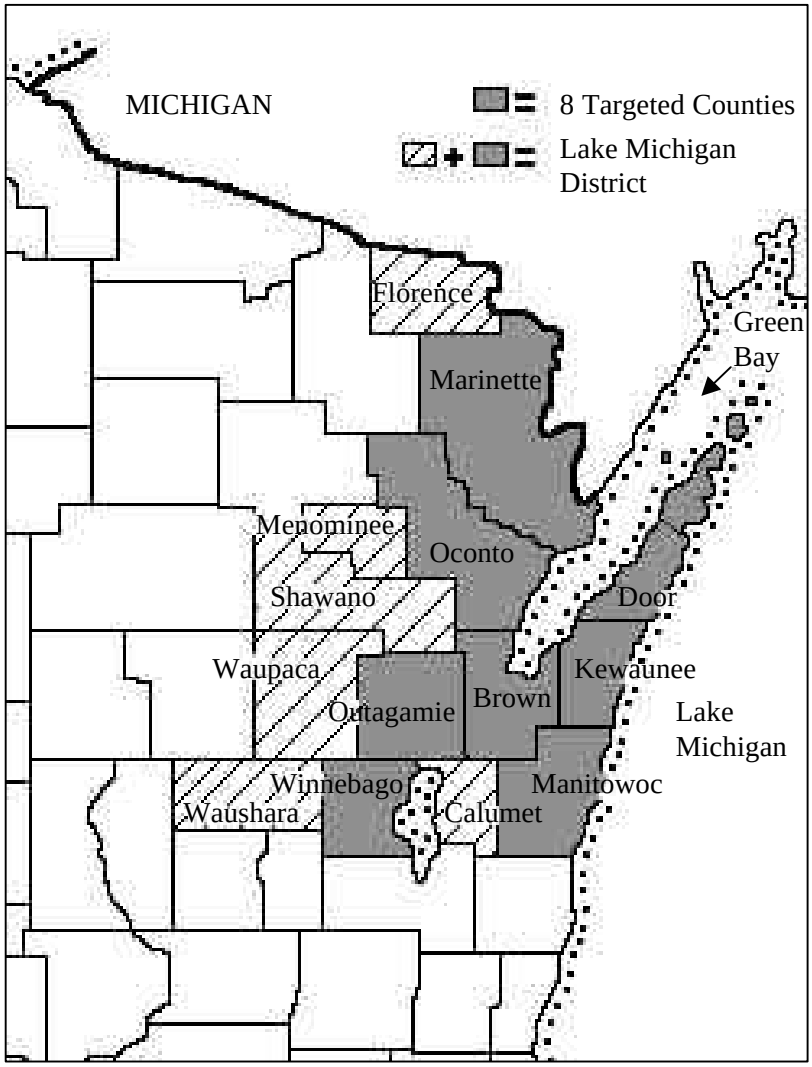


Figure 3-2
Lake Michigan District of Wisconsin



for boating trips involving fishing. This study also finds that about 77% of the individuals choosing the LMD as a destination are residents of the LMD. Since the frequency of use typically decreases as the distance to a site increases, we would expect substantially more than 77% of boating days in the district can be attributed to residents of the district.

The Penaloza survey asked boat anglers to identify their most frequently visited boat fishing site. For residents of the LMD, the percent indicating Green Bay or the Fox River are listed in Table 3-1. Note that the percentage citing Green Bay or the Fox River generally decreases as the county of residence is farther from these waters. The LMD counties that are not included in our

Table 3-1
Percent of Boat Anglers from Lake Michigan District Counties Choosing the Fox River or Green Bay as Their Most Frequently Visited Site

County of Residence	Included in Current Study Counties	Green Bay/Fox River as Most Frequently Visited Site
Brown	Yes	29%
Calumet	No	0%
Door	Yes	83%
Florence	No	0%
Kewaunee	Yes	17%
Manitowoc	Yes	25%
Marinette	Yes	8%
Menominee	No	0%
Oconto	Yes	8%
Outagamie	Yes	3%
Shawano	No	0%
Waupaca	No	0%
Waushara	No	0%
Winnebago	Yes	0%

Source: Based on data from WDNR boating study (Penaloza, 1991, 1992).

target population had no anglers citing the Fox River and Green Bay as their most frequently visited boating site.

Our eight targeted counties contain 83% of the population of the LMD (Wisconsin Legislative Reference Bureau, 1997). Most of the LMD counties not included in the sampling are the farthest from Green Bay, and it is likely that about 95% of the Green Bay fishing days by residents of the LMD are by residents of the eight targeted counties (see Section 3.5.5). By narrowing our sample to the eight targeted counties we significantly reduce the cost of assembling a sample, which requires visits to each county's courthouse because electronic records of fishing licenses do not exist.

By focusing on where anglers purchase their fishing licenses, rather than where they reside, the target population will include anglers who are residents of other Wisconsin counties and who are nonresidents. For instance, nonresidents who fish the Wisconsin waters of Green Bay are most likely to purchase their Wisconsin fishing licenses in Wisconsin counties near Green Bay. The same may be true for Wisconsin residents from other counties who primarily fish at Green Bay or other northeast Wisconsin destinations. Thus, the sample will represent a very large share of

anglers who are active in fishing the Wisconsin waters of Green Bay by including residents of those counties, who account for most fishing days in these waters, as well as including residents of other Wisconsin counties and nonresidents who purchase their licenses in these eight counties.

3.2.2 Sample Collection at County Courthouses

Our sample was selected from the population of anglers who purchased 1997-1998 fishing licenses in the eight targeted counties as a cost-effective means to identify and sample anglers in the target population.[2] Potential sample bias due to differences between a sample of 1997-1998 license holders and the target population of 1998 anglers who purchase licenses in these counties is addressed in Section 3.5.1.

We targeted an initial random sample of almost 11,500 anglers in the eight targeted counties to result ultimately in no less than 500 completed mail surveys. This sample size allowed for a conservative estimate of the incidence rate of Green Bay anglers, bad addresses, mail and telephone completion rates, and a substantial contingency for other unknowns.

The sample size targets were created by using the 1996-1997 license sales data from the WDNR (licenses valid from April 1, 1997 to March 31, 1998) to determine the proportions of fishing licenses sold per county for the eight targeted counties (Table 3-2).

Anglers' names and addresses were obtained from copies of 1997-1998 fishing season licenses sold in the eight targeted counties near Green Bay. Vendors keep carbon copies of each license sold until the end of the license season and then turn them over to the county clerk. As of July 1998, the most recent, accessible sample of Wisconsin fishing licenses were those turned in after the 1997 season (which ended in March 1998). To get this sample, each of the eight county clerks was visited over the three-week period from July 20 to August 11, 1998. The dates of these visits and the number of data entry assistants used by county are shown in Table 3-3.

The fishing licenses were randomly sampled so that each angler had a nearly equal probability of being sampled. Licenses were segregated by fishing license type.[3] One type of license was assigned to each data entry person who entered the data into an Excel workbook, keeping a separate worksheet for each type of license. For licenses issued to individuals, every 15th license

2. 1998-1998 licenses are valid for April 1997 through March 1998. A complete set of 1998 licenses is not available at courthouses, or any other location, until mid-1999.

3. In Kewaunee County licenses are filed by vendor and not by type. In this case, as each data entry person went through the vendor stack, he or she used a list to keep track of a separate count for each license type, and entered the data for each license type into a separate worksheet.

Table 3-2
1997-1998 Angling License Samples Obtained

County	Total Fishing Licenses Sold, 1996[a]	Proportion of 1996 Licenses Sold by Each County[b]	Number of Licenses Needed per County for Sample[c]
Brown	35,110	20%	2,340
Door	21,561	12%	1,437
Kewaunee	10,972	6%	731
Manitowoc	15,701	9%	1,046
Marinette	18,951	11%	1,263
Oconto	12,436	7%	829
Outagamie	26,753	16%	1,783
Winnebago	31,064	18%	2,070
Total	172,548	100%	11,499

a. Includes sales of all types of fishing licenses.
b. Percents may not total 100% due to rounding.
c. Number needed to get a total of about 11,500 licenses, while maintaining the county proportions of total license sales.

Source for fishing licenses sold: Based on WDNR Bureau of Customer Service and Licensing, Report of Fishing Licenses Sold by County, B130-30.

Table 3-3
Timeline for Sampling of Licenses by County

County	City Courthouse	Target Sample Size	Date (1998)	Data Entry Assistants
Brown	Green Bay	2,340	August 5/6	3
Door	Sturgeon Bay	1,437	August 3	2
Kewaunee	Kewaunee	731	July 30	2
Manitowoc	Manitowoc	1,046	July 29	2
Marinette	Marinette	1,263	August 7	3
Oconto	Oconto	829	July 24	2
Outagamie	Appleton	1,783	July 20/21	2
Winnebago	Oshkosh	2,070	August 10/11	3
All targeted counties		11,499		

was input (starting with the 14th license); and for licenses issued to married couples or families, every 7th license was input (starting with the 7th license), alternating between recording the husband's or wife's name. In any case where the selected license record was illegible (15 cases), the next legible license was recorded. The count was then resumed from the original illegible license.

For nonresident licenses, if the selected license record had a nondomestic address (two cases), the next license record with an American address was recorded. The count was then resumed from the original nondomestic address.

For each county, once all license types had been counted through, another count was made of the total number of licenses selected, and this total was compared to the target sample for the county. If the number of licenses selected was more than a few licenses short of the targeted sample, additional licenses were selected from each license type. A new skip interval was calculated for the license types issued to individuals and for the license types issued to married couples or families. The number of licenses obtained by county and license type are shown in Table 3-4.

3.3 TELEPHONE SURVEY

3.3.1 Telephone Survey Instrument

The telephone survey was used to identify the proportion of anglers who fish the waters of Green Bay, to obtain data on total fishing days and Green Bay fishing days, and to identify and recruit anglers who were active in 1998 in fishing the Wisconsin waters of Green Bay to participate in the followup mail survey. The telephone survey also collected information for all anglers in the telephone sample, regardless of whether they fished Green Bay in 1998. This allows a comparison of activity levels and attitudes for anglers who are active in Green Bay fishing versus anglers who are not, and allows a comparison of those Green Bay anglers who complete the followup mail survey to those who complete the telephone survey but do not complete the followup mail survey. The telephone survey collected the following information.

- ***Fishing activity level.*** Data were collected on the total days of ice-fishing and open-water fishing in 1998 up to the time of the telephone survey and how many of these days were in the waters of Green Bay. Because the survey was implemented in late 1998, over 95% of days fished in 1998 by these anglers are reflected in these data. These days are separated into days fished in the Lower Fox River and elsewhere in the waters of Green Bay (including tributaries up to the first dam or obstruction).

- ***Attitudes about Green Bay fishing.*** Anglers who did not fish Green Bay in 1998 were asked why they did not fish; and, if they would consider fishing Green Bay in the future, what things would have to change to consider fishing in the future. The questions about

Table 3-4
1997-1998 Angling License Sample Obtained

License Type	County								
	Brown	**Door**	**Kewaunee**	**Manitowoc**	**Marinette**	**Oconto**	**Outagamie**	**Winnebago**	**Total**
Resident annual	1,310	321	178	459	650	396	917	1,169	5,400
Husband and wife	671	147	62	220	276	237	637	520	2,770
Sportsman	236	45	34	102	102	56	214	188	977
Two day	49	452	356	146	20	5	2	0	1,030
Nonresident annual	25	115	24	16	80	33	12	12	317
Nonresident 15 day	13	65	12	10	26	18	6	27	192
Nonresident 4 day	41	181	39	52	127	55	27	205	731
Nonresident family annual	2	60	15	7	30	18	5	7	144
Nonresident family 15 day	0	65	7	8	25	14	5	13	152
Patron	0	0	1	14	0	0	0	0	15
Total sample obtained	2,347	1,451	728	1,034	1,336	832	1,825	2,141	11,694
Target	2,340	1,437	731	1,046	1,263	829	1,783	2,070	11,499
Total sample obtained as percent of target	100.3%	101.0%	99.6%	98.9%	105.8%	100.4%	102.4%	103.4%	101.7%

why they did not fish Green Bay and what would have to change are open-ended — potential responses are not provided to the respondent. These questions provide an indication of the share of anglers who are not active in Green Bay fishing who attribute not fishing in Green Bay to PCBs and fish consumption advisories — a damage category that is not otherwise quantified in this assessment. These anglers experience a damage in that the PCBs and resultant FCAs cause them to forgo fishing at a site they would otherwise choose to visit.

- ***Attitudes about fish contamination and fishery management options.*** Questions were asked about catching fish that are free of contamination and about the importance of 10 actions that could be taken to improve fishing in Wisconsin: six for the waters of Green Bay and four for other waters. These actions include increasing catch rates for sport fish and for panfish, cleaning up contaminants, increasing boat ramps and other facilities, improving water quality, and reducing the cost of a fishing trip. These questions identify the relative importance of improvements in different fishing characteristics for all anglers and for Green Bay anglers. The responses to these questions also provide a key point of comparison between those anglers completing the followup mail survey versus all other anglers completing the telephone survey.

- ***Socioeconomic characteristics.*** Questions include years of fishing experience, boat ownership, vacation home ownership with distance from Green Bay, age, employment status, racial group, household composition, and gender. These data assist in the statistical evaluation of group respondents.

- ***Mail survey solicitation.*** For anglers who actively fished Green Bay in 1998, the telephone survey concludes with a solicitation to participate in the followup mail survey; and confirms the correct name and address to which materials would be sent, and a telephone number for any future contact.

3.3.2 Telephone Survey Implementation

The telephone survey was conducted by Hagler Bailly's facility in Madison, Wisconsin. This 26-station centrally monitored interviewing facility uses CASES, a computer-assisted telephone interviewing (CATI) software developed and supported by the University of California, Berkeley. The telephone survey occurred between November 17, 1998 and January 15, 1999.

To ensure the efficient use of resources, the initial sample of license holders collected at county courthouses was split into two segments, with the first segment of 6,799 records (about 60% of

the sample) selected to be fielded.[4] The first segment of the collected sample was sufficient to reach the mail survey targets so the second segment of the collected sample was not used.

The fishing licenses provided names and addresses but no phone numbers. Phone numbers were assembled using regular and reverse directories, supplemented by directory assistance. We were unable to obtain phone numbers for about 32% of the anglers in our sample (see Table 3-5). This reflects changes in addresses, residents with unlisted numbers, and potentially invalid license information.

Table 3-5
Proportion of Starting Sample with Available Phone Number

	Total	Percent
Starting sample (part of the courthouse sample initially set up)	6,799	100%
Phone number found	4,597	67.6%
No phone number found[a]	2,202	32.4%

a. After using reverse directory and calling directory assistance.

The telephone survey was implemented with the sample of 4,597 records with an identified telephone number. Overall, the telephone survey was completed with 69% of the license holders with identified telephone numbers (see Table 3-6). At a minimum, eight attempts were used to reach sampled license holders. We attempted to convert all "soft" refusals (e.g., in instances where the angler stated it was an inconvenient time to call, we contacted them at a later time). The reasons given for refusals were 9% said they did not fish anymore, 6% said they do not do surveys, 22% hung up the telephone before an introduction could be read, 50% indicated they were just not interested, 4% asked to have their name taken off the list, and 9% gave miscellaneous other reasons.

Table 3-7 shows a comparison, by county, of the total number of 1997 license holders, the number of licenses in the full sample of 11,694, the number of licenses in the reduced sample of 6,799, and the number of completed telephone interviews. The table confirms that the telephone survey completions by county generally retain the proportion of license holders in the target population for 1997, which is also very similar to the proportion of license holders in 1996 that was used to develop the sampling plan (Table 3-2). Thus, we can expect the proportions to reflect also the proportions of license holders in 1998.

4. All records were assigned a random number, the records were sorted in ascending order by random number, and the first 6,799 records were selected.

Table 3-6
Disposition of Telephone Survey Sample

	Total	Percent of Total	Percent of Completes
A. Disposition of Sample			
Adjusted sample	4,597	100%	—
Refused telephone recruitment screening survey	1,115	24.3%	—
Language barrier/respondent incapable (elderly, ill)	158	3.4%	—
Called minimum of eight times	134	2.9%	—
Completed telephone surveys — total	3,190	69.4%	100%
B. Categorization of Anglers Completing the Telephone Survey			
Did not fish in 1998	520	—	16.3%
1998 angler, but not a Green Bay open-water angler[a]	1,831	—	57.4%
1998 Green Bay open-water angler declining mail survey	67	—	2.1%
1998 Green Bay open-water angler recruited for mail	753	—	23.6%
1998 Green Bay open-water angler eligible to be recruited, but after cutoff date to send the mail survey	19	—	0.6%

a. Includes 67 anglers who only ice fished Green Bay in 1998.

The telephone survey data on 1998 fishing activity were used to categorize anglers by participation in the Green Bay fishery. About 84% of 1997-1998 license holders fished in 1998 (Table 3-6). As seen in Table 3-8, about 26.3% of all 1997-1998 license holders (and 31.4% of the 1997-1998 license holders who fished in 1998) fished the open waters of Green Bay in 1998. Note that 62% of all 1997-1998 license holders have been active in Green Bay fishing in 1998 or at some time in the past.

For subsequent data analysis, we use 31.4% as the percent of anglers in our target population each year who are active in fishing the Wisconsin waters of Green Bay. We assume 1997 license holders who did not fish at all in 1998 are replaced in the population by an equal number of 1998 anglers who were not license holders in 1997. That is, the departing population members are replaced so that the total number in the population remains roughly unchanged (see Section 3.5 for additional discussion of this point).

Table 3-7
Disposition of Sample by County Where License Purchased

County Where 1997 License Purchased	1997 License Sales Reported by WDNR		Initial Sample of License Holders		Reduced Sample of License Holders		Telephone Surveys Completed	
	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Brown	28,800	19.6%	2,347	20.1%	1,407	20.7%	658	20.6%
Manitowoc	13,316	9.1%	1,034	8.8%	609	9.0%	317	9.9%
Marinette	16,920	11.5%	1,336	11.4%	736	10.8%	354	11.1%
Oconto	10,120	6.9%	832	7.1%	502	7.4%	247	7.7%
Outagamie	22,455	15.3%	1,825	15.6%	1,011	14.9%	514	16.1%
Winnebago	25,275	17.2%	2,141	18.3%	1,270	18.7%	554	17.4%
Door	19,457	13.3%	1,451	12.4%	841	12.4%	343	10.8%
Kewaunee	10,233	7.0%	728	6.2%	423	6.2%	203	6.4%
All Targeted	146,576	100%	11,694	100%	6,799	100%	3,190	100%

Source for fishing licenses sold: Based on WDNR Bureau of Service and Licensing, Report of Fishing Licenses Sold by County, B130-30.

Table 3-8
Telephone Survey Respondent Green Bay Fishing Activity in 1998

	1997-1998 License Holders		1997-1998 License Holders Who Fished in 1998	
	Number	Percent	Number	Percent
Fished Green Bay in 1998	906	28.4%	906	33.9%
- Fished Green Bay open water in 1998	839	26.3%	839	31.4%
- Fished Green Bay in 1998, but only ice fishing	67	2.1%	67	2.5%
Fished Green Bay sometime in the past, but not in 1998	1,084	34.0%	862	32.3%
Never fished Green Bay	1,197	37.5%	899	33.7%
Undetermined	3	0.1%	3	0.1%
Total	3,190	100.0%	2,670	100.0%

The telephone survey identified 839 Green Bay open-water anglers in 1998, of which 820 were recruited for the followup mail survey, with 753 (92%) agreeing to participate in the survey (Table 3-6). Nineteen Green Bay open-water anglers were identified too late to be recruited for the mail survey.

3.4 MAIL SURVEY

3.4.1 Mail Survey Instrument

The core of the mail survey is a series of eight choice questions concerning preferred alternatives for fishing conditions in the waters of Green Bay (see Section 1.4 and Figure 1-2), and a followup question to each choice question about how often the respondent would fish the waters of Green Bay under the preferred alternative. These questions provide the stated preference information used to value changes in Green Bay fishing conditions. The details of the choice questions and followup questions are discussed in Chapter 5, and the modeling of and results for the choice questions are discussed in Chapters 6 through 9. The mail survey questions before and after the choice question section support the development and evaluation of the choice questions, and are discussed in the remainder of this section.

The design of the mail (and telephone) survey instrument reflected a neutral presentation. The sponsor(s) of the survey and the intended use of the results for damage assessment were not identified. Cover letters for the mail survey identified that the survey would assist in "important management decisions to be made concerning fishing in and around Green Bay," and that "the results of this study will be made available to government and industry representatives."

In pretests, when respondents were asked who they thought the survey was being conducted for and why, the most frequent answers were they did not know or that it involved the State of Wisconsin to help evaluate what to do in Green Bay. Respondents often stressed to us the importance of their input given their concerns with FCAs, catch rates, costs, and other considerations in the waters of Green Bay. Respondents infrequently raised the potential link to the Superfund or NRDA cases. Given these considerations and the high response rates, we conclude the respondents treated their responses as having important input to management decisions that would affect them and did not consider the work to be for litigation.

Information in the survey was verified as factual, and the facts and survey presentation were repeatedly tested and peer reviewed for presentation and content. The final survey instruments reflected an 18-month process that involved five focus groups and four pretests involving about 200 anglers, most of whom were active in fishing the waters of Green Bay (Table 3-9).

The remainder of this section summarizes the content of the mail survey instrument (see Appendix E for a copy of this survey instrument, and Section 5.4 for additional discussion).

Table 3-9
Recreation Survey Pretesting Steps

Date	Site	Activity	Number of Participants	Type of Respondents	Focus	Investigators
4/22/97	Marinette, Wisconsin	Focus group	12	Anglers who fished Green Bay or Lake Michigan in the past 3 years	Investigate awareness of pollution and PCB issues, health concerns about eating fish, and behavioral responses to perceived pollution in Green Bay and Lake Michigan	Mike Welsh
4/23/97	Marinette, Wisconsin	Focus group	12	Anglers who did not fish Green Bay or Lake Michigan in the past 3 years		
6/23/97	Green Bay, Wisconsin	Focus group	12	Anglers who fished Green Bay or Lake Michigan in the past 3 years	Test survey materials, assess potential attributes and attribute levels for potential choice question, explore role of PCBs in anglers' perception of the Green Bay fishery	Mike Welsh
6/23/97	Green Bay, Wisconsin	Focus group	6	Anglers who did not fish Green Bay or Lake Michigan in the past 3 years		
6/24/97	Green Bay, Wisconsin	Focus group	12	Anglers who fished Green Bay or Lake Michigan in the past 3 years		
12/10/97	Green Bay, Wisconsin	In-depth interview	52	Anglers who fished Green Bay in the past 3 years or who would fish Green Bay in the absence of pollution-related issues	Test choice question survey materials, clarity of questions, and length of survey	Mike Welsh, Edward Morey, Jeff Lazo, Sonya Wytinck
12/11/97	Oshkosh, Wisconsin	In-depth interview	50			
8/16 to 08/30/98	Brown County residents	Mail/ Phone	26	Anglers who fished Green Bay in the past 12 months	Final pretest of survey	Mike Welsh, Sonya Wytinck
9/9/98	Green Bay, Wisconsin	In depth interview	18	Anglers who fished Green Bay in the past 12 months		Mike Welsh, Sonya Wytinck

The Study Area

The mail survey begins by clearly delineating the study area as the "Waters of Green Bay," which include the Bay of Green Bay, Sturgeon Bay, and the rivers and streams that feed into Green Bay up to their first dam, if any. This is reinforced through the cover page title, "What Do You Think About Fishing the Waters of Green Bay? 1998 Angler Survey;" a color map and definition of the study area inside the front page; and Questions 1 and 2, which ask about how the quality of fishing in these waters compared to other locations the anglers fish at.

Fishing Activity

Questions 3 through 6, 39, and 40 complete the respondent's record of Green Bay fishing days in 1998, including the number of additional days fishing the waters of Green Bay since the telephone survey (Q3), and the number of additional days anticipated in 1998 (for surveys mailed before the end of the year, Q39, Q40). Other fishing activity questions include how often they target different species (Q4), what percent of their open-water fishing days are from a boat (Q5), and (if they fish from a boat) how many people are in their typical boat fishing group (Q6). These questions are used to characterize the anglers by type of anglers (e.g., shore anglers for perch, boat anglers for sport-caught fish) and to evaluate further the validity of the data collection. For example, anglers who often target perch would be expected to place more importance on perch catch rates and FCAs than would anglers who seldom target perch.

Fishing Characteristics

The survey focuses on catch rates and FCAs for four species (yellow perch, trout/salmon, walleye, and smallmouth bass), and on costs to visit a Green Bay fishing site. Each of these fishing characteristics is given a consistent presentation to reduce any potential importance bias by stressing a specific characteristic (e.g., FCA levels). Questions 7 through 13 introduce the fishing characteristics to be addressed in the choice questions and thus begin the cognitive process of evaluating how important different levels of these characteristics are to anglers' fishing experiences. These questions also introduce a minimum set of common information, and introduce the concepts of relative importance and tradeoffs between alternative characteristics before the actual choice questions. See Section 5.4 for an additional discussion on the selection of these site characteristics (and omission of other site characteristics), and the selection of the levels of the characteristics.

Question 7 asks the respondent to rate the importance of various actions that can be taken to enhance the Green Bay fishery (similar to telephone survey Question 13), including adding boat launch facilities, shoreline parks, and nature trails; improving water clarity; increasing catch rates; removing PCBs and fish consumption advisories; and other items of concern to the respondent. This question addresses all the characteristics to be traded off in the choice questions and provides a consistency check between the telephone survey and mail survey concerning the relative

importance of actions to enhance the Green Bay fishery. Further, items in Question 7 that are not addressed in the choice questions (boat launches, shoreline parks, and trails) are an indirect reminder that there are other alternative (substitute) improvements than those addressed in detail later on.

Question 8 introduces the concept of catch time in terms of how long one fishes on average per fish caught; differentiates catch time from the bag limit; and asks about the importance of increasing fish populations and thus catch rates.

Questions 9 through 11 concern PCBs and FCAs. Question 9 introduces PCBs and the resulting FCAs, and asks whether the respondent was aware of the FCAs. Question 10 further defines FCAs to establish a consistent understanding, and identifies a subset of the potential health risks associated with eating PCB-contaminated fish. The health impacts identified (for women, increased risks of bearing children who have learning disabilities or develop more slowly; and for the total population, increased cancer risks) are consistent with the WDNR FCAs and published information (see Young, 1999 for a brief summary). Question 10 prepares the respondent to evaluate the relative importance of changes in FCAs versus catch rates and fishing costs by asking how bothersome, if at all, it is to fish with advisories of different severity levels.

Question 11 addresses if and how anglers react to the fish consumption advisories in terms of reducing days fished, changing the location of fishing, changing the type and size of fish targeted and kept, and changing methods of fish preparation and cooking. These response categories are similar to the types of impacts typically associated with FCAs (see Chapter 2), and reflect the intent of FCAs — to change behavior, as required, to reduce potential adverse exposure to PCBs.

Question 12 asks for a breakdown of expenses the respondent personally incurs on a typical day of fishing the waters of Green Bay. This question serves as a reminder of the costs the respondent incurs and is asked before the questions addressing tradeoffs between costs, catch rates, and FCA levels.

Question 13 addresses the relative importance of higher boat launch fees, catch times, and PCB contamination. For respondents who do not fish from a boat, this question introduces the concept that they should “think of the daily boat launch fee as a fee you would have to pay to fish the waters of Green Bay” so that the cost variable in the choice questions has a meaning to all respondents. This presentation was tested in the pretests and found to be accepted in a manner consistent with the ultimate choice questions (e.g., trading off costs versus FCA levels and catch rates).

Questions 15 through 34 are the fishing choice and followup questions, which are discussed in Chapter 5. Item 14 is not a question but an information section prior to the fishing choice questions.

Followup and Socioeconomic Questions

Questions 35 through 38 are followup questions to evaluate the responses to the choice questions and other survey questions. Question 35 asks how important each characteristic in the choice questions was to the choices (e.g., perch catch rate, perch FCA, trout catch rate, . . ., daily boat launch, or access fee). Question 35 is used to establish links from:

- attitudes and fishing behaviors to those characteristics anglers state they are most concerned about when making choices among alternatives in the choice questions (e.g., anglers who target perch can be expected to care more about perch catch rates and perch FCAs)

- characteristics anglers state they are concerned about and intended to rank high in their choices (Question 35) and the actual characteristic levels in alternatives selected in the choice questions (e.g., respondents who rank perch catch rates as one of the most important characteristics make choices that show a preference for perch catch rates).

When evaluated across the entire sample and all choice questions (see Section 5.4), these links substantiate that the responses to choice questions are meaningful because they reflect both actual behavior and attitudes, as well as reflecting intended responses to the choice questions.

Question 36 asks about perceived average catch rates, Question 37 asks about perceived FCA levels, and Question 38 asks about perceived average daily boat launch fees — all for the waters of Green Bay. These questions aid in understanding perceptions about fishing conditions in the waters of Green Bay. Note, however, that perceptions may reasonably differ from measured conditions, and may vary across individuals, because of different experiences and expertise; because the FCAs and catch rates have varied through time and vary throughout the Bay of Green Bay (in Wisconsin and Michigan), and between Green Bay and the Lower Fox River (the FCAs even vary by the size of fish for some species); and because of measurement error.

The mail survey concludes with education and household income questions, which were not asked in the telephone survey.

3.4.2 Mail Survey Implementation

The mail survey was also carried out by the Hagler Bailly Survey Center. Ten versions of the mail survey were prepared. These versions differed only in terms of the choice alternatives presented in Questions 19, 21, 23, 25, 27, 29, 31, and 33. Sampled anglers were randomly assigned a version number (1-10) before being called for the telephone screener survey to assure random assignment. The mail survey consisted of the following procedures.

1. ***Initial mail survey package.*** All 1998 Green Bay anglers who agreed to participate in the mail survey were mailed a survey booklet within one week of their completion of the telephone screener survey. This mailing consisted of a cover letter from Hagler Bailly, a mail survey booklet, an incentive (two $1 bills), and a postage-paid return envelope. This mailing was done from October 26, 1998 to January 11, 1999.

2. ***Thank you/reminder postcard.*** All anglers were mailed a postcard within one week of the initial survey mailing. This postcard thanked those who had responded and reminded those who had not responded to please do so.

3. ***Followup survey mailing.*** Approximately two weeks after the thank you/reminder postcard, all nonrespondents were sent a followup survey mailing. This mailing consisted of a cover letter from Hagler Bailly, another copy of the mail survey booklet, and a postage-paid return envelope. (This letter was revised after December 31, 1998, to remove references to the holiday season.)

4. ***Second followup survey mailing.*** Approximately two weeks after the first followup survey mailing, all nonrespondents were sent another followup survey mailing. This mailing consisted of a cover letter from Hagler Bailly, another copy of the mail survey booklet, and a postage-paid return envelope.

5. ***Special third followup survey mailing.*** Nonrespondents who had completed a telephone survey before November 20, 1998, were sent a third survey mailing. This mailing consisted of a cover letter from Hagler Bailly, another copy of the mail survey booklet, and a postage-paid return envelope. This was mailed in January, after the holiday season, and was sent four to six weeks after the second followup survey had been mailed.

6. ***Initial mail survey package to anglers who refused second phase.*** The 68 Green Bay anglers who, in the telephone survey, declined to participate in the second phase of the research were also mailed a survey package, although this initial mailing was not sent until January 8, 1999 (at least one month after their initial refusal). These respondents were thanked for their participation in the initial phase of research, and were asked to reconsider helping out with the second phase. Since the study was near completion, these anglers only received the first three mailings described above. Fifty percent of these respondents completed and returned the survey.

Table 3-10 shows the response rates to the mail survey. In the telephone survey, 839 anglers were identified as having fished the open waters of Green Bay in 1998. Eight-hundred-twenty of these identified anglers were sent a mail survey; 19 were not eligible as they were identified too late in the process to be included in the followup mail survey sample). By the cut off date of February 1, 1999, 647 had returned the mail survey. Overall, completed mail surveys were received from about 79% of the 820 Green Bay open-water anglers to whom the mail survey was

Table 3-10
Disposition of Mail Survey Sample

	Number of Surveys	Percent of Surveys
Number mailed	820	100%
Undeliverable	6	0.7%
Refused	4	0.5%
Not returned before cut-off date	163	19.9%
Completed	647	78.9%

sent and from about 77% of the 839 Green Bay open-water anglers identified in the telephone survey.

3.5 SAMPLE EVALUATION

This section evaluates the collected sample data in terms of potential sample bias comparing the sample versus the target population for the primary assessment (Section 3.5.1), potential nonresponse bias resulting from less than full participation of the sampled anglers (Section 3.5.2), and potential recall bias on how many days were spent fishing in 1998 (Section 3.5.3). To account for these potential biases, in Section 3.5.4 we apply corrections to the sample estimates for open-water fishing days to determine population estimates of open-water fishing days. No adjustments are made to the estimates of damages per open-water fishing days due to FCAs. In Section 3.5.5 we use the sample results to evaluate what share of all fishing days in the Wisconsin waters of Green Bay are likely to be by the target population.

3.5.1 Sample Bias

Sample bias refers to biases that may result from differences between the sample selected and the target population. The target population for the primary valuation is anglers who purchased licenses in the eight targeted counties and who actively fished Green Bay in 1998. Through the courthouse sampling procedures we have a random sample of 1997 anglers purchasing licenses in these counties without any significant sampling bias. Sample biases may arise from (1) differences between the 1997 license-holder population used to develop the sample and the 1998 population of anglers active in fishing the waters of Green Bay, and (2) differences between those individuals for whom a telephone number could and could not be identified.

1997 License Holders versus 1998 Anglers

Turning to the first issue, the sampling technique captured anglers who purchased licenses in 1997 and fished in 1998, but did not capture any anglers who fished in 1998 but did not purchase licenses in 1997, i.e., "new" anglers. This omission creates four questions: (1) How many of these "new" anglers are there?, (2) What percentage of them fished in Green Bay?, (3) How often did they fish in Green Bay and at all fishing sites?, and (4) How do these "new" anglers value service losses from FCAs compared to repeat anglers?

We address the first question by assuming that the number of "new" anglers in the population is the same as the number of "dropout" anglers who bought licenses in 1997 but did not fish at all in 1998 (otherwise the angling population size would continuously decrease; in fact, the fishing hours slightly increased from 1997 to 1998, as reported in Table 2-3). According to the telephone survey, 16.3% of all 1997 license holders did not fish at all in 1998 (Table 3-6). We assume that an equal number of "new" anglers replaces these "dropout" anglers in 1998.

The second question is the percentage of these "new" anglers who fished in Green Bay in 1998. We have no reason to expect that "new" anglers will prefer or reject Green Bay as a fishing location in greater or lesser proportions than did the telephone survey respondents who fished in 1998. Therefore, we assume that the same percentage of these "new" anglers fished in Green Bay as was reported by the survey respondents, i.e., 31.4% (Table 3-8).

The third question is how often these "new" anglers go fishing (at Green Bay and at all sites), compared to the anglers participating in the telephone survey. Anglers who fish every year may be more avid (i.e., fish more days per year) than anglers who only fish in some years. For example, Table 3-11 identifies that the number of fishing days is about 36% lower for anglers who did not fish Green Bay in 1998 but have in the past (e.g., they may be "intermittent" Green Bay anglers), and Table 3-12 suggests that females may be more likely to be "intermittent" anglers. Female license holders fish about 40% less than do male license holders (Appendix F, Table F-1).

Thus, it may introduce a bias to assume that the "new" anglers not captured by the survey fish the same amount as the survey respondents (who bought licenses in 1997 and were still fishing in 1998). To be conservative and account for this potential bias, we assume that the "new" anglers are less avid than the survey respondents and that they fished only 50% as often (half as many days per year). This assumption is conservative and may result in an underestimate of damages because the 50% assumption produces a larger reduction that other evidence suggests (Table 3-11 and Appendix F, Table F-1), and because the assumption that "new" anglers are less avid than long-time (or repeat) anglers may be false. For example, many of these "new" anglers may be new to the sport because they are recent immigrants to the area who are just as avid as long-time residents.

Table 3-11
Mean Fishing Days to All Sites in 1998 by Green Bay Experience
(telephone survey data)

	Fished Green Bay in 1998[a]	Fished Green Bay, Not in 1998	Never Fished Green Bay
Mean days ice fishing in 1998	4.9	3.2	1.8
(SE)	(0.29)	(0.25)	(0.18)
Mean days open-water fishing in 1998	24.1	15.5	12.0
(SE)	(0.82)	(0.67)	(0.56)
Mean days fishing in 1998	29.0	18.7	13.7
(SE)	(0.97)	(0.79)	(0.64)
Median	20	10	6

a. Anglers who participated in open-water fishing on the Wisconsin waters of Green Bay.

The fourth question censors whether these "new" anglers value service losses from FCAs different than do the repeat anglers. We make no adjustment to the value per fishing day for reductions in FCAs as a result of potential sample bias from using a 1997 sample of license holders and 1998 fishing activity. Several pieces of data from the survey suggest that per day fishing values will not be significantly different for these "new" anglers. First, attitudes about enhancements to the Green fishery are very similar for anglers who have (1) never fished Green Bay, (2) fished Green Bay but not in 1998 (and may be intermittent Green Bay anglers), and (3) fished Green Bay in 1998. Table 3-13 shows the average responses to the following question, "I am going to read you 10 actions that might be taken to improve the quality of fishing in Wisconsin. Six of these actions are for the waters of Green Bay and the other four are for other waters. For each statement, please tell me if, compared to other things that could be done to improve fishing, you think taking this action is, 'Not at all important' [= 1], 'Somewhat important' [= 2], or 'Very important' [= 3]." Results from this question are informative to understanding how values for reducing FCAs may vary across anglers and for considering what actions are most important to restore and enhance fishing in the waters of Green Bay and elsewhere in Wisconsin.

In Table 3-13, actions are ordered from the highest to the lowest average ranking given by all respondents, not in the order in which the actions were presented in the telephone interview. The two actions given the highest importance for all those interviewed were cleaning up contaminants in Green Bay and in inland waters so that none of the fish caught are contaminated. About 84% of the respondents ranked these actions as very important, and less than 2% thought they were not at all important.

Table 3-12
Socioeconomic Profile by Green Bay Experience
(telephone survey)

	Fished Green Bay in 1998	Fished Green Bay, Not in 1998	Never Fished Green Bay	All Respondents
Percent male	81.9%	77.2%	65.8%	74.2%
Mean age (SE) (Question 18)	41.5 (0.40)	43.6 (0.35)	41.7 (0.35)	42.3 (0.21)
Percent Caucasian (Question 20)	91.6%	91.8%	90.3%	91.2%
Percent Native American (Question 20)	5.0%	5.2%	5.1%	5.0%
Percent with job for which they receive a wage or salary	84.3%	82.9%	82.3%	83%
Percent — work full-time	77.5%	74.4%	72.3%	74.6%
Percent — work part-time	6.7%	7.8%	9.4%	8.1%
Percent — homemaker	2.0%	1.9%	4.7%	3.0%
Percent — retired	7.1%	8.5%	6.6%	7.4%
Percent — self employed	4.4%	5.0%	3.7%	4.3%
Mean N of people in household (SE) (Question 21)	3.2 (0.05)	3.0 (0.04)	3.2 (0.04)	3.1 (0.02)

The action ranked next in importance was improving the clarity of water in Green Bay, which was slightly more important to those who had never fished Green Bay (about 70% of those who had never fished Green Bay thought it was very important compared to 61% of those who had fished in the waters of Green Bay in 1998). The remaining actions were very important to some anglers but not the majority of anglers. Only 29% of anglers felt increasing panfish catch rates was very important (34% of 1998 Green Bay anglers), and 22% felt that increasing public boat launches on inland waters was very important. Note also that anglers, including Green Bay anglers, felt that additional inland boat ramps were slightly more important than additional Green Bay boat ramps.

Next, evidence here suggests that the anglers that fish less often do not necessarily have significantly lower values per fishing day, if lower values at all, for eliminating FCAs in Green Bay. For example, while female license holders tend to fish about 30% to 40% less often than do male license holders (Table F-1), they have per day values for reducing FCAs that are 40% larger

Table 3-13
Importance Rating of 10 Actions to Improve Wisconsin Fishing
(telephone survey Question 13, where 1 = not at all important, 2 = somewhat important, and 3 = very important; mean and SE reported)

	Fished Green Bay in 1998	Fished Green Bay, Not in 1998	Never Fished Green Bay	All Respondents
Clean up contaminants so that none of the fish caught in Green Bay are contaminated	2.83 (0.01)	2.81 (0.01)	2.87 (0.01)	2.84 (0.01)
Clean up contaminants so that none of the fish caught in the inland waters of Wisconsin are contaminated	2.82 (0.01)	2.79 (0.01)	2.87 (0.01)	2.83 (0.01)
Improve the water clarity in Green Bay	2.51 (0.02)	2.57 (0.02)	2.66 (0.02)	2.59 (0.01)
Increase average catch of panfish like yellow perch on Green Bay	1.95 (0.03)	1.97 (0.03)	1.88 (0.02)	1.93 (0.01)
Provide additional public boat launches on inland waters	1.96 (0.02)	1.90 (0.02)	1.89 (0.02)	1.91 (0.01)
Increase average catch of sport fish like trout, salmon, bass, and walleye on Green Bay	1.88 (0.02)	1.86 (0.02)	1.89 (0.02)	1.88 (0.01)
Provide additional public boat launches on Green Bay	1.89 (0.02)	1.82 (0.02)	1.82 (0.02)	1.84 (0.01)
Make existing boat ramps around Green Bay free	1.80 (0.03)	1.78 (0.02)	1.82 (0.02)	1.80 (0.01)
Reduce the cost of fishing licenses	1.69 (0.03)	1.71 (0.02)	1.76 (0.02)	1.72 (0.01)
Reduce the cost of launching a boat on inland lakes	1.70 (0.02)	1.68 (0.02)	1.75 (0.02)	1.72 (0.01)

(Chapter 9). Anglers who reside farther away from Green Bay tend to fish Green Bay less than anglers who live closer to Green Bay, but are estimated to have similar values per fishing day for the removal of FCAs as those anglers who live closer to Green Bay (see Chapter 9).

Missing Telephone Numbers

The second source of potential sampling bias is that phone numbers could not be identified for about one-third of the anglers identified in the courthouse sample. Some anglers have unlisted phone numbers (approximately 21% of households in the sample area do not have listed phone numbers, which corresponds to about two-thirds of the sample for which phone numbers were not found). Other anglers may have moved out of the area and are replaced by other anglers moving into the area, with no clear bias. Other anglers may have provided inaccurate or invalid addresses, with unknown bias.

A study evaluating the design of the national hunting and fishing survey found that the amount of fishing days by households without telephones was higher than for households with telephones (Westat, 1989, page 6-4). Therefore, the omission of anglers without telephones may result in understated estimates of days per angler.

Research by Piekarski (1989) indicates that households with nonlisted telephone numbers are more likely to be multifamily housing units and renter-occupied than are listed households. In addition, nonlisted households are also more likely to be urban, especially in metropolitan statistical areas with large central cities. Younger persons (both female and male), as well as single, divorced, and separated householders (with and without children), are more likely to be unlisted than other types of households. Retired householders are over-represented, while employed householders are under-represented, in a sample of listed households. Finally, we are unaware of any consistent evidence that household income differs significantly between listed and nonlisted households.

Given the mixed evidence relevant to anglers for whom no phone number could be found, and that the values per fishing day and the number of fishing days (which are multiplied to obtain damages) may be offset for some unlisted anglers (e.g., see discussion of female anglers above), we conclude that no adjustments to the estimates of days per angler, and of the value per fishing day from reductions in FCAs, are warranted because of unlisted phone numbers.

3.5.2 Nonresponse Bias

Nonresponse bias refers to biases resulting from the differences between the respondents and the nonrespondents in the sample of anglers who purchase licenses in the eight sample frame counties and who are active in Green Bay fishing. For the reasons presented below, we conclude that nonresponse bias, if any, would have a very small impact on per day value estimates, but may

affect the estimates of fishing days per angler, for which we make an adjustment, as described below.

Telephone Survey

The telephone survey high response rate of 69.4% can be expected to reduce potential nonresponse bias. External data for anglers who purchase their licenses in the eight sample frame counties and who are active in fishing the waters of Green Bay are not readily available against which to compare our telephone sample. The two observable variables we have for our telephone nonrespondents are the county where they purchased their Wisconsin fishing license, and the type of license purchased. The survey participation rates in the telephone survey are very similar regardless of the type of license purchased or the county in which the fishing license was purchased (see Appendix F, Tables F-2 and F-3). While we have no evidence to indicate clearly that nonrespondents to the telephone survey fish any more or less than respondents, it may be the case that anglers who fish less often may find the topic less salient to them and, compared to anglers that fish more often, may be less likely to participate in the telephone survey, which starts by identifying "we are conducting a study of people's opinions about fishing."

To be conservative in the damage assessment, while we have no evidence of this potential bias, we assume it exists in the estimate of open-water fishing days and make an adjustment for it. We assume 31.4% of these nonrespondents are Green Bay anglers (as in the sample of active anglers as a whole), but that they fish Green Bay 50% as often as do the anglers who completed the telephone survey (see Section 3.5.4). As noted above, the values for reducing FCAs are similar to (and in some cases larger) than for anglers who fish more often, and therefore we make no adjustment for potential nonresponse in the telephone survey to the per angler estimates of fishing days or damages per fishing day resulting from FCAs.

Mail Survey

The mail survey had a high response rate, with 79% of those mailed the survey (and 77% of all identified 1998 Green Bay anglers in the telephone survey) returning the survey.[5,6] Evaluating these results, we find no basis for a potential response bias and make no adjustments.

There was little difference in fishing avidity between those recent Green Bay anglers who completed and returned the mail survey and those who did not. In fact, Table 3-14 shows that

5. This included 50% of those who were not recruited to receive a mail survey when called for the telephone survey, but who were still sent the mail survey.

6. Item nonresponse is very low at 4% or less for most all questions. The exceptions are 4-11% for the individual species in the target species question (Question 4), 7% for income, and up to 20% for comment questions for which responses were optional.

Table 3-14
Fishing Days in 1998: Mail Respondents versus Nonrespondents
(telephone survey data)

	Returned Mail Survey	Did Not Return Mail Survey[a]	Total
Number of respondents	647	192	839
Total open-water fishing days (SE)	24.56 (0.96)	23.51 (2.01)	24.32 (0.86)
Mean total fishing days (SE)	28.59 (1.10)	29.37 (2.43)	28.77 (1.02)
Mean Green Bay open-water days (SE)	9.80 (0.55)	10.28 (1.06)	9.91 (0.49)
Mean Green Bay ice-fishing days (SE)	1.18 (0.16)	2.05 (0.37)	1.38 (0.15)

a. This includes 1998 Green Bay open-water anglers who either were not sent the mail survey or who did not return the mail survey. These results exclude 67 anglers who ice fished the waters of Green Bay but did not open-water fish the waters of Green Bay.

nonrespondents were slightly more avid than those who returned the survey, averaging a half-day more of reported fishing in 1998.

Mail survey response rates did not differ much by gender: about 76% for females and 77% for males. Seventy-two percent of the anglers who returned the survey live in a household in which they or someone else owns a boat, compared to 69% of anglers who did not return the survey. While about 27% of both groups own vacation homes, those who returned the survey had vacation homes slightly closer to Green Bay (mean of 84 miles compared to 93 miles).

The two groups, respondents and nonrespondents, were similar socioeconomically with the exception of age. The average age of the nonrespondents was 36.4 years compared to 43.3 years for those who returned the mail survey. About 83% of those who returned the mail survey, and 86% of those who did not respond, work at a job for which they receive wages or a salary. In both cases 92% of the employed respondents were employed full time. Of those who do not receive wages or a salary, homemakers and students were less likely to return the survey (about a 70% response rate compared to the overall 79%), but together make up only 3.2% of the total Green Bay anglers who were sent a mail survey. The racial makeup of both mail respondents and nonrespondents was similar to each other and to the original telephone survey sample.

As shown in Table 3-15 respondents and nonrespondents hold very similar opinions about the 10 actions to improve Wisconsin fishing, with the nonrespondents placing a slightly higher importance on cleaning up contaminants and improving water clarity in Green Bay. When asked how important it is to them that the fish they catch are free of contaminants, 89% of the nonrespondents said very important compared to 79% of the respondents. This suggests that nonrespondents to the mail survey may value removing PCBs and the resultant FCAs more highly than do respondents.

Table 3-15
Importance Rating of 10 Actions to Improve Wisconsin Fishing:
Mail Survey Respondents versus Nonrespondents
(telephone survey Question 13; mean and SE reported)

	Returned Mail Survey (N = 647)	Did Not Return Mail Survey[a] (N = 192)
Clean up contaminants so that none of the fish caught in Green Bay are contaminated	2.82 (0.02)	2.87 (0.03)
Clean up contaminants so that none of the fish caught in the inland waters of Wisconsin are contaminated	2.81 (0.02)	2.87 (0.03)
Improve the water clarity in Green Bay	2.47 (0.03)	2.65 (0.04)
Increase average catch of panfish like yellow perch on Green Bay	1.96 (0.03)	1.99 (0.06)
Provide additional public boat launch facilities on inland waters	1.96 (0.03)	1.92 (0.05)
Increase average catch of sport fish like trout, salmon, bass, and walleye on Green Bay	1.88 (0.03)	1.89 (0.06)
Provide additional public launch facilities on Green Bay	1.89 (0.03)	1.86 (0.05)
Make existing boat ramps around Green Bay free	1.80 (0.03)	1.78 (0.05)
Reduce the cost of fishing licenses	1.67 (0.03)	1.70 (0.05)
Reduce the cost of launching a boat on inland lakes	1.71 (0.03)	1.68 (0.05)

a. This includes all 173 Green Bay open-water anglers who did not return the mail survey and 19 Green Bay open-water anglers who were not mailed the survey because they were identified too late in the process.

In summary, Green Bay open-water anglers who returned the mail survey were on average older, a little less avid about fishing, and only slightly less concerned about contamination than those who did not return the survey. Thus, we conclude that potential response bias, if any, is likely to be very small and could slightly bias downward the damage estimates.

3.5.3 Recall Bias

Due to the timing of our survey in late 1998, we collected data on the annual number of days fishing in 1998 up to the time of the telephone survey and updated the estimates in the mail survey, which added about 2% to the estimates. The process of collecting fishing activity data on an annual recall basis, rather than in sampling waves throughout the year, may be subject to recall bias, and may result in increased estimates of fishing activity. Recall bias in recreation studies is sometimes referred to as "telescoping," where respondents assign events from the past time periods into more recent time periods (Pollock et al., 1995). Recall bias for recreational fishing was examined by Westat (1989; see also Chu et al., 1992) as part of the methods development for the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (National Survey). Westat, with recreation data collected in Wisconsin and Texas, compared estimates of fishing activity using repeated two-week recall versus annual recall (as well as semiannual and quarterly recall).[7] The two-week recall sample was selected by Westat as providing estimates with limited or no recall bias. The ratio of annual fishing days from the repeated two-week recall sample compared to the annual recall sample was 62.2% (adjusted for drop-outs of avid anglers; see Westat pages 6-16 to 6-19).

To account for potential recall bias when computing aggregate damages for the target population, we multiply our best estimates from the mail survey of 9.95 Green Bay fishing days and 24.98 total fishing days per Green Bay angler (see Table 4-1 and discussion in Section 4.2) by 62.2% to adjust for potential recall bias. As discussed in Section 3.5.4, these adjusted fishing day estimates are combined with other sampling adjustments to reduce further the mean sample estimates to be applied to all anglers in the target population.

The Westat study also found a small recall bias in annual recall of fishing participation rates (e.g., they did or did not fish). The Westat study was conducted with the general population, while our study already identified individuals who held fishing licenses in 1997 and who are much more likely to have fished in 1998 than the general population. Thus, any potential participation recall bias in our study is minimized or eliminated, and no correction is made for this potential bias.

7. The Wisconsin sample is particularly relevant as it focused on northeast Wisconsin in a triangular region between Green Bay, Madison, and Milwaukee.

3.5.4 Adjusting the Sample Estimates to the Population Estimates

Based on the above discussion of potential sampling, nonresponse, and recall biases, the sample mean estimates of fishing days are adjusted to be applied to the target population to compute aggregate damages. These adjustments and the resulting population mean estimates are illustrated in Table 3-16. In Table 3-16, the 4,596 anglers in the telephone sample are grouped according to disposition in the telephone survey, and for each group the number of Green Bay anglers and the number of Green Bay open-water fishing days per angler are computed reflecting adjustments for potential recall, sampling, and nonresponse biases, as follows.

1. For the 647 anglers who completed the mail survey (Table 3-16, line 1), their sample mean estimate of 9.95 Green Bay fishing days (Table 4-1) is multiplied by 62.2% to result in a recall-adjusted population mean Green Bay open-water fishing days of 6.19 (9.95 × 62.2%). This is the final estimate for these 647 anglers (last column of Table 3-6).

2. For the 192 Green Bay open-water anglers who completed only the telephone survey (line 2), we assume the same recall-adjusted estimate of 6.19 Green Bay open-water fishing days as for those who also completed the mail survey (e.g., 100% of the mail survey recall adjusted estimate is used). As with the telephone survey, these anglers had actually fished slightly more than respondents who completed the mail survey.

3. For the 1,831 anglers who completed the survey and who were active anglers, but who were not active in fishing Green Bay (line 3), none are Green Bay anglers and there are no Green Bay fishing days.

4. For the 520 1997 license holders who did not fish in 1998 and for the 100 license holders who refused the interview saying they no longer fish (line 4), we assume they are replaced in the population by 1998 license holders who did not have licenses in 1997 (“new” anglers). We assume 31.4% of these “new” anglers are Green Bay anglers, the same as for the 2,370 anglers active in open-water fishing who completed the telephone survey (resulting in 163 + 31 = 194 “new” Green Bay anglers). We assume these “new” anglers fished 50% as many days (adjusted for recall) as the 647 in the mail sample of 1997 license holders who also fished in 1998 for an estimated 3.11 (6.19 × 0.5) open-water fishing days in Green Bay.

5. For the 291 individuals who did not answer the telephone, or for whom language barriers prevented communication, and for the 245 individuals who hung up their telephone before the introduction was read (line 5), we assume 31.4% are Green Bay anglers (as in the population who completed the telephone interview). We assume they fish Green Bay the same number of days as the license holders who completed the mail survey (adjusted for recall) because there is no evidence to suggest these anglers are different from anglers who completed the telephone or mail surveys.

Table 3-16
Adjustment from the Mail Sample Estimated Open-Water Fishing Days to the Population Estimated Open-Water Fishing Days in 1998 for Anglers Active in Open-Water Fishing on the Wisconsin Waters of Green Bay

Telephone Sample Disposition	Number of Anglers in Telephone Survey	Percentage Who Are Green Bay Active	Number Green Bay Anglers	Green Bay Days as % of Recall Adjust. Sample Mean	Final Estimated Green Bay Days per Angler
1. Green Bay anglers who completed telephone and mail survey	647	100%	647	—	6.19[a]
2. Green Bay anglers who completed telephone survey only	192	100%	192	100%[b]	6.19
3. Non-Green Bay anglers who completed telephone survey	1,831	0%	0	—	—
4. Did not open-water fish in 1998					
> Completed telephone survey	520	31.4%	163	50%	3.11
> Refused telephone survey	100	31.4%	31	50%	3.11
5. No contact completed					
> No answer or language barrier	291	31.4%	91	100%	6.19
> Hung up before introduction	245	31.4%	77	100%	6.19
6. Others/refused telephone survey					
> Not interested	558	31.4%	175	50%	3.11
> Take name off list/other	212	31.4%	67	50%	3.11
7. Population estimates of Green Bay open-water fishing days in 1998 (% of mail survey estimate of 9.98)	4,596	31.4%	1,444	—	5.25 (52.8%)
8. Population estimate of total open-water fishing days in 1998					13.19[c]

a. Sample mean of 9.95 (Table 4-1) × 62.2% for recall adjustment (Section 3.5.3) = 6.19 recall adjusted open-water Green Bay fishing days.
b. Note that, through the telephone survey, Green Bay open-water anglers who were nonrespondents to the mail survey had fished slightly more than respondents completing the mail survey (Table 3-14).
c. Equals sample mean of 24.98 (Table 4-1) × 52.8% combined recall, sample, and nonresponse adjustment factor = 13.19.

6. For the 770 (558 + 212) anglers who were contacted by telephone and did not hang up before the introduction, but then refused the telephone survey (line 6), we assume 31.4% were Green Bay open-water anglers who fish half as often as the license holders who completed the mail survey.

Under the above assumptions, in Table 3-16, the total estimated number of Green Bay open-water anglers in the original telephone sample is 1,444, and the weighted average Green Bay open-water days is 5.25, which equals 52.8% of the initial sample best estimate of 9.95 (line 7). About 80% of this difference is because of adjustments for recall bias and about 20% is because of adjustments for sampling and nonresponse bias. We apply this same 52.8% correction factor to the 24.98 sample estimate of total open-water fishing days (Table 4-1) to develop a population estimate of 13.19 total open-water fishing days in 1998 (line 8). Applying the 52.8% correction factor to the total (open-water plus ice) fishing days estimates in Table 4-1 results in adjusted total fishing days per sampled angler of 5.87 on Green Bay and 15.34 at all sites.

By way of comparison, the adjusted target population estimates of 5.87 Green Bay total fishing days per Green Bay angler is nearly equal to the 1996 National Survey estimate for Lake Michigan anglers of 5.8 ± 2.0 days of Lake Michigan fishing, and the 15.34 total fishing days estimate is less than the National Survey estimate of 20.2 ± 8.4 total fishing days per Lake Michigan angler. The National Survey estimates are based on a sample of only 36 anglers.[8] The total fishing day estimate of 15.34 is slightly more than the approximately 14 day estimate from the Westat survey for Wisconsin residents from the same region, which was based on a sample of over 1,700 anglers (although the estimates are over a decade old and include non-Green Bay anglers, who fish less often than do Green Bay anglers — see Table 3-11). Further, these estimates are generally consistent with the WDNR creel estimates of angler activity in the waters of Green Bay for 1998.[9]

8. The Lake Michigan day estimates are not exactly comparable as Green Bay angling is a subset of Lake Michigan angling. Some Lake Michigan anglers may fish in Lake Michigan inside and outside of Green Bay, and some Green Bay anglers may never fish in Lake Michigan outside of Green Bay.

9. The WDNR does not report the estimated number of open-water fishing days in the waters of Green Bay. An approximation can be developed by dividing the number of open-water fishing hours in the Wisconsin open-water creel survey for 1998 (905,762 from Table 2-1) by the creel estimate of four hours fishing per day, which results in 226,440 days. Dividing that number of fishing days by 48,600 Green Bay anglers in the target population (Chapter 8), who account for the vast majority of these fishing days, results in 4.7 Green Bay open-water days per angler in March through December. Recall the open-water creel survey omits certain time periods (see Footnote 1 in Chapter 1).

3.5.5 Target Population Coverage of All Open-Water Fishing in the Wisconsin Waters of Green Bay

While the target population for the primary assessment is those Green Bay open-water anglers who purchase their Wisconsin fishing licenses in one of eight targeted counties near the waters of Green Bay, data from the WDNR and from our survey indicate that the target population may account for on the order of 90% of all Green Bay open-water fishing days, and our sample generally reflects the distribution of Green Bay open-water fishing days by origin of residence of the anglers. This can be ascertained by examining our sample in three groups: anglers from the Lake Michigan District (see Figure 3-2), anglers from out-of-state, and anglers from the rest of Wisconsin outside of the LMD. For each group, we use data and assumptions to evaluate the approximate share of the group's Green Bay open-water fishing days that is likely to be represented in our target population and approximately what share of the total number of Green Bay open-water fishing days the group is likely to account for.

The computations in the remainder of this Section 3.5.5 are based on a combination of literature data and our survey data and are intended only to indicate the potential magnitude of how the target population covers the entire population of Green Bay anglers, rather than to be precise estimates, either for the total or individual components of this analysis.

Lake Michigan District

The population of the targeted counties is about 83% of the LMD population (Wisconsin Legislative Reference Bureau, 1997). If we assume that the incidence of fishing is the same throughout the LMD, then 83% of all LMD license holders are in the eight targeted counties.[10]

We expect the incidence of Green Bay anglers to be less in the omitted counties than the included counties because the omitted counties are farther from the site. Table 3-17 shows the incidence of Green Bay fishing by county for our sample. Anglers who purchased licenses in a county adjacent to Green Bay (Brown, Door, Kewaunee, Marinette, and Oconto) were about twice as likely to fish Green Bay as those who purchased their licenses in one of the nonadjacent targeted counties. This reflects that resident anglers in nearby counties are more likely to fish Green Bay than are resident anglers from more distant counties (consistent with the evidence presented above that the median travel distance for boat fishing is 10 miles), and some anglers from outside the region who fish in Green Bay purchase licenses near the site. Because the omitted counties are even farther from the site than the three nonadjacent counties in our sample, we can expect an even lower

10. We further assume that LMD anglers purchase their licenses in their county of residence. Because some residents of omitted counties (and all residents of Menominee County) who fish Green Bay may purchase their licenses in one of the eight targeted counties, it may be that over 83% of LMD anglers are covered in our target population.

Table 3-17
1998 Green Bay Angler Incidence Rate by County Where License Purchased

County Where 1997-1998 License Purchased	Number of Screeners Completed	Number of Green Bay Anglers Identified	Green Bay Angler Incidence Rate
Brown County	658	246	37.4%
Door County	343	139	40.5%
Kewaunee County	203	54	26.6%
Manitowoc County	317	63	19.9%
Marinette County	354	113	31.9%
Oconto County	247	60	24.3%
Outagamie County	514	86	16.7%
Winnebago County	554	78	14.1%
All targeted Counties	3,190	839	26.3%
- Adjacent to Green Bay	1,805	612	33.9%
- Not adjacent to Green Bay	1,385	227	16.4%

incidence of Green Bay anglers in these counties. For the omitted LMD counties, we assume the incidence of Green Bay open-water anglers to be 50% as much as for included counties.

Next, we expect the number of open-water fishing days per Green Bay angler to decrease with distance from the site. In a later analysis (Table 4-2) we find that anglers who reside in the three nonadjacent counties report 60% as many Green Bay open-water fishing days per angler as do anglers who reside in the five adjacent counties, and further that anglers from elsewhere in Wisconsin report 55% as many Green Bay open-water fishing days per angler as do anglers who reside in the five adjacent counties. For the omitted LMD counties, we assume the rate of Green Bay fishing days by Green Bay open-water anglers is 55% as large as for included LMD counties.

Combining the above data and assumptions, our target population can be expected to account for about 95% of the Green Bay open-water fishing days by anglers from the Lake Michigan District.[11]

11. 83%/[83%+ (17% × 0.5 × 0.55)] = 94.7%, where 83% and 17% are the population percentages for the included and omitted LMD counties, and 0.5 and 0.55 are the adjustments for reduced incidence and reduced Green Bay fishing days in omitted LMD counties.

Recall that Penaloza (1992) reported about 77% of boat trips in the LMD district originated by anglers in the LMD (these percentages may be even higher in 1998 given that the reduced catch rates from the early 1990s to 1998 may deter anglers who are farther away more than they deter anglers from nearby counties). In our data we find that the percent of boat versus nonboat days does not vary much with distance from the site, so we assume about 77% of all Green Bay fishing days are from anglers residing in the LMD. Thus, the residents from the eight counties in the target population will account for about 73% of all Green Bay fishing days (77% × 95%). Our sample may omit about 4% of the total Green Bay open-water fishing days by excluding five LMD counties from our target population (77% LMD total minus 73% of this total that is expected from the targeted counties).

Table 3-18 identifies our sample number of anglers and reported Green Bay days by residence. About 76% of our sampled anglers, and about 83% of the reported days, are from residents of the eight targeted counties. Thus, our sample has a slightly higher percentage of days by anglers residing in the targeted counties than the above data supports may be likely to occur for all Green Bay fishing days.

Table 3-18
Number and Percent of Sampled 1998 Green Bay Angler Fishing Days by Resident State/County (telephone and mail survey data)

State/County of Residence	Number of Anglers		Green Bay Open-Water Fishing Days		Green Bay Ice-Fishing Days		Green Bay Fishing Days	
Wisconsin	531	82%	5,672	88%	736	96%	6,408	89%
In targeted counties	494	76%	5,381	83%	721	94%	6,102	85%
Not in targeted	37	6%	291	5%	15	2%	306	4%
Michigan	13	2%	266	4%	23	3%	289	4%
Other state	103	16%	502	8%	7	1%	509	7%
All	647	100%	6,440	100%	766	100%	7,206	100%

Out-of-State Anglers

Table 3-18 reports that anglers from out-of-state account for about 18% of the respondents and 12% of the Green Bay fishing days in the sample. This reflects that out-of-state anglers tend to fish Green Bay fewer days than do resident anglers (Table 3-19). The exception is anglers from Michigan who fish more days in Green Bay, which is reasonable as almost all of these 13 anglers live in a county (and in or near the city of Menominee) that is adjacent to Wisconsin and to both the Bay of Green Bay and the Menominee River (which is part of the waters of Green Bay).

Table 3-19
Mean Days Fishing Green Bay in 1998 by Resident State
(telephone survey data)[a]

State of Residence	N	Mean Days Ice Fishing in 1998 (SE)	Mean Days Open-Water Fishing in 1998 (SE)	Mean Days Fishing in 1998 (SE)
Wisconsin	752	1.9 (0.18)	9.8 (0.53)	11.7 (0.60)
Michigan	16	3.1 (1.34)	18.9 (6.38)	22.0 (6.34)
Other states	138	0.2 (0.11)	4.9 (0.39)	5.2 (0.40)
All	906	1.7 (0.15)	9.2 (0.46)	10.9 (0.52)

a. Per-angler days increase slightly in the final mail sample reflecting end-of-year fishing days. See Chapter 4.

Our sample is likely to include most nonresident anglers who fish the waters of Green Bay. This is because nonresident anglers are most likely to purchase their licenses in a county near their fishing destination. In fact, we find that 90% of our sample of out-of-state anglers purchased their licenses in one of the five adjacent counties, and only 10% purchased a license in one of the three nonadjacent counties. Further we find that 99% of reported open-water fishing days in Wisconsin by out-of-state anglers in our telephone sample are on the waters of Green Bay. While a few out-of-state anglers who fish Green Bay may purchase their Wisconsin fishing licenses outside of our targeted counties, is appears likely that most all will purchase their licenses in the targeted counties: we assume 95% of Green Bay fishing days by out-of-state anglers are reflected in our sample. Thus, our sample omits less than 1% of all Green Bay open-water fishing days (5% of the approximately 12% of total Green Bay open-water fishing days by out-of-state anglers).

Anglers from the Rest of Wisconsin

Anglers from the rest of Wisconsin who fish the waters of Green Bay are likely to purchase their licenses near their residences, or near where they plan to fish. Anglers from the rest of Wisconsin account for 6% of our sample anglers and 5% of our sample of Green Bay open-water fishing days (Table 3-18). Our target population omits Green Bay fishing days by those Green Bay anglers who purchase their licenses outside of the targeted counties. The size of this omission is unknown. However, for simplicity, if we assumed 100% coverage of Green Bay fishing days from LMD anglers by residents of our eight targeted counties and 100% coverage of out-of-state anglers, the difference of 6% between the sample share of fishing days by anglers residing in our targeted counties (83%) and the projected share of fishing days by anglers residing in LMD

counties (77% or more) would approximately represent the omission of Green Bay open-water fishing days by Wisconsin anglers who reside outside of the eight targeted counties.

Target Population Coverage of All Green Bay Fishing Days

Based on the above computations, selection of our target population is likely to account for about 90% of all Green Bay open-water fishing days. The sample does not account for Green Bay open-water fishing days by LMD residents outside of the eight targeted counties (about 4%), by out-of-state anglers who purchase their licenses outside of the eight targeted counties (less than 1%), and by residents from other counties in Wisconsin who purchase their licenses outside of the eight targeted counties (about 6%).