Net Benefits of Recreational Fishing, Beachgoing, and Boating in the Great Lakes, Upper Mississippi River, and Ohio River Basins: A Review of the Literature

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Executive Summary

This report reviews the recreational valuation literature on fishing, beachgoing, and boating in the Great Lakes, Upper Mississippi River, and Ohio River Basins. Its purpose is to determine whether the existing literature is sufficient to: (a) estimate the current net value of these activities in the study region; and (b) estimate how these values might change with the introduction of aquatic nuisance species (ANS).

Estimating the net value of a recreational activity requires: (a) an estimate of the average net value per day; and (b) an estimate of the total number of days taken to engage in that activity. In surveying the relevant literature, Cornell Univeristy (CU) adopted the following premises:

- No single study is sufficient to estimate a comprehensive net value of recreational fishing, beachgoing or boating in either the Great Lakes Basin or the Upper Mississippi and Ohio River Basins. Although a number of studies have estimated the net value per day for these activities, they have been limited in their geographic coverage. Because recreational values can be expected to vary in different parts of our study region, none of these existing individual studies can be used as an estimate of the average net value per day estimate for the entirety of either or both basins.
- However, if a sufficient number of studies is conducted within a region, even if each of those studies is limited in its geographic focus, these studies can, *considered as a set*, help determine the range of net values per day that might be expected for the region. This range of net values per day can be multiplied by the number of days users take part in the activity to approximate the total annual recreation net value.

The following conclusions were drawn with regard to estimating a baseline net value of recreational activities in the three basins:

- Too few studies of the net value of beachgoing and boating have been conducted within the study region to establish the range of net values per day of these activities. **Therefore, based on the existing literature, it is not possible to estimate the total annual net value of either beachgoing or boating in either the Great Lakes Basin or the Upper Mississippi and Ohio River Basins.**
- For the Great Lakes, however, a sufficient number of studies have been conducted to establish that the net value per day of recreational fishing likely falls between $20 and $75 ($2012). When the endpoints of this range are multiplied by the USFWS estimate of about 18 million angler days in the Great Lakes in 2006, it results in **an estimate of the aggregate annual net value of recreational fishing in the Great Lakes of $360 million to $1.35 billion ($2012)**.

- It is important to note that this range is an estimate of *net value*, which is distinct from other economic measures that may have been reported such as *expenditures* and *economic impacts*. Cornell reports net values in this report because, according to economic theory and Federal regulation, net value is considered the appropriate measure for assessing the benefits of public policy alternatives.

Estimating the change in net value of an activity in response to ANS requires estimates of how: (a) resource quality would change in response to ANS (e.g., the change in the numbers of fish that anglers would catch); (b) the average net value per day would change as resource quality changed; and (c) the total number of trips to engage in that activity would change. With regard to estimating how the net values of recreational activities would change if ANS were introduced:

- Insufficient evidence exists in the literature to address any of these questions and, consequently, **it is not possible based on the existing literature to estimate how the total annual net value of recreational fishing, beachgoing, or boating would change if ANS were introduced in to the Great Lakes and/or the Upper Mississippi and Ohio River Basins**

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I. Study Background

GLMRIS Background Information

The United States Army Corps of Engineers (USACE), in consultation with other federal agencies, Native American tribes, state agencies, local governments and non-governmental organizations, is conducting the Great Lakes and Mississippi River Interbasin Study (GLMRIS). In accordance with the study authorization, USACE will evaluate a range of options and technologies (collectively known as "ANS controls") to prevent the spread of aquatic nuisance species (ANS) between the Great Lakes and Mississippi River basins by aquatic pathways.

An ANS is a nonindigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural or recreational activities dependent on such waters. See 16 U.S.C. § 4702(1) (FY13).

As a result of international commerce, travel and local practices, ANS have been introduced throughout the Mississippi River and Great Lakes basins. These two basins are connected by man-made channels that, in the past, exhibited poor water quality, which was an impediment to the transfer of organisms between the basins. Now that water quality has improved, these canals allow the transfer of both indigenous and nonindigenous invasive species.

USACE is conducting a comprehensive analysis of ANS controls and will analyze the effects each ANS control or combination of ANS controls may have on current uses of: (a) the Chicago Area Waterway System (CAWS), the only known continuous aquatic pathway between the Great Lakes and Mississippi River basins; and (b) other aquatic pathways between these basins. Following the *Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementation Studies*, Water Resource Council, March 10, 1983, USACE will:

- Inventory current and forecast future conditions within the study area;
- Identify aquatic pathways that may exist between the Great Lakes and Mississippi River basins;
- Inventory current and future potential ANS;
- Analyze possible ANS controls to prevent ANS transfer, to include hydrologic separation of the basins;
- Analyze the impacts each ANS control may have on significant natural resources and existing and forecasted uses of the lakes and waterways within the study area; and
- Recommend a plan to prevent ANS transfer between the basins. If necessary, the plan will include mitigation measures for impacted waterway uses and significant natural resources.

Significant issues associated with GLMRIS may include, but are not limited to:

- Significant natural resources such as ecosystems and threatened and endangered species;
- Commercial and recreational fisheries;
- Current recreational uses of the lakes and waterways;
- ANS effects on water users; and
- Effects of potential ANS controls on current waterway uses such as flood risk management, commercial and recreational navigation, recreation, water supply, hydropower and conveyance of effluent from wastewater treatment plants and other industries.

GLMRIS Navigation and Economics Product Delivery Team

In support of GLMRIS, the Navigation and Economics Product Delivery Team (PDT) was formed. The PDT was tasked with assessing the current value of *economic* activities within the GLMRIS detailed study area that *could* change with the implementation (Future With Project (FWP) condition) or lack of implementation (Future Without Project (FWOP) condition) of a GLMRIS project. The PDT is comprised of several sub-teams, each of which focuses on a specific economic activity within the GLMRIS study area.

Fisheries Economics Team

The Navigation and Economics PDT's Fisheries Economics Team focused on fishing activities within the U.S. waters of the Great Lakes, Upper Mississippi River, and Ohio River Basins (i.e., the GLMRIS detailed study area) that *could* change in the FWOP and/or FWP condition.

Five baseline economic assessments, which quantitatively or qualitatively describe the current economic activities dependent on fisheries, were developed. The reports focus on the following categories: commercial, recreational, charter, and subsistence fishing, as well as professional fishing tournaments. Each baseline assessment focuses exclusively on the specified fishing activity within the GLMRIS detailed study area – to include the U.S. waters of the Great Lakes, Upper Mississippi River, and Ohio River Basins. It is imperative to note that collectively, these values do *not* represent a comprehensive value of these three basins. Each basin has further economic (e.g., non-use values) and environmental values that are not captured in this economic appendix. Rather, the fishing-related economic activities assessed by the Fisheries Economics Team serve as indicators of key aspects of the economy that could change in the future, with or without the implementation of a GLMRIS project.

Report Purpose

In support of GLMRIS, Cornell University (CU) was tasked, in part, with estimating the current net value of recreational activities that take place within the Great Lakes Basin (GL), and Upper Mississippi River and Ohio River Basins (UMORB) that could be affected by ANS transfer between these basins. Cornell University completed this review of existing literature to aid in the determination of which previously published studies of recreational fishing, beachgoing, and boating are potentially relevant to GLMRIS.

II. Introduction and Report Summary

Objectives of this Report

There are two specific objectives of this review:

> Objective 1: To assess whether the existing body of recreational valuation studies can be used to estimate the current net value of recreational fishing, beachgoing and boating for the Great Lakes and Upper Mississippi and Ohio River Basins, and
>
> Objective 2: To assess whether these studies can be used to provide estimates of how recreational values might change with the introduction of ANS.

The first objective focuses on establishing a baseline value of the recreational activities in the GLMRIS study area. The second objective is directed toward assessing how much this baseline value is likely to be affected by ANS. The values estimated in Objective 1 provide a conceptual upper bound for potential losses under Objective 2.

The region on which CU will focus in this report includes the watersheds within the following Great Lakes and Upper Mississippi and Ohio River Basins states: Minnesota, Iowa, Missouri, Wisconsin, Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia, Pennsylvania and New York. It should be noted that most of the available literature for these activities in this region has been conducted in the Great Lakes "coastal" states. Consistent with USACE procedures and guidelines (USACE 1983), all dollar values reported in this review will be updated to FY $2012 using the consumer price index (CPI Value=226.889, USACE 2012), unless otherwise noted.

The following process was used to identify studies to be included in this review. First, CU examined existing recreational valuation databases (e.g., Loomis and Richardson, 2008; EVRI, 2002) and databases and literature reviews of valuation estimates for specific recreational activities (e.g., Boyle et al., 1998/1999; NOEP, 2012). These studies were supplemented with others identified in original web and journal searches for recreational valuation studies conducted within the study area. CU generally has not included estimates for studies for which the sample data used in the study were collected prior to 1985, due to concerns about the "shelf life" of recreational values and the substantial evolution of valuation methods since the mid 1980s.

As a preview of our findings, CU concludes that, with respect to establishing a baseline value for recreational fishing:

- There are several studies that estimate the value per day for recreational fishing in the Great Lakes. These estimates generally range from $20 to $75 per day ($2012 dollars).

Combining these estimates with an estimate of the total participation in recreational fishing generates an estimated aggregate value from recreational fishing in the Great Lakes of $360 million to $1.35 billion per year.

- There are fewer estimates of value per fishing day available for the Upper Mississippi and Ohio River Basins, and there are no available estimates of total fishing participation specific to these study basins, so it is not possible to generate a reliable range of estimates of aggregate value of recreational fishing for the entire study area.

The existing literature on the value of recreational activities in the Great Lakes and Upper Mississippi and Ohio River Basins is not sufficient for generating defensible estimates of the baseline value of beachgoing and boating in these basins.

- In the case of boating, there is information on the rate of participation (number of boating days) in the Great Lakes, but there are too few estimates of the recreational value per boating day to generate a reliable overall estimate of the aggregate value of this recreational resource.
- In the case of beachgoing, there are too few estimates of recreational value per beach day to generate reliable estimates for the aggregate value of this recreational resource, and there are no comprehensive estimates of total beachgoing participation (number of days) for either the Great Lakes or the Upper Mississippi and Ohio River Basins.

With respect to Objective 2, CU concludes that the existing literature is not sufficient to generate reliable estimates of the impact that ANS might have on the recreational values enjoyed by anglers, beachgoers, or boaters in the study area. The remainder of this report provides our evidence and logic for these claims.

Overview of Conceptual Foundations: Net Value

This report focuses on economic measures of the value of recreational fishing, boating and beachgoing in the Great Lakes, Upper Mississippi and Ohio River Basins, and on how those values might change due to inter-basin transfer of ANS. Consistent with USACE procedures and guidelines (USACE, 1983, 2000, 2012), the net (economic) value is defined as the amount that those recreational resources contribute to the Federal planning objective of national economic development (NED).

> "The Federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the Nation's environment**,** pursuant to national environmental statutes, applicable

> executive orders, and other Federal planning requirements… Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed." (USACE, 1983, p. iv).

Because many different measures of the economic value of recreational activities have been reported in various outlets, it is important to distinguish the NED concept of net value from other, related measures that are often reported, such as "expenditures" and "economic impacts." The net value of a resource is the difference between the amount an individual would be willing to pay to access the resource and the amount that they actually have to pay for gasoline, lodging, entry fees, and food at the recreation site and other trip-related costs. For reference CU provides a brief discussion of the alternative measures of economic activity in the Appendix. The interested reader is also referred to Scodari (2009) and Aiken (2009) for further discussion.

Measures of net value are typically expressed as value per unit, such as net value per day of a recreational activity. The aggregate annual net value generated by a recreational resource is the average net value per day (or per trip) multiplied by the total number of days (trips) taken to engage in that activity. This is the appropriate measure of the annual net value generated by a recreational resource from a NED perspective for the purposes of Objective 1 of this review.

The issue of interest in Objective 2 is how the baseline net value might change as a consequence of inter-basin transfer of ANS. Here, a change in the quality of the recreational resource will typically affect both the net value per trip for that activity and the total number of trips taken to engage in that activity. For example, if fishing quality in a region were to decline as a consequence of an ANS, recreationists may continue their recreational activities at the site(s) they currently use, but get less satisfaction (and less net value) from each trip; they may choose to recreate at other sites that provide less net value than they previously enjoyed; they may choose to fish fewer times per year; or they may cease fishing altogether. The change in aggregate annual net value from the fishery would account for both the change in net value per trip and the change in total number of trips.

Overview of Conceptual Foundations: Methods of Valuing Recreation

Because most outdoor recreation activities are publicly provided, rather than being purchased from a private supplier, it is usually not possible to estimate either total value or net value directly from observed market data (USACE 2012). USACE recognizes alternative "non-market valuation" procedures "for estimating use and willingness to pay by means of travel behavior, user surveys, and other quantifiable measures" (USACE 2000, p. E-183). Three non-market valuation methods – the travel cost method, the contingent valuation method, and unit day values – are specified in USACE procedures and guidelines for estimating the net values of recreational activities and estimating how those net values change in response to water-related projects. To this CU adds two other methods widely used in contemporary project analyses, benefit transfers and meta analysis. CU briefly describes each of these methods below.

The *travel cost method* uses actual visitation data on the number of trips taken to a recreation site to estimate the net value of the resource and how that net value changes as the quality of the resource changes. The travel cost method works by comparing the number of trips taken to a site by people who live close to the site to the number of trips taken by people who live farther from the site. "The basic premise of the travel cost method is that per capita use of a recreation site will decrease as out-of-pocket and time costs of traveling to the site increase, other variables being constant" (USACE 2000, p. E-184). The total value per trip, net value per trip, and number of trips taken can be calculated for recreationists living different distances from the site and for sites with different resource quality.

Contingent valuation relies on survey questions about hypothetical behavior to estimate the net value of a resource or the net value of a change in resource quality: "The contingent valuation method estimates NED benefits by directly asking individual households their willingness to pay for changes in recreation opportunities at a given site." (USACE 2000, p. E-185). Depending on how the survey questions are structured, contingent valuation can be used to measure the total amount the recreationist is willing to pay for access to a site (total value), the amount the recreationist is willing to pay over and above the actual cost of visiting the site (net value), or the amount the recreationist would be willing to pay if a change occurred to the quality of the site (change in net value). The aggregate net value of the resource or of a change in the quality of the resource can be estimated by summing the individual net values for all users in the study area.

Often times, original estimates that use the travel cost method or contingent valuation are not available for a specific project. In such instances, a third approach identified by the USACE is the *unit day value* method.

> "The unit day value method relies on expert or informed opinion and judgment to estimate the average willingness to pay of recreational users. By applying a carefully thought-out and adjusted unit day value to estimated use, an approximation is obtained that may be used as an estimate of project recreation benefits" (USACE 2000, p. E-185).

The principles for using unit day values in the USACE planning process are grounded in the economic and environmental principles and guidelines stated in USACE 1983 and 2000. Ranges for these values are annually updated in USACE memoranda (e.g. USACE 2012) to account for changes in economic conditions by multiplying the 1982 unit day value by Consumer Price Index (CPI) factors published by the Bureau of Labor Statistics. Unit day values are selected from the updated ranges using a system that assigns points based on five criteria: activities, facilities, relative scarcity, ease of access and aesthetic factors.

The USACE provides a range of unit day values to use as a proxy for the net value of different types of recreation. USACE procedures and guidelines state that unit day values should not be used when evidence suggests that the value of a recreational activity lies outside the range of published unit day values. Accordingly, in each of the following reviews for recreational fishing, beachgoing and boating, CU assesses whether estimates of net value per recreational day fall within the published range of unit day values for that activity.

The unit day value method represents the simplest type of a benefits transfer valuation approach. Broadly defined, "Benefits transfer refers to the process of using valuation results for one or more sites derived in original demand studies (the study sites) to calculate benefits estimates at another site (the project site)" (Scodari, 2009 p. 49). The unit day value method uses administratively-determined unit-day values for general and specialized recreation activities developed using expert judgment. In this report, two additional benefits transfer methods are used. The first, which CU refers to as *average benefits transfer* in the remainder of this report, calculates the average of estimates from a number of previous studies of like resources within the region being studied and uses these averages to predict that value of the current site being studied. CU will also draw from *meta analysis* research, wherein a statistical model is developed that accounts for differences among published estimates between regions and/or activities or due to differences in methodology.

Thus far, CU has presented each of the valuation methods separately, which is not always the case in the studies reviewed. For example, Rosenberger and Loomis (2000, 2001) provide both benefits transfer and meta analysis estimates for Great Lakes and Northeast recreational fishing. Breffle et al. (1999) uses both the travel cost method and a variation of contingent valuation in a study of Great Bay recreational fishing.

Summary of Results for Recreational Fishing, Beachgoing and Boating

In the following subsections CU summarizes the findings of our literature review organized around the two objectives identified in the introduction and, where appropriate, provide net value estimates drawn from the literature. Chapters II to IV of this study provide details on the individual studies reviewed. To facilitate comparisons across studies, all dollar values reported in this review are updated to FY $2012 using the consumer price index (CPI value=226.889, USACE 2012), unless otherwise noted.

Recreational Fishing

Estimating the Net Value of Fishing: Chapter II reviews available studies that estimate the net value of recreational fishing in the Great Lakes, Upper Mississippi and Ohio River Basins. Table II.a provides a summary of estimates of net value per day of fishing from selected studies reviewed in Chapter II, organized by the valuation method used. Studies included in the table are those that provide sufficiently reliable estimates of the net value of fishing applicable to the study area.

No single study in Table II.a covers the entirety of the study region in terms of geography or species targeted. This lack of a comprehensive, region-wide study is important because evidence provided in a number of studies suggests that fishing values will vary across recreational sites and types of fishing. Therefore, fishing values estimated in one part of our study region may not apply very well to other parts of our study region. For this reason, CU concludes that *no existing individual study* can be used to provide a representative net value per day estimate for the entirety of either or both basins.

Nevertheless, when *considered as a set,* CU believes that the studies included in Table II.a can be used to help determine the range of net values per fishing day that might be expected for the Great Lakes portion of the study area. While the range of net values provided by the various studies is broad, there is some convergence across studies. Because these studies were conducted in a variety of settings within the Great Lakes region, this range of net values likely encompasses the average net value within that region. An examination the values in Table II.a reveals that the number of observations above $75 are few and spread out. Dropping the top three value estimates (Boyle et al. 1999, Salmon; Boyle et al. 1999, Bass; and Aiken 2009, Walleye (WI)), which CU characterizes as outliers, suggests that average net value estimates will likely lie in the range from $20 to $75 ($2012).

The estimates of net value in Table II.a can be used to evaluate whether it is appropriate to use USACE's published unit day values to estimate the net value of recreational fishing in the study region. Because the relevant unit day values tend to be lower than the estimates from

Table II.a. Estimated Willingness to Pay Values per Person per Fishing Day

Valuation Method	Estimated Net Value/ Day ($2012)[a]	Fish Category	Location	Reference
Average Benefits Transfer	45	Cold water fish	Great Lakes and the Northeast	Loomis and Richardson (2008)
Average Benefits Transfer	48	Warm water fish	Great Lakes and the Northeast	Loomis and Richardson (2008)
Average Benefits Transfer	44	Anadromous runs	Great Lakes and the Northeast	Loomis and Richardson (2008)
Average Benefits Transfer	23	Mixed species	Great Lakes and the Northeast	Loomis and Richardson (2008)
Average Benefits Transfer	56	Species not specified,	Great Lakes and the Northeast	Loomis and Richardson (2008)
Average Benefits Transfer/Meta Analysis	45-54	General	Great Lakes and the Northeast	Rosenberger and Loomis (2001)
Meta Analysis	90[b]	Bass	Great Lakes	Boyle et al. (1999)
Meta Analysis	109[b]	Salmon	Great Lakes	Boyle et al. (1999)
Travel Cost Method	41	Trout	Michigan Great Lakes	Lupi et al. (1998)
Travel Cost Method	51	Salmon	Michigan Great lakes	Lupi et al. (1998)
Travel Cost Method	42	Salmon and/or Trout	Wisconsin Water, Southern Lake Michigan	Phaneuf et al. (1998)
Travel Cost Method	42-55	Anadromous Runs	Lake Erie Tributaries	Kelch et al. (2006)
Contingent Valuation	54	Yellow Perch	Green Bay	Bishop et al. (1990)
Contingent Valuation	25	General	New York Great Lakes	Connelly and Brown (1991)
Contingent Valuation	28	General	New York Inland Waters	Connelly and Brown (1991)
Contingent Valuation	41	Salmon and Trout	Wisconsin Water, Great Lakes	Lyke (1993)
Contingent Valuation	22	General	New York Great Lakes	Connelly et al. (1997)

(continued on next page)

Table II.a. Estimated Willingness to Pay Values per Person per Fishing Day (continued)

Valuation Method	Estimated Net Value/ Day ($2012)[a]	Fish Category	Location	Reference
Contingent Valuation	22	General	New York Inland Waters	Connelly et al. (1997)
Contingent Valuation	50 (IA), 50 (IL), 68 (MO), 69 (IN), 71 (WV)	Bass	Selected States in Great Lakes and UMORB[c]	Aiken (2009)
Contingent Valuation	48 (PA), 53 (NY)	Trout,	Selected States in Great Lakes and UMORB[c]	Aiken (2009); Harris (2010);
Contingent Valuation	49 (MI) 68 (MN), 74 (OH), 91 (WI)[b]	Walleye	Selected States in Great Lakes and UMORB[c]	Aiken (2009)

a. Rounded to the nearest dollar.

b. As discussed in the text, these three observations are regarded as outliers.

c. UMORB denotes the Upper Mississippi and Ohio River Basins.

these studies, CU concludes that unit day values should not be used to estimate the net value of fishing in the Great lakes and the Upper Mississippi and Ohio River Basins.

As noted above, identifying the value of a fishing day is only one element needed to estimate the aggregate net value of recreational fishing. A measure of how much fishing occurs, such as angler days per year, is also needed. The US Fish and Wildlife Service provides periodic estimates of Great Lakes fishing effort as part of its National Survey of Fishing Hunting and Wildlife Associated Recreation (e.g. USFWS, 2008). This report does not break out participation data for the either the Great Lakes Basin or the Upper Mississippi and Ohio River Basins. However, it does report fishing participation for the Great Lakes, a resource that has received substantial popular attention due to concern about ANS in recent years and for which aggregate expenditure and economic impact values have been reported by private and government entities (American Sportfishing Association, 2008; Great Lakes Commission, 2012).

While they are somewhat dated, CU uses participation data from the 2006 National Recreation Survey (USFWS 2008), as this is the most recent basin-wide survey of recreational fishing that has been reported[1]. These estimates have been used elsewhere for calculating

[1] A more recent survey was completed in March 2012, but the summary reports are not expected until November 2012. (http://wsfrprograms.fws.gov/Subpages/NationalSurvey/2011_Survey.htm)

the impact of recreational fishing for the Great Lakes (USFWS, 2008; American Sportfishing Association, 2008). For comparative purposes it is helpful to use the same baseline for aggregating values.

Multiplying the USFWS estimate of about 18 million angler days in the Great Lakes in 2006 by the range of a net values ($20 to $75 in $2012 dollars) identified above, results in a total annual recreation net value estimate ranging from $360 million to $1.35 billion.[2]

Estimating Changes in the Net Value of Fishing in Response to ANS: While several studies have been conducted within the study region that attempt to estimate the impact that changes in fishing quality would have on recreational values from fishing, CU concludes that individually and collectively these studies do not provide a good basis for calculating economic losses associated with potential declines in catch rates, a measure of fishing quality that can potentially be linked to ANS. Our review of available studies shows that changes in net values that occur due to changes in catch rate depend on current catch rates at a site, the availability of alternative fishing sites, and other factors. Therefore, transferring estimates of economic losses associated with a decline in fishing quality based on a study at one site to other sites within the study area is not recommended.

Beachgoing

Estimating the Net Value of Beachgoing: There has been relatively very little research that measures the recreational use value of a beach day (Freeman 1995; Song et al. 2010). Estimates of net beach recreation values are highly variable across non-market valuation methods, over time, and across states and water bodies (Atiyah, 2009).

Few recreation valuation studies have been conducted for Great Lakes beaches, and CU was unable to identify any inland water recreation studies that provided values for beachgoing as a standalone activity. The estimated net economic values per person per beach recreation day are reported in Table II.b from the three studies conducted in the Great Lakes. A fourth study, reported in Murray et al. (2001) and Yeh et al. (2006) and discussed in Chapter III, is

[2] It is useful to contrast this range of net value estimates with available estimates of expenditures and economic impact from fishing in the Great Lakes. The USFWS (2008) reports that Great Lakes recreational angling-related expenditures in 2006 totaled $1.7 billion ($2012), of which trip-related expenditures were $1.2 billion ($2012). Using these data, a study conducted for the American Sportfishing Association estimates the economic importance of Great Lakes fishing to be approximately $7 billion in 2006 (American Sportfishing Association, 2008), which translates to about $8 billion in $2012. For reference CU provides a brief discussion of the alternative measures of economic activity in the Appendix. The interested reader is also referred to Scodari (2009) and Aitken (2009) for further discussion.

Table II.b. Estimated Net Values per Person per Beach Recreation Day

Valuation Method	Estimated Net Value/Day ($2012)	Location	Study
TCM	$33 -35	Two Lake Erie (Ohio) Beaches	Sohngen et al. (1998)
TCM	$48	Chicago Beaches	Shaikh (2006a,b)
TCM	$46-$62	Michigan State GL Beaches	Song et al. (2010)

a. Rounded to the nearest dollar.

not included in this table because these papers did not provide estimated net values for recreation beach days.

Each of the individual studies listed in Table II.b has too narrow a geographic focus to serve as the basis for providing comprehensive net value estimates for the entire study region. While there is a convergence in estimated net benefits across the three studies conducted in the Great Lakes, in the range of $33 to $62 ($2012) per beach recreation day, CU maintains that three studies are not enough to reliably establish range of net values per day for beachgoing.

The estimates of net value from the studies reported in Table II.b can be used to evaluate whether USACE's published unit day values should be used for estimating the net value of beachgoing in the study region. Because the estimates of the net value per day in Table II.b are well above the range of relevant unit day values published by USACE, USACE unit day values should not be used to estimate the net value of beachgoing in the study region.

Even if a reliable range of estimates of value per beachgoing day were available, there is no estimate of how much beach visitation occurs within the GLMRIS study area. This prevents us from calculating the aggregate net value of the resource, but this number is likely to be large: in Michigan alone there are almost 600 Great Lakes public beaches that have been identified by health departments and state agencies, along with substantial private access (Song et al. 2010). Further, beachgoers tend to use beaches multiple times a season. Shaikh (2006a,b) reports that the average beachgoer in Chicago went to the beach 14 times a season. Lake Erie beach visitors (Murray et al. 2001) indicated that they planned to visit 15 times that season.

As a result of the above data limitations, CU concludes that the existing body of literature on beach valuation is inadequate for providing estimates of the net value of beachgoing in the Great Lakes and Upper Mississippi and Ohio River Basins.

Estimating Changes in the Net Value of Beachgoing in Response to ANS: The existing literature is also inadequate for projecting estimates of loss in net values of beach recreation associated with ANS. Two studies have estimated water quality impacts on beach recreation within the Great Lakes region (Song et al. 2010 and Murray et al. (2001)/Yeh et al. (2006)) and CU has not located any studies in the Upper Mississippi and Ohio River Basins. Further, these two studies focus on E. Coli contamination and corresponding beach advisories (related to sewage overflows), which seem unlikely to correspond to the effects of ANS. Overall, CU therefore concludes that the existing body of literature on beach valuation is not sufficient for providing estimates of changes in net economic value associated with the quality of beach recreation.

Recreational Boating

Estimating the Net Value of Recreational Boating: Little valuation research on recreational boating has been conducted in the Great Lakes and the Upper Mississippi and Ohio River Basins. The recreational values data base maintained by Rosenberger, Loomis and colleagues over the years contains two publications for Great Lakes or Northeast states from 1985 to 2011, with respect to motor boating and two more studies in the category of floating/rafting/canoeing. These few studies are not enough to reliably estimate the aggregate value of recreational boating in the region.

In a contingent valuation study of recreational boating on Lake Ontario and the St. Lawrence River in 2002, Connelly et al. (2005, 2007) report that average net value per boating recreational day to be almost $87 ($2012). If one assumed that "the estimated value was distributed equally among people on the boat, a "rough estimate" of net value per person per day would be about $29. Comparison of values across subsets of the data indicates that net value varies systematically with boat size, and whether or not a marina, yacht club, or pier is used. A separate travel cost study of canoeing in the Boundary Water Canoe Area in Minnesota, a very different kind of system with very different types of use, provides a per person per day net value estimate of $12 ($2012) (Hellerstein, 1991).

Three other studies are reviewed in Chapter IV, but are not included here because they provide inadequate information for assessing the reliability of the estimated values.

Estimates of the net value of recreational boating could be based on USACE unit day values. While CU was able to conclude that USACE unit day values likely underestimate actual net recreational values for fishing and beachgoing, insufficient studies are available to allow us to determine whether this is the case for estimating the net value of recreational boating.

While there is a shortage of studies on the net value per day of recreational boating, a recent USACE study of the Great Lakes Basin (USACE 2008) does provide estimates of annual recreational boating effort. This study estimates that about 17 million boat days occurred on the Great Lakes and connecting waters in 2003, a level of participation similar to that for recreational fishing. However, despite having data on participation, the data on net recreational boating values is too sparse (a single study conducted in New York) to estimate the net value of the entire Great Lakes. Nor is any similar activity data available for the Upper Mississippi and Ohio River Basins.

In summary, CU concludes that the existing literature does not provide a large enough body of research to identify reliable estimates of net economic value for a day of recreational boating in the study area.

Estimating Changes in the Net Value of Recreational Boating in Response to ANS: With the exception of Connelly et al. (2007), the existing body of research does not address change in net economic value associated with resource quality. The quality variation in the Connelly et al. study is in water levels, a factor of recreational boating quality that is not likely to be associated with ANS.

Outline of the Remainder of the Report

The remainder of the report is organized into four chapters, an appendix, and a glossary of acronyms used in this report. Chapters III through V synthesize the relevant economic valuation literature on recreational fishing, beachgoing, and boating, respectively. Each chapter begins with an overview, provides a description of each study that is potentially relevant to recreational valuation in the GLMRIS study area, and concludes with a short synthesis. Chapter VI provides additional technical and econometric details about the studies reviewed in Chapters III through V for readers who are interested in additional information. The appendix provides a discussion intended to clarify the difference between the net economic value approach adopted here and other measures of economic contribution, such as expenditures and economic impact analyses.

III. Economic Valuation Studies of Recreational Fishing in the Great Lakes and Upper Mississippi and Ohio River Basins

Over the years a large body of non-market valuation research on recreational fishing has developed, with several major studies conducted in the GLMRIS study area. This attention has been driven by the importance and widespread nature of this recreational activity as well as the fact that catch rate statistics were a readily available measure of the quality of the resource. This later feature fostered the development of new methods of valuation techniques that accounted for quality changes, particularly in the travel cost method.

Several authors have collected and summarized fisheries valuation research for the purposes of conducting benefit transfers and meta-analyses. Sorg and Loomis (1984) covered the literature on outdoor recreation from the mid-1960's to 1982, identifying 93 benefit estimates in all. Walsh et al. (1992) summarized estimates of net value from 70 study sites from recreational value research in the United States from 1968-1988. This data set was updated and combined with other literature reviews in a series of reports by Loomis and co-authors, including Rosenberger and Loomis (2000, 2001), Kaval and Loomis (2003), and Loomis (2005). Loomis and Richardson (2008) updated these studies, cross-checking with a separate Sport Fishing Data Base (Boyle et al., 1999). Rosenberger and Loomis (2000, 2001) demonstrate that although there is substantial variation in estimates of net values across studies, these estimates vary systematically and in expected/explainable ways.

CU now turns to a discussion of the various studies that are potentially relevant to the GLMRIS study, and assess the relevance of individual studies and the collected body of research to estimating net values for recreational fishing in the study area and how these net values might be affected by quality changes, such as those that might be caused by ANS. The reports are ordered by method (Average Benefits Transfer (BT), Meta Analysis (MA), Travel Cost Method (TCM), Contingent Valuation (CV), and methods that use a combination of techniques).

As noted in the introduction, CU limits our literature review to studies that use data collected in 1985 or after. Limiting the data collection to this time period is motivated by concerns about the "shelf life" of non-market valuation estimates.[3] Our particular choice of cut off in

[3] Researchers in non-market valuation have not identified, or to our knowledge specifically discussed and debated, the "shelf life" for non-market values. In other words it has not been documented whether WTP estimates provided in research from decades ago are relevant as measures of value for current policy purposes even after they are adjusted by consumer price (CPI) indices. This is of particular concern for recreational activities such as recreational fishing in the Great Lakes in which the level of activity, and hence underlying demand, has changed substantially over generations and over time. For example, the 2006 National Survey of Fishing, Hunting, and Wildlife-Related Recreation reports that from 1996 to 2006 Great Lakes recreational fishing declined by 30% (USFWS, 2008, p. 18). While some research is ongoing on generational effects on recreational

1985 is somewhat arbitrary, but is also informed by the fact that Talhelm et al.'s (1979, 1988) well-known reports on the Great Lakes fishery cover research up to 1985. Further, in the mid-1980s the statistical approaches used in travel cost analyses underwent fundamental change.

Moreover, CU only includes studies in our review that endeavor to provide values over a geographical region, rather than a single inland lake (e.g. Eiswerth et al. 2008) or river stretch (e.g. Collins et al. 2005) or narrowly defined subset of fishermen (e.g. Provencher and Bishop, 1997). An exception to these inclusion criteria is Kelch et al. (2006), as their research provides unique insights into Ohio/Lake Erie Steelhead Salmon. Finally, our review of the data does not include valuation studies measuring the effects of toxic contamination (e.g. Montgomery and Needleman, 1997) or changes in water quality without accounting for changes in catch rate (e.g. Parsons and Kealy, 1992; Feather et al. 1995).

Each review will be structured following the outline in Box 1.

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values (e.g. Englin 2012), the appropriateness of transferring values over extended time periods remains an open empirical issue. Economic methods for valuing recreational activities such as angling have evolved substantially over time. In the decades since the Talhelm report, "single site" recreation valuation studies of the type employed in the work prior to the Talhelm report, have largely been replaced by "Multisite" choice methods that use statistical approaches that better account for substitutability across fishing activities and sites and the incorporation of fishing quality into the econometric modeling. In turn this more complete accounting is able to accommodate the effects of a change in quality in one part of the fishery: if the quality of angling in one part of a fishery is affected by, say, pollution or ANS, anglers may decrease their effort in that site/fishing mode combination and offset their reduced fishing by increasing effort at other fishing and or other fishing modes.

Box 1: The Structure of Each Review

<u>Identifying Name of Study (date)</u>

Location:

Data Type, Date:

Project Sponsor:

Publications (Date, Type):

Stated Purpose of Research Effort:

Data Collection/Sampling Information:

Reported Values:

Assessment of Study and Relevance to GLMRIS:

Notes *r.r. = response rates*
n = number of complete responses
WTP = willingness to pay
ABT = average benefits transfer
MA = meta analysis
TCM = travel cost method
CV = contingent valuation
Unless otherwise indicated, all reported values are adjusted to $2012 using the CPI.

Loomis and Richardson (ABT 2007):

Location: Northeast recreation area, including the Great Lakes

Data Type, Date: Average benefits transfer, using original estimates from 1967 to 2005.

Project Sponsor: National Council of Science and the Environment

Publications: Loomis and Richardson (2008, Report)
Loomis (2011, personal communication)

Stated Purpose of Research Effort: Within the limits of the then available literature, this study sought to provide up-to-date benefit transfer values and estimated meta-analyses equations. Values for fisheries and other recreation use values were reported in tabular form by region.

Data Collection/Sampling Information: This report is the most recent iteration of a cumulative effort to assimilate recreational values studies that includes Sorg and Loomis (1984), Walsh et al. (1992); Rosenberger and Loomis (2000, 2001), Kaval and Loomis (2003) and Loomis (2005). The fishing values were updated and cross-checked with a separate Sport Fishing Data Base (Boyle et al., 1999, see the review Boyle et al. (MA 1999) below.).

Reported values: The following average values were reported for different fishing categories for fresh and saltwater fishing in the Great Lakes and the Northeast (Loomis, 2011, Personal communication), where N represents the number of estimated values used.

Species	Cold Water	Warm Water	Anadromous	Mixed	Not Specified
Average	45	48	44	22	56
N	58	119	33	30	112

Assessment of Study and Relevance to GLMRIS: The above values include observations for salt water fishing and for other fishing activities in the Northeast Recreation Area outside the GLMRIS region. However, because the values include the Great Lakes region and non-Great Lakes states within the Upper Mississippi Basin (e.g., Iowa and Missouri) and Upper Ohio River Basin (e.g., West Virginia), these values are relevant to the GLMRIS study with respect to providing an estimate of the current net value of the fishery. These data are not appropriate for changes in fishing quality however.

Rosenberger and Loomis (ABT/MA 2001):

Location: Northeast recreation area, including the Great Lakes

Data Type, Date: Average benefits transfer and meta analysis, using original estimates from 1967 to 1998.

Project Sponsor: United States Forest Service (USFS)

Publications: Rosenberger and Loomis (2001, Report)
Rosenberger and Loomis (2000, Journal Article)

Stated Purpose of Research Effort: Within the limits of the then available literature and data, this study sought to provide up-to-date benefit transfer values and estimated meta-analyses equations. Values for fisheries and other recreation use values were reported in tabular form by region.

Data Collection/Sampling Information: This report is an interim iteration of the cumulative efforts of assimilating recreational values studies discussed in the main text.. This string of research includes Sorg and Loomis (1984), Walsh et al. (1992), Kaval and Loomis (2003), Loomis (2005) and Loomis and Richardson (2007).

Reported values: The net benefits per recreational fishing day in the Great Lakes and the Northeast, based on the averaging the values estimates from 43 studies is $45 ($2012). The corresponding value from the meta analysis is $73. These data include both fresh and saltwater studies.

Assessment of Study and Relevance to GLMRIS: The above values include observations for salt water fishing and for other fishing activities in the Northeast Recreation Area outside the GLMRIS region. However, because the values include the Great Lakes region and non-Great Lakes states within the Upper Mississippi Basin (e.g. Iowa and Missouri) and Upper Ohio River Basin (e.g. West Virginia), these values are relevant to the GLMRIS study with respect to providing an estimate of the current net value of the fishery. These data are not appropriate for changes in fishing quality however.

Boyle et al. (MA 1999)

Location: National, including the study region

Data Type, Date: Meta analysis, using original estimates from 1982 to 2005.

Project sponsor: U.S. Fish and Wildlife Service (USFWS)

Publications: Boyle et al. (1998, Report)
Boyle et al. (1999, Report)

Stated Purpose of Research Effort: This study involved developing a database of recreational valuation studies (Boyle et al., 1998) and a meta analysis of the values in the data base (Boyle et al. 1999) as part of an effort by the USFWS to improve the efficacy of, and consistency in, their analyses involving the economic valuation of sports fishing opportunities. Specifically, the meta analysis of these data was intended to: 1) provide a means to systematically explore the variation in sport fishing value estimates across studies; 2) provide formal models for use in developing welfare estimates for sport fishing opportunities in cases where original estimates are not available; and 3) identify where the are representation gaps in the economic valuation for various sportfishing opportunities.

Data Collection/Sampling Information: A review of the literature identified citation information on over 250 sport fishing studies, but active collection efforts were limited to 150 studies due to resource limitations. After winnowing this data using various criteria, the data base resulted in detailed study information for 70 studies that provided a total of 1002 per-day and per-trip welfare estimates. A statistical, meta analysis was conducted on these data (see technical information in Chapter VI), indicating that estimated net values varied significantly with the type of fish caught, the type of waterbody and method used to collect data.

Reported Values: The net benefits per day, based on the simple average of 461 value estimates for recreational fishing across the county, is $62 ($2012). The corresponding value from the meta analysis is $73. Two sample scenarios were estimated for Great Lakes fisheries: Great Lakes Bass ($90) and Great Lakes Salmon ($109).

Assessment of Study and Relevance to GLMRIS: The estimated values are relevant to GLMRIS, although some caution is merited in adopting these values because the estimated values have relatively large standard deviations and thus lack statistical precision (see technical details in Chapter VI).

Lyke (TCM 1993):

Location: Wisconsin Waters of Lake Superior and Lake Michigan and inland fisheries.

Data Type, Date: Multisite TCM; Primary data collection, 1990. (1989 fishing season)

Project sponsor: University of Wisconsin Sea Grant Institute.

Publications: Lyke (1993, Dissertation)

Stated Purpose of Research Effort: The purpose of this study was to investigate whether the net value of fishing quality to anglers, as represented by catch rates per unit of effort, could be measured using the TCM, and whether TCM and CV estimates are similar for the same quality change. For a discussion of the comparability across the two methods, refer to the Lyke (1993) entry in the CV subsection below.

Data Collection/Sampling Information: A stratified sample based on geographic location and the estimated number of Great Lakes anglers within a county was drawn from 1988 fishing licenses purchased in Wisconsin. Screening postcards were used to identify people who fished for trout or salmon in the Wisconsin Great Lakes and/or inland waters in 1989 (r.r. = 70%). Based on the postcard information, two separate mail survey questionnaires were distributed to respondents who: 1) Indicated that they fished on the Wisconsin Great Lakes in 1989 (Wisconsin Great Lakes Sport Fishing Survey (WGL), r.r. = 90%, n = 274); or 2) Indicated that they did not fish on the Wisconsin Great Lakes in 1989 (Wisconsin Sport Fishing (WSF) Survey, r.r. 85%, n = 239).

The questionnaires were mailed in February 1990, using a recall approach to elicit travel cost information from 1989[4]. In the WGL questionnaire, 29 separate Lake Michigan and Lake Superior areas were identified, and anglers were allowed to supplement this list. More detailed information (e.g. catch rates for particular species, seasonal variation in fishing effort, average distance and time traveled, and method of fishing) was requested about the two areas with the most frequent visits. A similar approach was used for the (WSF) survey,

[4] Ideally travel cost data could be collected immediately after every trip or through the use of a regularly collected travel log. However, such an approach is simply beyond the capacity of most survey efforts. The question thus arises as to the consequences of relying on lengthy recall periods. The USFWS suggests that there is systematic recall bias: the USFWS's "Research found that the amount of activity and expenditures reported in 12-month recall surveys was overestimated in comparison with that reported using shorter recall periods." (2008, p. vii). This finding of upward recall bias is consistent with past research conducted by Cornell (Connelly and Brown 1995, Connelly et al. 2000). However, more recent research by Connelly and Brown (2011) that more carefully controls for potential methodological effects in comparisons across more and less frequent contacts provides evidence that the recall effects may occur in the other direction, and that even if there are significant effects they are not substantial (<10%). As such, the issue of recall bias effects remains unsettled. Nevertheless, calls for shorter recall periods should not be abandoned. Other factors being constant, shorter recall periods will be preferred to longer recall periods.

with the difference being that the respondent self-identified the specific bodies of water fished.

Reported Values: The results from a number of TCM net value estimates are provided in this dissertation for various scenarios. Of most relevance to GLMRIS are the mean net-benefit per trip values for All Wisconsin Great Lakes ($35.38 per trip ($2012), p. 172), Wisconsin parts of Lake Michigan ($34.33 per trip ($2012), p. 140), Wisconsin parts of Lake Superior ($1.04 per trip, p. 140) and Inland Wisconsin ($260.32 per trip ($2012), p. 140). Because the net values for Great Lakes fishing were elicited for each *trip*, and trips "may mean stopping for an hour on the way to work, or it may mean fishing for several days hundreds of miles from home" (p. 141) it is not clear how the values translate into per day values. In comparing these values to other results in the literature, the author notes that the estimated values are "compatible or a little low relative to the cold water fishing literature" but that the "per day values for Inland fishing are much higher than other values" (p. 139) in the literature.

Assessment of Study and Relevance to GLMRIS: The sampling effort was rigorous and resulted in a high response rate. The data has been used for further modeling development by Phaneuf et al. (TCM 1997 - see review below). However, there are some aspects of the methodology that are not described sufficiently to judge their reliability (see Chapter VI), and the dissertation lacks sufficient detail explaining how values were derived, which complicates assessment of the quality of the analysis.

Due to the concerns about and lack of documentation regarding modeling issues CU concludes that the values from this study are not appropriate for use in the GLMRIS project.

Jones and Sung (TCM 1993):

Location: Michigan inland fisheries and waters of the Great Lakes.

Data Type, Date: Multisite TCM; Primary data collection, 1983-1984.

Project sponsor: Michigan Department of Natural Resources (MDNR), U.S. Environmental Protection Agency (USEPA)

Publications: Jones and Sung (1993, Report)
Jones and Lupi (2000, Journal Article)

Stated Purpose of Research Effort: This research had two major objectives. The first was to address several methodological issues associated with travel cost models. The second was to allow the state to use the model to improve fisheries management and to perform Natural Resource Damage Assessment for injuries to Michigan State fisheries.

Data were taken from a mail survey of 1% of the anglers licensed to fish in Michigan during the 1983 and 1984 license years (r.r.= 59%; n = 10,948). Questionnaires were sent out at various times over the period from November 1983 to September 1984, resulting in recall periods from less than a month to almost 14 months. While the survey data used in this study was collected prior to our general cutoff data of 1985, CU includes this study in our review because its method of categorizing anglers by fishing activity is utilized in later research and because of the statistical methods used.

The questionnaire requested detailed information on the angler's most recent fishing trip, including species sought, location, trip length, trip expenditures etc., as well as demographic background including fishing experience and preference information. Importantly, while details were provided about the most recent trip, the data collection effort had "severe data limitations at the total participation level. We do not know the total number of season trips" (Jones and Sung, p. 4). Catch rates for Great Lakes warm and cold water fish and for anadromous runs were obtained from MDNR creel studies. It was determined that creel data could not be used for inland fishing: instead proxies for fishing quality, such as total lake acreage per county for each of cold water and warm water lakes, and miles of cold water and warm water rivers and streams broken down by quality level (top quality, second quality, other), were used. The MDNR classifies top quality streams as those that have good self-sustaining stocks of warm/cold game fish. Secondary quality streams contain populations of warm/cold game fish, but these populations are appreciably limited by factors such as pollution, competition, or inadequate natural production.

Reported values: Standard values such as net value per day of fishing were not reported for these data, in part because of the data limitation on total fishing days. The model was used to demonstrate how changes in recreation days might be affected by eliminating PCB contamination on the Kalamazoo River. However, the estimated improvement values are not germane to GLMRIS.

Assessment of Study and Relevance to GLMRIS: The overall contribution of the study to estimating fishing recreation values in the GLMRIS area is limited by the lack of data on total trips taken during the season, which prevents consideration of how quality affects the frequency of trips and shifts in trip locations across a season. As such, this work is not relevant to the objective of estimating net values of recreational fishing in the study area and does not provide adequate information for estimating how changes in quality will affect net values of the recreational fishing resource.

MSU (TCM 1996)

Location: The Great Lakes and Inland Waters of the State of Michigan

Data Type, Date: Multisite TCM; Primary data collection 1994-1995.

Project sponsor: Michigan Department of Natural Resources (MDNR)

Publications: Hoehn et al. (1996, Report)
Various conference papers/staff reports: e.g. Chen et al. (1999), Lupi and Hoehn (1997), Lupi et al. (1998)
Lupi et al. (2003, Journal Article)

Stated Purpose of Research Effort: This study was funded to provide an economic model of recreational fishing which could help the MDNR protect and manage Michigan's fishery resources. The results of the study were to be consistent with Natural Resource Damage Assessment guidelines, allowing for defensible estimates of environmental injuries under Federal and State environmental laws. As such, the economic model had to be capable of measuring the economic value of changes in natural resource quality at a number of sites.

The MSU study implemented a repeated travel cost visitation model that involved multiple contacts during the 1994 fishing season. Random digit dialing was used to identify Michigan Residents who were potential anglers for the 1994 season, where potential meant that they fished in the previous year or stated an intention to fish in the upcoming season. Of the respondents who were identified as potential anglers, 78% agreed to participate. Of those who agreed to participate, 80% completed the entire CATI panel survey that followed anglers during the course of the 1994-95 fishing year. To balance respondent burden with the need for accuracy frequent anglers were called more than infrequent anglers, with panel frequencies ranging from three to eight interviews over the fishing season. Each interview basically consisted of asking whether the respondent had fished or not since the previous interview, and if they fished, respondents were asked the location, duration, and species targeted for each trip. To enhance accuracy, fishing logs were provided. In this manner MSU was able to get detailed cost and quality data for each trip. This approach to collecting data avoids possible recall biases and other issues associated with aggregating estimated trips and costs across an entire season.

Reported values: In various reports the authors demonstrated how days fishing and consequent changes in total WTP would be affected by specified changes in the fishery. For example, they provided simulations for lake closures in specific counties (due perhaps to a contamination incident) and increases in lake trout on the St. Mary's River (an outcome of increases in lamprey treatments). As a result, this effort only provided limited information

regarding net-benefits per day of recreational fishing. The authors reported user day values for trout and salmon of about $41 and $51, respectively ($2012, Lupi et al. 1998).

Assessment of Study and Relevance to GLMRIS: Because of the high quality data collection methods and the application of state of the art statistical methods, this study can be regarded as an exemplar for Great Lakes travel cost fisheries research. The MSU model provides a snapshot of how anglers responded to travel costs and site quality for Michigan fisheries circa 1994-95, but it remains an open question of whether its estimated values are applicable beyond Michigan state waters. The model could be used to simulate the catch rate impacts associated with hypothetical ANS, and indeed has been used so for evaluating the benefits of Sea Lamprey control (Lupi et al. 2003).

Phaneuf et al. (TCM 1997)

Location: Wisconsin waters of Lake Superior and Lake Michigan.

Data Type, Date: Multisite TCM; Secondary data from Lyke (1993) (1989 fishing season)

Project sponsor: US EPA, USDA Western Regional Project W-133.

Publications: Phaneuf (1997, Dissertation)
Phaneuf et al. (1998, 2000, Journal Articles)
Herriges et al. (1999, Book Chapter)

Stated Purpose of Research Effort: The broad aspects of this data collection effort are described in the TCM entry for Lyke (TCM 1993). Phaneuf and co-authors used the Lyke (1993) Wisconsin Great Lakes Fishing Survey to develop a new modeling approach for recreational modeling.

Reported Values: Phaneuf et al. (1998) reported seasonal values from a variety of statistical models that effectively close the Southern portion of Lake Michigan (this could be attributed to an environmental disaster). Converting these seasonal values to average per trip net value using information provided in Lyke (TCM 1993) provides an estimate of about $53/trip. CU converted this value to a rough per-day value estimate of $42 by dividing the per-trip value by 1.25. This indirect adjustment factor (1.25=25/20) was derived from the 1991 National Survey of Fishing, Hunting and Wildlife-Associated Recreation (USFWS 1993) by dividing the estimated 25 million annual Great Lakes fishing days by the estimated of 20 million annual Great Lakes trips fishing trips.

Assessment of Study and Relevance to GLMRIS: The new approach to modeling recreation is a contribution. However, such a modeling approach is appropriate only for limited numbers of site choices, and is not extendable to settings with more choices. The use of only the GL data set from the Lyke (TCM 1993) study preempts concerns about substitutes mentioned in that review.

Phaneuf et al.'s values could be aggregated to estimate net values. Yet expanding a localized study to the entire geographical area of GLMRIS would not be appropriate because of the widely varying opportunities and conditions in the Great Lakes and UMORB.

Upneja et al. (TCM 2001)

Location: Inland and Great Lakes waters of Pennsylvania

Data Type, Date: Single site TCM; Primary data collection 1995-1996

Project sponsor: Center for Rural Pennsylvania

Publications: Upneja et al. (2001, Journal Article)

Stated Purpose of Research Effort: The objective of this study was to determine the economic benefits of sportfishing activities in the commonwealth of Pennsylvania.

Data Collection/Sampling Information: Drawing every 70th name from the list of licensed Pennsylvania anglers in 1994, a mail survey was administered in stages between June 1995 and May 1996. Anglers were asked to report trip expenditures of their most recent fishing trip, the species targeted, the total number of fishing trips taken and other recreational information. The response rate was 6.5% (n=987).

Reported values: Estimated mean net value per person per day is $435.

Assessment of Study and Relevance to GLMRIS: The 6.5% response rate and technical issues discussed in Chapter VI preclude this study for use in basin-wide estimates of net value under the GLMRIS study.

Besedin et al. (TCM 2004)

Location: Michigan Great Lakes (Michigan, Huron, Erie, Superior)

Data Type, Date: Multisite TCM; Secondary data 2001

Project sponsor: US EPA

Publications: Besedin et al. (2004, Presentation)
US EPA (2004, Report)

Stated Purpose of Research Effort: Building from an analysis of Michigan State Great Lake waters, this study evaluates recreational fishing losses in the Great Lakes hydrological region caused by "impingement and entrainment" of fish by power plant cooling water intake structures (CWIS). It was completed as part of the Environmental Protection Agency's (EPA's) regulatory impact analysis for regulations of power plant CWIS under section 316(b) of the Clean Water Act.

Data Collection/Sampling Information: A sample of 10,000 anglers was taken from a subset of the Michigan Department of Natural Resources (MDNR) Measurement of Sportfishing Harvest in Lakes Michigan, Huron, Erie, and Superior study, conducted in 2001, which surveyed boat, shore and ice anglers at fishing sites in Michigan State's Great Lakes waters. No socio-economic data was collected. Catch rate data were estimated from ten years of MDNR creel data. After excluding non-Michigan residents and anglers who traveled more than 120 miles one way to the fishing site, single-day TCM data were available for 9,758 GL and tributaries anglers.

Reported values: Per-Trip net values are reported for simulated scenarios of reductions in **"**impingement and entrainment" of fish by cooling water intake structures. These values cannot be used to estimate the current net value of fishing or how that value might change in response to ANS because they are specific to this source of environmental impact. Net values for an additional fish caught on a trip were also reported.

Assessment of Study and Relevance to GLMRIS: The limited discussion of data collection provided in the conference presentation and the US EPA report make it difficult to assess the quality of the data and, hence, the overall study. From the econometric modeling perspective (see technical report for this study in Chapter VI) there is some concern that modes of fishing (e.g. warm water fishing) could not be/were not separated in the statistical analyses creating potential biased in the estimates.

The reported WTP values are not appropriate for developing an estimate of the net benefits of the total recreational fishing resource as they report only changes in net benefits

associated with the regulation being considered. A subset of the WTP estimates reported in this study, i.e. WTP for an additional fish per trip, are relevant to estimating net economic value of the GLMRIS fishing resources only to the extent that values per fish could be used as a measure of quality change within the Great Lakes.

Murdock (TCM 2006)

Location: Michigan Great Lakes

Data Type, Date: Multisite TCM; Secondary data 1998.

Project sponsor: The data collection was funded by the Fox River Group

Publications: Murdock (2002, Dissertation)
Murdock (2006, Journal Article)

Stated Purpose of Research Effort: The contribution of this study is primarily methodological in that it focuses on developing a way to address unobserved quality characteristics of recreation sites in statistical models.

Data Collection/Sampling Information: The model was applied to data collected as part of an Natural Resource Damage Assessment plan potentially resulting from releases of hazardous substances to the Lower Fox River and the Bay of Green Bay (see Desvousges et al. 2000 and MacNair and Desvousges 2007). A random digit dialing telephone survey recruited Wisconsin anglers willing to complete a fishing diary each month for June through September 1998. Of the recruited anglers 81% returned at least one of their monthly diaries and 64% completed all four months. This paper uses data on the 512 anglers who completed all four months of the survey and reported taking a single day fishing trip. The fish trip log collected information on fishing location, distance travelled, trip and location characteristics, and number of fish caught of each species, size and the number of fish eaten. As with the Breffle et al. (1999) study reported below, contingent valuation-like data were also collected, but are not reported here because it pertains mostly to fish consumption advisories.

Fish catch measures were obtained by combining information from the Wisconsin Department of Natural Resources (WDNR) and the data collected in the survey. As a result catch rates vary across sites but not anglers. 737 fishing sites were visited by anglers and organized into roughly seven by five mile quadrangles.

Reported values: No estimates of WTP per day are provided. Illustrative policy values for a 10% increase in walleye and musky catch are reported in miles rather than dollars.

Assessment of overall study quality and contributions: The net values are provided in miles travelled/water quality tradeoffs rather than dollars and are hence not relevant to the GLMRIS project.

Kelch et al. (TCM 2006)

Location: Lake Erie Tributaries

Data Type, Date: Single site TCM; Primary data collection 2003

Project sponsor: Ohio Sea Grant College

Publications: Kelch et al. (2006, Journal Article)

Stated Purpose of Research Effort: The objective of this research was to provide net value estimates to policy makers interested in assessing the effectiveness of steelhead salmon stocking programs and providing access and opportunities for fishing operations. Fishing for anadromous fish represents a high quality fishing experience, and interest in steelhead fishing in Lake Erie tributaries has risen in recent years.

Data Collection/Sampling Information: Between October 2002 and April 2003 Ohio Sea Grant staff contacted over 500 steelhead anglers on the streambanks of eight Lake Erie tributaries and asked them to participate in a mail survey about steelhead fishing. Of the over 500 anglers contacted, 487 agreed to provide their names and addresses, and 375 responded to the mailed survey with usable information (r.r. =77%). Of this 93% were on single day trips, and only these data were used in the analyses.

Reported values: Estimated net-benefits per single-day fishing ranged from $42 to $55 ($2012).

Assessment of overall study quality and contributions: This is a straightforward, solid study. If it can be assumed that there is little substitution between anadromous run fishing and other fishing activities and that substitution options to other tributaries are low, then this provides a useful contribution to Great Lakes fishery valuation research.

Relevance to GLMRIS: Subject to the caveats above regarding substitution alternatives and concerns that conditions differ in other parts of the Great Lakes, the net values could be used to contribute to estimates of the current net value of anadromous fishing in the Great Lakes. Yet expanding these localized estimates to the entirety of anadromous fishing effort in the Great Lakes may not be appropriate because of varying conditions at other sites.

Milliman (CV 1986):

Location: Green Bay, Wisconsin.

Data Type, Date: CV; Primary data collection 1986

Project sponsor: University of Wisconsin – Madison, Wisconsin Sea Grant, National Sea Grant.

Publications: Bishop et al. (1990, Journal Article)
Milliman et al. (1992, Journal Article)

Stated Purpose of Research Effort: In 1983, the Wisconsin Department of Natural Resources (WDNR) initiated a regulatory program for yellow perch in Green Bay with the intent of rehabilitating this fishery. Amongst other efforts, this study sought to estimate WTP values for the current fishery and WTP values for the projected improvements to the fishery.

Data Collection/Sampling Information: The basis for estimating the value per angler trip was a CV survey of perch anglers conducted in 1986. WDNR creel census clerks and university-employed clerks intercepted perch anglers at all the significant fishing sites along the Wisconsin shores of Green Bay. Anglers were asked whether they would be willing to complete a mail questionnaire from the university regarding perch fishing. A sample of 600 anglers was drawn at random from those who agreed to participate in the study. The survey was mailed during the fall of 1986 (r.r. = 91%).

In the mail survey respondents were asked about the fishing trip during which they were initially intercepted. Expenditure and other travel cost information were collected along with information about the number of fish caught and the average size of these fish. To estimate net benefits, respondents were asked if they would have still taken the trip if their total expenses had increased by a specified number of dollars, wherein the dollar value varied across respondents. Respondents answered yes or no to this question.

Reported values: Estimated average net-benefits per trip under existing conditions was about $54 ($2012). Other values are reported for hypothetical improvements in catch and fish length, but are not replicated here.

Assessment of Study and Relevance to GLMRIS: This is a straightforward application of the dichotomous choice CV method. This provides a localized net value for a fishing day under the conditions that existing in Green Bay in 1986 and is thus relevant to the GLMRIS study. Yet expanding a localized study to the entire geographical area of GLMRIS would not be appropriate because of the widely varying opportunities and conditions in the Great Lakes and UMORB.

Connelly and Brown (CV 1990)

Location: Inland and Great Lakes waters of New York

Data Type, Date: CV; Primary data collection 1989 (for 1988 fishing season)

Project sponsor: New York Department of Environmental Conservation (NYDEC)

Publications: Connelly et al. (1990, Report)
Connelly and Brown (1991, Journal Article)

Stated Purpose of Research Effort: This research was conducted to provide baseline data on the recreational value of the freshwater fisheries in New York State and to show how comparisons of value can be made over time. The authors note that these valuation estimates were needed to help justify fisheries management expenses and as a data base for evaluating future policy alternatives.

Data Collection/Sampling Information: A systematic sample of resident and nonresident New York fishing license holders was selected for the license year over the period from October 1987 through September 1988. The licenses were sorted and the sample was stratified by county of purchase. A questionnaire was mailed in January 1989, in which respondents were ask to list for calendar year 1988 the number of days fished, species sought and travel cost by location (r.r. =62.4%; n=10,314, of which about ½ were asked CV questions).

After eliciting information about the entire fishing season, respondents were asked to recall a specific fishing trip from amongst those they had previously identified. Respondents were then asked how many days they spent on the trip and the cost for their share of the expenses. Next, a series of questions was asked to get respondents to think in more detail about how much they would be willing to pay for that trip if their share of expenses had increased. Finally, respondents were asked 'What is the maximum amount that you would have been willing to pay before you would have decided not to go?'

Reported values: This research provides a number of values for various fresh water resources in New York. Considered in total, these suggest that there is variation in recreation values across locations within a state. Despite this, the overall variation between GL and inland waters is not that large. Net value for GL was about $25 ($2012). For inland lakes the value is $28 ($2012).

Assessment of Study and Relevance to GLMRIS: The large sample in this study provides broad coverage across the entire state, and was stratified in ways that would allow aggregation

across sites. The demonstration of variation of values across sites within a state demonstrates the concerns raised in various parts of this review about potential biases associated with aggregation of data in which values are not matched with effort.

The estimates from this study provide a regional net value for a fishing day under the conditions that would be relevant to the GLMRIS study. Yet expanding a single state study to the entire geographical area of GLMRIS would not be appropriate because of the widely varying opportunities and conditions in the Great Lakes and UMORB.

Lyke (CV 1993)

Location: Wisconsin Waters of Lake Superior and Lake Michigan and inland fisheries.

Data Type, Date: CV; Primary data collection, 1990. (1989 fishing season)

Project sponsor: University of Wisconsin Sea Grant Institute.

Publications: Lyke (1993, Dissertation)

Stated Purpose of Research Effort: The purpose of this study was to investigate whether valuation of environmental quality, as represented by catch rates per unit of effort, could be measured using the TCM, and whether TCM and CV estimates converge for the same quality change. The TCM model and overall data collection effort was discussed in the Lyke (TCM 1993) entry above. Here CU concentrates on the CV estimates.

Data Collection/Sampling Information: After individually estimating personal expenditures for Great Lakes fishing, respondents were asked to suppose that fishing conditions remained the same in the upcoming year, but that annual costs would rise by a specified amount that varied across anglers. Respondents indicated whether or not they would still choose to fish in the Wisconsin Great Lake.

Reported values: Annual mean net values were estimated and the information in the dissertation allows these values to be converted into net value per trip. The average CV net value per Great Lakes trip was estimated to be about $51 ($2012). This is larger than the corresponding estimate from the TC model of about $35 ($2012) although this interpretation is made with some qualifications because of concerns about interpreting the TCM values estimated in Lyke (TCM 1993). CU converted Lyke's estimated CV value to a rough per-day value estimate of $41 by dividing the per-trip value by 1.25. This indirect adjustment factor (1.25=25/20) was derived from the 1991 National Survey of Fishing, Hunting and Wildlife-Associated Recreation (USFWS 1993) by dividing the estimated 25 million annual Great Lakes fishing days by the estimated of 20 million annual Great Lakes trips fishing trips.

Assessment of Study and Relevance to GLMRIS: Much of the data and estimation issues raised in the Lyke (TCM 1993) review do not carry over to the CV analysis, as the latter uses only the CV responses to the Wisconsin Great Lakes Sport Fishing Survey. A limitation of the data is that it measures per trip net value rather than per day net value, making it difficult to compare with other surveys. The CV data is found to provide higher values than the TCM.

This study provides a regional net value for a marginal fishing trip under the conditions that existing in Wisconsin Great Lake Waters in 1988. It is relevant to the GLMRIS objective of estimating net value of the fishery resource. Yet expanding a localized study to the entire

geographical area of GLMRIS would not be appropriate because of the widely varying opportunities and conditions in the Great Lakes and UMORB.

Connelly et al. (CV 1997)

Location: Inland and Great Lakes Waters of New York

Data Type, Date: CV; Primary data 1996-1997

Project sponsor: New York Department of Environmental Conservation (NYDEC)

Publications: Connelly et al. (1997, Report)

Stated Purpose of Research Effort: A systematic sample of resident and nonresident New York fishing license holders was selected for the license year over the period from October 1995 through September 1996. The licenses were sorted and the sample was stratified by county of purchase. A questionnaire was mailed in January 1997, in which respondents were ask to list for calendar year 1996 the number of days fished, species sought and travel cost by location (r.r. =62.4%; n=8,760, of which about ½ were asked CV questions). While this mail survey asked respondents to recall activities across the entire year, a separate phone survey was conducted each quarter in 1996. The completion rate for the entire year was 30%. Although the response rates varied greatly across methods, the average annual fishing days (17.6-17.7 days in 1996) were nearly identical.

After eliciting information about the entire fishing season, respondents were asked to recall a specific fishing trip from amongst the trips they had listed in the seasonal section. Respondents were then asked how many days they spent on the trip and the cost for their share of the expenses. Next, a series of questions was asked to get respondents to think in more detail about how much they would be willing to pay for that trip if their share of expenses had increased. Finally, respondents were asked 'What is the maximum amount that you would have been willing to pay before you would have decided not to go?' These questions were designed to parallel those in Connelly and Brown (1990) and allow comparison of values across time.

Reported values: This research provides a number of values for various fresh water resources in New York. Net value for GL was about $22 ($2012). For inland lakes the value is $22 ($2012).

Assessment of Study and Relevance to GLMRIS: This large sample provides broad coverage across the entire state, and was stratified in ways that would allow aggregation across sites. In conjunction with Connelly and Brown (CV 1991) this research is unique in the sense that it allows comparison of estimates obtained using the same methods for fishing seasons eight years apart. Site-by-site comparisons across the two survey years indicated that values either remained the same or declined over time, which would be consistent with a fall in

recreational fishing effort on the GL that commenced in the early 1990s. In combination with a decline in fishing effort, the total estimates for the net-benefits of New York GL fishing fell from $133 million dollars in 1988 ($2012) to $91 million dollars in 1996 ($2012).

The estimated values provide a regional net value for a fishing day under the conditions that existing in New York in 1988 and are relevant as such to the GLMRIS project. Yet expanding a single state study to the entire geographical area of GLMRIS would not be appropriate because of the widely varying opportunities and conditions in the Great Lakes and UMORB.

National Survey of Fishing, Hunting and Wildlife Associated Recreation – NFHWAR (CV 2006)

Location: All 50 states and the District of Columbia

Data Type, Date: CV, Primary Data 2006

Project sponsor: U.S. Department of Interior, Fish and Wildlife Service (USFWS), and U.S. Department of Commerce, U.S. Census Bureau.

Publications: USFWS (2008, Report)
Aiken (2009, Report)
Harris (2010, Report)

Stated Purpose of Research Effort: In an effort to provide information about the importance of wildlife-based recreation in the U.S., the current form of National Survey of Fishing, Hunting, and Wildlife-Associated Recreation has been conducted every five years since 1991 with only minor changes during that period.

Data Collection/Sampling Information: A multistage probability sample of "sportspersons" was drawn from Census Bureau files, generating 22,000 complete interviews (r.r. = 77%). Interviews were conducted by telephone and in person. While the survey is motivated, in part, by requests from State agencies to provide state-level information, small sample sizes in some Great Lakes and individual states were "too small to report data accurately" and in other cases consisted of only 10-29 observations.

The survey elicits information about type and frequency of fishing, species targeted, fishing and boat expenditures and demographic characteristics, From the perspective of this review, the above information is augmented by CV questions that differentiated between within-state and out-of-state residents. After asking respondents to think about their share of expenses for a typical trout (or bass or walleye) trip during 2006, respondents were asked to provide an open ended CV indicting the additional cost that would have prevented him/her from taking even one such trip.

Reported values: Harris (2010) and Aiken (2009) provide estimates of net value per day of bass, trout and walleye fishing for selected states. The values reported exclude the Great Lakes. Average $2012 net value per day for in-state residents for Bass Fishing are $50 (Iowa), $68 (Missouri), $50 (Illinois), $69 (Indiana), and $71 (West Virginia). For trout fishing, WTP/day is $48 (Pennsylvania) and $53 (New York). Walleye fishing net value per day is $68 (Minnesota), $91 (Wisconsin), $48 (Michigan) and $74 (Ohio).

Assessment of Study and Relevance to GLMRIS: This periodic survey is important because it provides a series of snapshots of fishing effort. As such it is a source that is used for aggregating fishing effort across states and regions. A limit of this data is that coverage is thin in some settings, and the CV data are spotty and not linked to the quality of the resource.

With respect to providing net values his study could be of use to GLMRIS to fill in gaps for some species in some states where other non-market valuation studies have not been conducted.

Breffle et al. (Combined Methods 1999)

Location: Wisconsin Waters of Lake Superior and Lake Michigan and inland fisheries.

Data Type, Date: Combined travel cost method and choice experiments (a variation on contingent valuation), Primary Data Collection, 1999. (1998 fishing season)

Project sponsor: University of Wisconsin Sea Grant Institute.

Publications: Breffle et al. (1999, Report)
Morey and Breffle (2006, Journal Article)

Stated Purpose of Research Effort: The USACE documents (2000, 2012) treat TCM and CV methods as mutually exclusive. However, beginning in the 1990s, non-market valuation researchers began combining these two methods (Whitehead et al. 2008). The following study uses an approach that combines the travel cost method with choice experiments (a variation on contingent valuation).

The objective of this research was to assess compensable values of losses of recreational fishing opportunities as a result of releases of polychlorinated biphenyls (PCBs) into the waters of Green Bay. This report was prepared as part of the Lower Fox River/Green Bay Natural Resource Damage Assessment. This study offers a counterpart to the MacNair and Desvousges study referenced in the review of Murdcoch (TCM 2003) above.

Data Collection/Sampling Information: A three-step procedure was used to collect data from a random sample of individuals in the target population of anglers who purchased licenses in counties near Green Bay and who were active in fishing the Wisconsin waters of Green Bay. First, a random sample of anglers was drawn from county lists of 1997 resident and non-resident license holders. Second, using the license holder list, a telephone survey was conducted to identify and recruit Green Bay anglers for a follow-up mail survey. The telephone survey (r.r. = 69.4%), conducted from November 1998 to January 1999, collected data on the per day costs per angler and the number of fishing days under then current, 1998, conditions at Green Bay, along with attitudinal data. The cost and visitation data served as the primary inputs for the revealed preference model. Third, a mail survey with the stated preference questions was conducted with the current Green Bay anglers (r.r. = 78.9%, n=647). Respondents who agreed to participate in the mail survey were mailed a survey booklet within one week after they completed the telephone survey.

Reported values: The reported values in the study primarily pertain to the values estimated for different levels of water pollution in Green Bay. As such the values are generally not applicable to the GLMRIS project. For example, Breffle et al. (1999) report the following WTP

values ($2012) for a 10% increase in catch rates for a range of species in Green Bay holding the contamination level constant: Yellow Perch ($1.03), Trout/Salmon ($1.07), Walleye ($0.56), Smallmouth Bass ($0.90), All Species at Once ($3.56). For these estimates the fish consumption advisory (FCA) level was kept constant at 4, which corresponds to the least restrictive of the actual FCAs in in Green Bay in 1998 (do not eat more than once a week for perch, and once a month for trout/salmon, bass and walleye).

Assessment of Study and Relevance to GLMRIS: The study is useful in that it provides an example of how combined valuation methods could be used for fishing quality changes at one site while considering possibilities of substituting in and out of the fishery. This could lead to defensible estimates of compensatory damages without the additional cost of "collecting legally defensible data on all the sites [which] can cost hundreds of thousands of dollars." (Morey and Breffle, 2006, p. 151)

The values reported here are not appropriate for GLMRIS because they only focus on improvements in quality. As shown in the Jones and Sung and MSU technical summaries in Chapter VI, values for losses and gains in quality are not symmetric.

Synthesis of Recreational Fishing Net Values

Estimating the Net Value of Fishing: This chapter reviews available studies that estimate the net value of recreational fishing in the Great Lakes, Upper Mississippi and Ohio River Basins. Table III.a provides a summary of estimates of net value per day of fishing from selected studies reviewed in this chapter, organized by the valuation method used. Studies included in the table are those that provide sufficiently rigorous estimates of the net value of fishing applicable to the study area.

The estimates of net value in Table III.a can be used to evaluate whether it is appropriate to use USACE's published unit day values (UDVs) to estimate the net value of recreational fishing in the study region. The USACE procedures and guidelines state that the UDV approach is not appropriate "If evidence indicates a value outside the published range" (USACE 2012). For "most warm water fishing" the relevant UDV would be "General Recreation" with an associated $2012 range of $3.72 to $11.17 (USACE 2012, p. 1). For "unique experiences such as inland and marine fishing for salmon and steel head" the UDV would be classified as "Specialized Recreation", with corresponding UDVs of $15.13 to $44.21 (USACE 2012, UDV attachment, p. 1). Because the estimates of the net value per day of fishing in Table III.a tend to lie above the range of UDVs published by USACE – particularly for warmwater fishing – USACE UDVs should not be used to estimate the net value of fishing in the Great Lakes and Upper Mississippi and Ohio River Basins. Instead, estimates should be used from studies conducted specific to the region for the specific activities (coldwater and warmwater fishing).

No single study in Table III.a covers the entirety of the study region in terms of geography or species targeted. This lack of coverage is important because evidence provided in a number of studies suggests that fishing values will vary across recreational sites and types of fishing. Therefore, fishing values estimated in one part of our study region may not apply very well to other parts of our study region. For this reason, CU concludes that *no existing individual study* can be used to provide an average net value per day estimate for the entirety of either or both basins.

Nevertheless, when *considered as a set,* CU believes that the studies included in Table III.a can be used to help determine the range of net values per fishing day that might be expected for the study area. While the range of net values provided by the various studies is broad, there is some convergence across studies. Because these studies were conducted in a variety of settings within the Great Lakes region, this range of net values likely encompasses the average net value within the region. An examination the values in Table III.a reveals that the number of observations above $75 are few and dispersed. Dropping the top three value estimates (Boyle et al. 1999, Salmon; Boyle et al., 1999 Bass, and Aiken, 2009 Walleye), which

Table III.a. Estimated Willingness to Pay Values per Person per Fishing Day

Valuation Method	Estimated Net Value/ Day ($2012)[a]	Fish Category	Location	Reference
Average Benefits Transfer	45	Cold water fish	Great Lakes and the Northeast	Loomis and Richardson (2008)
Average Benefits Transfer	48	Warm water fish	Great Lakes and the Northeast	Loomis and Richardson (2008)
Average Benefits Transfer	44	Anadromous runs	Great Lakes and the Northeast	Loomis and Richardson (2008)
Average Benefits Transfer	23	Mixed species	Great Lakes and the Northeast	Loomis and Richardson (2008)
Average Benefits Transfer	56	Species not specified,	Great Lakes and the Northeast	Loomis and Richardson (2008)
Average Benefits Transfer/Meta Analysis	45-54	General	Great Lakes and the Northeast	Rosenberger and Loomis (2001)
Meta Analysis	90[b]	Bass	Great Lakes	Boyle et al. (1999)
Meta Analysis	109[b]	Salmon	Great Lakes	Boyle et al. (1999)
Travel Cost Method	41	Trout	Michigan Great Lakes	Lupi et al. (1998)
Travel Cost Method	51	Salmon	Michigan Great lakes	Lupi et al. (1998)
Travel Cost Method	42	Salmon and/or Trout	Wisconsin Water, Southern Lake Michigan	Phaneuf et al. (1998)
Travel Cost Method	42-55	Anadromous Runs	Lake Erie Tributaries	Kelch et al. (2006)
Contingent Valuation	54	Yellow Perch	Green Bay	Bishop et al. (1990)
Contingent Valuation	25	General	New York Great Lakes	Connelly and Brown (1991)
Contingent Valuation	28	General	New York Inland Waters	Connelly and Brown (1991)
Contingent Valuation	41	Salmon and Trout	Wisconsin Water, Great Lakes	Lyke (1993)
Contingent Valuation	22	General	New York Great Lakes	Connelly et al. (1997a)

(continued on next page)

Table III.a. Estimated Willingness to Pay Values per Person per Fishing Day (continued)

Valuation Method	Estimated Net Value/ Day ($2012)[a]	Fish Category	Location	Reference
Contingent Valuation	22	General	New York Inland Waters	Connelly et al. (1997a)
Contingent Valuation	50 (IA), 50 (IL), 68 (MO), 69 (IN), 71 (WV)	Bass	Selected States in Great Lakes and UMORB[c]	Aiken (2009)
Contingent Valuation	48 (PA), 53 (NY)	Trout,	Selected States in Great Lakes and UMORB[c]	Aiken (2009); Harris (2010);
Contingent Valuation	49 (MI) 68 (MN), 74 (OH), 91 (WI)[b]	Walleye	Selected States in Great Lakes and UMORB[c]	Aiken (2009)

d. Rounded to the nearest dollar.

e. As discussed in the text, these three observations are regarded as outliers.

f. UMORB denotes the Upper Mississippi and Ohio River Basins.

CU characterizes as outliers, suggests that average net value estimates will likely lie in the range from $20 to $75 ($2012).

As noted above, identifying a range of the value of a fishing day is only one of the components needed to estimate value of recreational fishing in the region. A measure of how much fishing occurs, such as angler days per year, is also needed. The US Fish and Wildlife Service provides periodic estimates of Great Lakes fishing effort as part of its National Survey of Fishing Hunting and Wildlife Associated Recreation (e.g. USFWS, 2006). This report does not break out participation data for the either the Great Lakes Basin or the Upper Mississippi and Ohio River Basins. However, it does report fishing participation for the Great Lakes, a resource that has received substantial popular attention due to concern about ANS in recent years and for which aggregate expenditure and economic impact values have been reported by the government and private entities (Great Lakes Commission, 2012; American Sportfishing Association, 2008).

While they are somewhat dated, CU uses participation data from the 2006 National Recreation Survey (USFWS 2008), as this is the most recent survey reported[5]. Although the USACE has expressed its own concerns about using the USFWS (2008) report for generating a

[5] A more recent survey was completed in March 2012, but the summary reports are not expected until November 2012. (http://wsfrprograms.fws.gov/Subpages/NationalSurvey/2011_Survey.htm)

value of recreation for GLMRIS (USACE 2012), the USFWS estimates of Great Lakes angler days remain the best currently available. Moreover, these estimates have been used elsewhere for calculating recreational value for the Great Lakes (e.g., American Sportfishing Association, 2008). For comparative purposes it is helpful to use the same baseline for aggregating values.

Multiplying the USFWS estimate of about 18 million angler days in the Great Lakes in 2006 by the range of a net values ($20 to $70 in $2012 dollars) identified above, results in a total annual recreation net value estimate ranging from $360 million to $1.35 billion.

Estimating Changes in the Net Value of Fishing in Response to ANS: While several studies have been conducted within the study region that attempt to estimate the impact that changes in fishing quality would have on recreational values from fishing, CU concludes that individually and collectively these studies do not provide a good basis for calculating economic losses associated with potential declines in catch rates, a measure of fishing quality that can potentially be linked to ANS. Our review of available studies shows that changes in net values that occur due to changes in catch rate depend on current catch rates at a site, the availability of alternative fishing sites, and other factors. Therefore, transferring estimates of economic losses associated with a decline in fishing quality based on a study at one site to other sites within the study area is not recommended.

An analysis by Johnston et al. (2006) points to another possible approach to estimating damages, multiply WTP per fish by the reduction in fish catch. Motivated by policy analyses that call for welfare estimates denominated in per fish units (e.g. US EPA 2004), they conduct a meta analysis of the marginal value of catching an additional fish. The meta regression results demonstrate that reported values vary systematically with methodological variations across studies, angler attributes, and resource and context attributes. After statistically accounting for these variations across studies, "These results suggest that WTP per fish is closely related to the type of species targeted. Moreover, model results appear to be consistent with common intuition regarding the highest verses lowest value recreational fish" (Johnston et al. 2006, p. 23). Despite this positive result, a closer examination of the data suggests that WTP per fish varies widely for a species across studies. For example, Johnston estimates marginal WTP for walleye to be $5.10 ($2012) in the Breffle et al. (Combined Methods1999) study and $27.95 ($2012) based on Murdoch's analysis.

On the basis of this wide variability in value per fish across studies, CU would not recommend using a WTP per fish approach based on the existing literature to address quality changes in the GLMRIS study area.

IV. Economic Valuation Studies of Beachgoing in the Great Lakes and Upper Mississippi and Ohio River Basins

Relative to its popularity as a recreational activity[6], researchers have expressed surprise that there has been comparatively very little research on measuring the recreational use value of a beach day (Freeman 1995; Song et al. 2010). A substantial literature has built up on the valuation of water quality improvements and decrements, typically motivated by levels of water impairment under the Clean Water Act. For example, Iowa State University has undertaken a substantial statewide water quality valuation effort (http://www.card.iastate.edu/environment/). However, WTP for water quality improvements encompasses a range of activities in addition to beachgoing and these studies do not isolate benefit measures for individual activities. Other research (e.g. , Rabinovici et al. 2004), focuses on health impacts associated with water contamination, which would only be relevant to the current project to the extent that invasive species foster water quality contamination problems related to health outcomes. A broader focus on water quality improvements also includes non-use use values over and beyond values associated with swimming or other water recreation (e.g., Carson and Mitchell 1993). Moreover, many of the studies that have focused on beach recreation have been directed toward valuing specific beach projects such as erosion control (e.g. Croke et al. 1987) or beach renourishment (e.g. Van Houtven and Poulos 2009). In all, this broader set of studies on water quality is neitheramenable to isolating the value of a beach recreation day nor estimating how such values would be affected by ANS, and hence not of direct relevance to the GLMRIS project.

With respect to non-market valuation research, a meta analysis by Atiyah (2010) identifies 35 studies from 1975 to 2005 that estimate use value estimates for beach visit days under existing conditions. However, the geographical coverage of beach studies has been far from comprehensive.

> "The beaches of Florida and California have been examined more often than the rest of the coastal states combined, leading with 10 and 8 studies respectively. On the East Coast, most studies have been conducted in Massachusetts and New Jersey, but many coastal states and the Great Lakes have few or no studies on beach use. This is likely because Florida and California are considered major beach destinations and thus have dominated the research agenda." (Atiyah 2010, pp. 56-57).

One Great Lakes study was included in Atiyah's review (Sohngen et al. 1999). CU has located four additional studies (two of which were produced after the 2005 end-date for Atiyah's data set). All of these studies used the travel cost method (TCM).

[6] Leeworthy et al. (2005) estimate that over 900 million days of marine beach recreation (excluding the Great Lakes) were taken the United States in 2005. This averages to over 4 days per person per year.

Based on the 35 published and gray literature studies included in Atiyah's (2010) meta analysis, it is evident that that beach recreation values are highly variable across non-market valuation methods, over time and across states. Loomis (2005) identifies 22 net-benefit/person/day estimates for "going to the beach" in the Northeast, with a mean value of $51 ($2012). This information suggests that that application of the USACE unit day values (UDV) of $3.72 - $11.17 for general recreation (e.g. picnicking and swimming) is not appropriate for application to the GLMRIS project.

Atiyah's (2010) meta analysis further demonstrates that estimated recreational beach day values varied significantly by whether the study used CV (lower value estimates) or TCM (higher), whether average values per trip (higher) or marginal values (lower) per trip were collected, where the beach was located (California had lower values) and by authorship and year. While annual and total values of beaches are higher the, perhaps surprising, lower recreational day values for California beaches is explained by the higher frequency of visits and the availability of substitute activities. Within the beachgoing valuation studies conducted in the Great Lakes region reviewed on the following pages, estimated values have systematically varied with difficulty of access, the Great Lake on which the beach is located, proximity to large populations, beach length, presence of zebra mussel shells, and contamination advisories (Murray et al. 2001; Yeh et al. 2006; Song et al. 2010).

CU now turns to individual assessments of the Great Lakes beach recreational values studies. CU begins with a review of the Loomis (2005) benefits transfer report and Atiyah's (2010) meta analysis thesis (MA). CU then examines four travel cost studies that have been conducted in the region.

Loomis (ABT, 2005)

Location: Northeast area, corresponding to Forest Service Region R9 (Northern United States Eat of the Rocky Mountains)

Data Type, Date of Data Collection: Average benefits transfer; Secondary Data.

Project sponsor: US Forest Service, Pacific Northwest Research Station

Publications: Loomis (2005, Report)

Summary: This report served two functions. First, it provided information from a literature review of economic studies conducted from 1967 to 2003 in the United States. Second, it develops basic guidelines on performing benefits transfers in the context of recreational use valuation.

Data Collection/Sampling Information: This study is an iteration of a long series of data collection activities covering recreational valuation studies from mid-1960s to 1982 (Sorg and Loomis 1984), 1968 to 1988 (Walsh et al. 1992), 1968 to 1993 (MacNair 1993) and 1993 to 1998 (Loomis et al. 1999). Rosenberger and Loomis (2001) then merged many of these reports and improved coding procedures. The present report added new studies up through 2003, resulting in a data set with 1,239 estimates of net values for 30 outdoor recreation activities.

There are 22 estimated values from an unspecified number of studies conducted in an area that roughly follows the Northeast census region (the northeastern states extending eastward from Minnesota/Iowa/Missouri)

Reported Values: The estimated net value per day of "going to the beach" is $51 ($2004) with a range from $5 to $141.

Assessment of Study and Relevance to GLMRIS: This study is useful in that it demonstrates the range of beach recreation values across a number of studies. With the exception of Sohngen et al. (1999), which CU reviews below, all studies reported in the northeast region were conducted at saltwater sites. Beyond background information on beach recreation values, this report does not bring any information relevant to the GLMRIS project.

Atiyah (ABT 2009)

Location: United States, Secondary Data from 35 studies

Data Type, Date of Data Collection: Average benefits transfer; secondary data.

Project sponsor: Not Specified aside from University Affiliation, University of California Los Angeles

Publications: Atiyah (2009, Dissertation)

Summary: The study reviewed is one of three papers/chapters in a doctoral dissertation. The overall objective was is to explore the degree to which beach recreation values currently available in the literature can be useful in guiding beach management policy, especially when original research is not possible. A literature review was conducted to identify estimates of net values. A statistical analysis of these values was undertaken to identify what effect that factors (geography, value type and methodology, authorship and year of study) have on value estimates.

Data Collection/Sampling Information: Studies were identified primarily by drawing from the National Ocean Economic Program (NOEP) data base for non-market values (see http://www.oceaneconomics.org/nonmarket/valEstim.asp) . Thirty five studies providing 98 value estimates were identified, primarily from the coastal regions with a concentration of studies from California and Florida. One Great Lakes study was included in Atiyah's review (Sohngen et al. 1999).

Reported Values: The range in values of this study was from $0.08 ($2012) to $140. No average was provided.

Assessment of Study and Relevance to GLMRIS: This study is useful in that it demonstrates the range of beach recreation values across a number of studies, providing evidence that they vary systematically due to a number of factors including methodology (travel cost method estimates are higher than contingent valuation estimates), beach location and author and year published. With the exception of Sohngen et al. (1999) which CU reviews below, all studies used were saltwater sites. Hence, this report does not bring any additional information specific to the GLMRIS project.

Sohngen et al. (TCM 1998)

Location: Two Lake Erie Beaches, Maumee Bay and Headlands State Park

Data Type, Date of Data Collection: Single site TCM; Primary data collection 1997.

Project sponsors: Lake Erie Protection Fund, the Ohio Sea Grant College Program, National Sea Grant College Program, State of Ohio, the Greater Toledo Convention and Visitors Bureau, and the Lake County Visitor Bureau.

Publications: Sohngen et al. (1998, Report)
Values are also reported in Parsons (2003, Book Chapter)

Summary: The objective of this study was to provide the first estimate of the recreational value of freshwater beaches to provide better information to policy makers, beach managers and local officials.

Data Collection/Sampling Information: In the summer of 1997, questionnaires were distributed using a random assignment to beach users at two beaches (Maumee Bay and Headlands) at opposite ends of Ohio's Lake Erie coast. The two beaches also vary dramatically in terms of amenities on the beach. Individuals who agreed to complete the questionnaire but did not send a prompt response were sent a follow-up questionnaire. Response rates across the two sites were 52% (n=394) and 62% (n=376).

Information was collected on the frequency of visits, expenditures, demographic characteristics and attitudes. Average number of single day beach trips per season ranged from 6.0-7.9 at these sites, with an average mileage traveled of 26-35 miles. Multiple day trips averaged 3.7-3.9 a season at these, with the average distance traveled being 86-175 miles. Response patterns suggest that water quality has a relatively small effect on decisions to go to a beach, but that "individuals appear to be concerned about the water quality at the particular beach they are visiting."

Reported values: Parsons (2003) summarizes the range in day trip values (in $2012) being between $20 and $47 for Maumee Bay with a midpoint of $33. For Headlands the range was $16-$55 with a midpoint of $35.

Assessment of Study and Relevance to GLMRIS: This represents a novel first application to Great Lakes beach recreation that directly reports a value per beach day. Subject to technical concerns about the role of substitute beach sites, this paper provides a localized value estimate for a beach day that could be used as input in to the GLMRIS project. Yet, it is

questionable if such localized beach estimates are appropriate as estimates for the entire GLMRIS region.

Sohngen et al. (TCM 2001/2006)

Location: 15 Lake Erie Beaches

Data Type, Date of Data Collection: Multisite TCM; Primary data collection 1998.

Project sponsors: National Oceanographic and Atmospheric Administration, Ohio State University Sea Grant College Program.

Publications: Murray et al. (2001, Journal Article)
Yeh et al. (2006, Journal Article)

Summary: Reflecting concerns about deteriorating water quality at Great Lakes beaches, resulting in beach closure advisories, and increased efforts to provide information about beach advisories, this study, sought to estimate the benefits of reduced closure days and the role of information in choice decisions.

Data Collection/Sampling Information: Respondents were intercepted at 15 different Lake Erie beaches during randomly selected sampling periods in summer 1998 (r.r. =56%, n=1587). The questionnaire asked individuals to log the type of trip (single or multiple day) on which they were intercepted, how they were spending their time on that trip, and the number of single or multiple-day trips they had taken and planned to take to each to the 15 Lake Erie Beaches and beaches outside of that set throughout the entire year. The average visitor took 15 beach trips to these targeted beaches a season and three other beach trips. Home zip code and information on income were gathered for the travel cost analysis. Other demographic and attitudinal variables were collected along with information centered on how respondents learned about and reacted to beach advisories. Information on water quality (average E. Coli measurements per season), number of advisories per seasons and grain size, slope of beach, number of zebra mussel shells and facilities were gathered from other sources.

Reported values: Reported values focus on the value of reduced beach closure advisories, and hence localized pollution levels. Murray et al. (2001) estimate that removing an advisory on each beach that experiences them could improve seasonal welfare by up to nearly $39 per season ($2012).

Assessment of Study and Relevance to GLMRIS: This study provides useful information about pollution costs and how recreationists' choices are affected pollution advisories. It also demonstrates the variety of quality variables that might need to be considered in assessing the net value of beach recreation on the Great Lakes coast.

This study does not provide information useful for estimating aggregate net values for beach recreation in the Great Lakes. It is only related to assessing the impact of water quality changes if ANS can be linked to beach closure and related advisories.

Shaikh (TCM 2006):

Location: Chicago Beaches

Data Type, Date of Data Collection: Single site TCM; Primary data collection 2004.

Project sponsor: Joyce Foundation, University of Chicago.

Publications: Shaikh (2006a, Mimeo)
Shaikh (2006b, Presentation).

Summary: The objectives of the project were to assess the economic value of a day at the beach and the total seasonal value of Chicago Beaches along with the economic impact of swimming bans.

Data Collection/Sampling Information: A total of 1573 in-person, on-site surveys were conducted on nine different Chicago beaches in the summer of 2004. The proportions of surveys conducted on each beach were based on attendance by beach. Between 85% and 90% of individuals approached agreed to do the survey.

The information collected in the survey included: trip distance, mode of transport, time traveled and other travel expenses, activities and time on the beach and demographic characteristics. Perceptions of beach quality and the existence of swim bans were also elicited.

Reported Values: The estimated value of a day at the beach was $48 ($2012) and the average visitor went to the beach 14 times in a season.

Assessment of Study and Relevance to GLMRIS: This study is unique in the Great Lakes in that it provides information about urban beachgoing and could be of use to other similar settings across the Great Lakes.

Song et al. (TCM 2010)

Location: Great Lakes Beaches on all Michigan State Great Lakes

Data Type, Date of Data Collection: Multisite TCM; Primary data collection 2007 (recall data for 2006).

Project sponsors: Not identified.

Publications: Song et al. (2010, Conference Presentation)

Summary: This study sought to provide recreation use values for Great Lakes beaches in Michigan, including the entirety of nearly 600 separate beaches across the four Great Lakes in the state.

Data Collection/Sampling Information: Using a web-based survey drawing from a representative web-based survey panel in 2006, the survey instrument identified respondents who indicated that they had visited a Great Lakes beach in the previous year. Beach visitors (n=2566) were ask to provide the beach name and other identifying information for the beach they had visited the most during the last three years, with over 66% providing enough information to precisely locate the beach visited. Household zip code and demographic information also were available. Data available about the beaches included length of beach and number of days of beach advisories and closures in 2006. The total number of beach days per season was not collected.

Reported Values: The estimated net value of a day at the beach in $2012 ranged from $46 (Lake Superior) to $62 (Lake Erie) with an estimate for all sites being $52. The estimated loss associated with closing a particular site on a day the individual had chosen to go to the beach ranges from $-0.11 (Superior) to $-1.01 (Erie), with a central estimate of $-0.37. If instead all the sites on an entire lake were closed on the day an individual decided to go to the beach, then the estimated average losses would be $-83 (Michigan), $-3 (Superior), $-15 (Huron) and $-15 (Erie). The differences in values across lakes are explainable. Lake Michigan sites are numerous and popular. Lake Superior has low visitation rates.

Assessment of Study and Relevance to GLMRIS: This study demonstrates that the net value of current beach use and changes in use are affected by whether substitute beach sites are available. Therefore, it is necessary to account for the pattern of impacts on beaches that ANS might have in simulating economic losses. (That is, economic losses will differ if affected beaches are clumped in one region vs. randomly distributed.) The authors note “In general, the estimated economic loss per person per trip of closing an individual site is not large. This appears to reflect the presence of many substitutes of the loss/closure of one beach site.”

While it may be true that the economic losses of closing an individual site are not large, it is less true for the loss of all beaches in a region or even all Great Lakes beaches.

This study provides value estimates consistent with day use and is relevant to the GLMRIS project as such. While this study provides estimates for beach recreation for four Great Lakes coastlines in Michigan, these values may not be extendable to other states.

Synthesis of Beachgoing Net Values

Evidence from recreation beach valuation studies conducted across the United States from 1975 to 2005 (Atiyah, 2009) suggest that the range of possible values of beach recreation days will exceed the USACE unit day values (UDV) for general recreation. Such a finding is consistent with a recent USACE report that notes that unit day values "used by the Corps… are significantly lower (in real terms) than unit values for comparable recreation activities estimated in contemporary recreation demand studies" (Scodari, 2009, p. 50) Given this result, USACE procedures and guidelines recommend that site or regional TCM or CV values be used.

Table IV.a summarizes the average WTP per day of beach recreation reported in the TCM studies reviewed above earlier in this section that were deemed appropriate for use in the GLMRIS project.

Table IV.a. Estimated WTP Values per Person per Beach Recreation Day

Valuation Method	Estimated Net Value/Day[a] ($2012)	Location	Study
TCM	$33 -$35	Two Lake Erie (Ohio) Beaches	Sohngen et al. (1998)
TCM	$48	Chicago Beaches	Shiakh (2006)
TCM	$46-$62	Michigan State GL Beaches	Song et al. (2010)

a. Rounded to the nearest dollar.

While there is some convergence in estimated values across the three studies, CU maintains that it is premature to draw conclusions regarding the average or a range of per person/per day net values. By itself, this precludes being able to estimate an aggregate net value for beach recreation in the GL Basin, let alone the UMORB.

An equally fundamental problem is that there is no estimate of aggregate beach visitation in either basin. There are a number of piecemeal publications that provide estimates for particular beaches or stretches of coastline. However, the only published attempt that CU is aware of that tries to provide a contemporary estimate of beach users and beach days across the Great Lakes is Austin et al. (2007). They proceed by transferring ratios of beach swimmers to total population (0.43) and swimming days per population (4.4) per person from a study of coastal population in marine (saltwater) coastal states with similar swimming season lengths as in the Great Lakes (see Leeworthy and Wiley 2001; Leeworthy et al. 2005

provide national projections for marine (saltwater) beaches for 2010). These states include Connecticut, Delaware, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Oregon, Rhode Island, Virginia, and Washington. On this basis Austin et al. estimate that there are about 8 million swimmers and 84 million Great Lakes swimming days per year. Taking the ratio of swimming days per swimmer provides an estimate of 10 swimming days per swimmer.

CU is cautious with respect to this projection. First, to our knowledge there is no evidence that coastal beach visitation to population patterns parallel those in the GL Basin. Further, based on the survey data provided by Shaikh (TCM 2006), Murray et al. (2001), and Yeh et al. 2006), the measured, as opposed to projected, visitation rates by beachgoers is 14 to 18 visits per season rather than 10. Austin et al. (2007) similarly raised questions about the accuracy of their own projections by comparing their estimates with those of other estimates for particular localities. They note "For example, Chicago's beaches receive about 27 million visitors a year according to one source, and we estimate 27 million swimming days for all of Illinois" (p. 35). On the basis of these types of comparison they conclude that their estimate is likely to be conservative. In all, CU finds reason to discount the Austin et al. projection for use in policy evaluation.

The existing literature is also inadequate to begin to project estimates of economic loss associated with ANS. Only two studies have estimated quality impacts on beach recreation within the GL region, and CU has not located any studies in the UMORB. Further the two quality studies focus on E. Coli contamination and corresponding beach advisories, which may or may not correspond to the effects of ANS.

The Song et al. (TCM 2006) results point to the issue of substitution effects across beaches as a dominant concern in any efforts to simulate the economic effect of ANS. The key point is that the *distribution* of beaches impacted by ANS will fundamentally affect the level of damages. One cannot simply say, for example, that ANS will impact 20% of the beaches on Michigan's Lake Michigan coast. The level of damages will be fundamentally related to how that 20% is distributed, whether for example the beaches are clumped in a contiguous manner or randomly distributed across the entire coast.

In all, CU concludes that the existing body of literature on beach valuation is inadequate for providing aggregate estimates of total recreational use value and changes in value associated with the quality of beach recreation.

V. Economic Valuation Studies of Boating in the Great Lakes and Upper Mississippi River Basins

In his 1995 review of the water recreation literature, Freeman said, "There is virtually no literature on the value of access to marine waters for boating activities other than fishing" (p. 393). This lack of information is seen in other sources as well. The data base maintained by Rosenberger, Loomis and colleagues over the years contains only two Great Lakes states studies in the Northeast from 1985 to 2011 with respect to motor boating, and three more studies in the category of floating/rafting/canoeing, which is not enough to provide data for a benefits transfer analysis (see Loomis and Richardson, 2008 or http://recvaluation.forestry.oregonstate.edu/)[7].
Recreational boating may fall in either the general ($3.72-$11.17) or specialized ($15.13-$42.21) UDV category. The USACE 2012 UDV document suggests that boating should be included in the General Category. However, white water boating, especially in back-country or hard-to-access areas characterized by "low density use", might be categorized as Specialized Recreation.

Following the format used in the recreational fish and beachgoing reviews in Chapters 2 and 3, CU now provides a review of six studies that give estimates of net value for recreational boating in the study region. Net value for recreational boating varies with the type of boating activity, so CU includes that in the data type section of each review. The study reviews are organized by method as follows: meta analysis (MA), travel cost method (TCM) and contingent valuation (CV). Within each method, the studies are ordered chronologically. CU does not report separate values for benefits transfer because the limited number of studies that are relevant to the GLMRIS are evaluated individually here.

[7] (One of the studies reported in the Loomis and Richardson data set focuses on willingness to pay for reductions in phosphorus run off (Matthews et al., 2002), but it did not separate out willingness to pay values associated with recreational boating, so it is not reviewed here.)

Rosenberger and Loomis (MA 2000)

Location: Northeast area, corresponding to Forest Service Region R9 (Northern United States East of the Rocky Mountains)

Data Type, Date of Data Collection: Meta analysis; Secondary data.

Project sponsor: US Forest Service, Rocky Mountain Research Station

Publications: Rosenberger and Loomis (2001, Report)
Rosenberger and Loomis (2000, Journal Article)

Summary: This study served two functions. First, it provided information from a literature review of economic studies spanning 1967 to 1998 in the United States and Canada. Second, it developed guidelines for performing benefits transfers in the context of recreational use valuation.

Data Collection/Sampling Information: This study was the most recent iteration of a long series of data collection covering recreational valuation studies from mid-1960s to 1982 (Sorg and Loomis 1984), 1968 to 1988 (Walsh et al. 1992), 1968 to 1993 (MacNair 1993) and 1998 to 1998 (Loomis et al. 1999). This study merged many of these reports and improved coding procedures. The resulting data set included 760 travel costs and contingent valuation net value estimates from 163 separate research efforts covering 21 recreational activities.

Reported Values: The estimated net value per motorized boating trip was about $43 and for float boating was about $62 ($2012).

Assessment of Study and Relevance to GLMRIS: The data provides comprehensive coverage of recreational values across a number of recreational activities. For technical reasons (see Chapter VI) CU does not recommend using the net value estimates above for either motorboating or float boating under the GLMRIS project. Further, this study does not estimate how net value might change in response to changes in resource quality.

Hellerstein (TCM 1991)

Location: Boundary Waters Canoe Area, Minnesota

Data Type, Date of Data Collection: Canoeing; Single site TCM; Secondary data (from 1980)

Project sponsor: US Forest Service, Rocky Mountain Forest and Range Experiment Station

Publications: Hellerstein (1991, Journal Article)

Summary: The objective of this paper was to evaluate how different statistical models affect net value estimates.

Data Collection/Sampling Information: Data were taken from 27,433 overnight permits issued for the Boundary Waters Canoe Area in 1980, comprising a complete census of overnight visitors. The date of the study falls before 1985, the cutoff date identified for studies to be uses in this review. However, it was included in this analysis because the modeling techniques are consistent with methods used currently. In addition, the application to canoeing is unique within the study area.

While the data provided information about the distance travelled to the site and the length of stay, individual characteristics were not observed and thus could not be incorporated into the modeling framework (see technical notes in Chapter VI).

Reported Values: The estimated net value per trip ranged from $9 ($2012) to $17.

Assessment of Study and Relevance to GLMRIS: This study provides information about an activity that is not present elsewhere in our literature review.

This study is potentially relevant to GLMRIS for estimating the total value of canoeing in remote areas, although some caution is warranted because of the age of the data. This study does not estimate how net value changes as resource quality changes.

Bowker et al. (TCM 1997)

Location: Gauley River, West Virginia

Data Type, Date of Data Collection: Whitewater rafting; Single site TCM; Primary data collection in 1993.

Project sponsor: Not identified.

Publications: Bowker et al. (1997, Working Paper)

Summary: The objective of this research was to develop and statistically test whether individual single site travel cost demand models for whitewater rafting trips could be transferred from one study area to another. In addition to the Gauley River, which lies in West Virginia in the GLMRIS target area, TCMs were developed for four other sites out of the target area.

Data Collection/Sampling Information: A random sample of names was drawn from outfitter records of those people who used outfitter services on that river in 1993. Questionnaires were mailed asking for information on trips, expenditures and various socioeconomic variables. Response rates for the five study areas ranged from 28% to 46%, but no specific response rate for the Gauley River study area was provided. Because this data is drawn from outfitter records, the estimated values are only relevant to guided rating trips.

Reported Values: The estimated net value per trip ranged from $365 ($2012) to $502 for a guided rafting trip.

Assessment of Study and Relevance to GLMRIS: The limited discussion of data collection provided makes it difficult to assess the quality of these data. The focus of the paper was on benefits transfers, and the information was limited on the attributes of the actual study. The relatively high estimated net value per trip is intriguing, as the direction at least is consistent with the idea that whitewater rafting is a unique experience that should be differentiated from other types of boating.

This study is not is not relevant to GLMRIS, because not enough information is available to assess the overall quality of the reported net values.

Bhat et al. (TCM 1998)

Location: Northeast and Great Lakes Ecological Region

Data Type, Date of Data Collection: Motor boating and water skiing, TCM, Secondary data collected in 1985-1987.

Project sponsors: U.S. Forest Service (USFS)

Publications: Bhat et al. (1998, Journal Article)

Summary: The purpose of this research was the Renewable Resource Planning Act requirement that the USFS develop general estimates of the economic value of a variety of outdoor recreation activities in the United States. Net value for motor boating was estimated along with similar values for several other recreation activities. The specific purpose of the paper was to provide a methodology for estimating recreation values in the U.S. using what the authors refer to as an "ecoregional" approach. The ecoregional approach divides landscapes into various size ecosystem units that represent geographical groups or associations of similarly functioning ecosystems. The Northeast and Great Lakes Ecoregion corresponds somewhat with the GLMRIS study area. It includes parts of Minnesota, Missouri, Wisconsin, Illinois, Indiana, Ohio, Michigan, Kentucky, Tennessee, West Virginia, Pennsylvania and New York .

Data Collection/Sampling Information: Data for this study was obtained from the Public Area Recreation Visitor Study (PARVS) and the "CUSTOMER" survey. PARVS and CUSTOMER were ongoing multi-agency data collection efforts that conducted on-site interviews at over 350 sites across the continental United States from 1985 to 1992. Sites included National Parks, Forests and Rivers, USACE and Tennessee Valley Authority Reservoirs and numerous state recreation areas. Data were collected on the respondents' personal and household characteristics, the main activity of the trip during which they were being interviewed, trip expenditures, distance and time of travel. Individuals completed a 12 month profile of the total number of recreational trips taken, list of sites visited and activities taken, and length of each trip.

Reported Values: The undated estimated net value per day was reported to be $9.85. Assuming a reference date of $1992, this translates to about $16 ($2012).

Assessment of Study and Relevance to GLMRIS: This approach differs from the other TCM studies reviewed in this document which focus on the values for an individual site/activity and the reason that individuals choose one site over the other. This study instead lumps all

sites into one unified model, which along with other technical issues discussed in Chapter VI creates likely biases. For this reason this study is not relevant to the GLMRIS project.

Shafer et al. (TCM 2000)

Location: Pennsylvania water bodies

Data Type, Date of Data Collection: Motor boating, single site TCM; Primary data collection 1994.

Project sponsor: Not identified.

Publications: Shafer et al. (2000, Journal Article)

Summary: The objective of this study was to estimate the economic value of seven major motor boating sites in Pennsylvania, three of which lie in the Great Lakes or Upper Mississippi and Ohio River Basins (Three Rivers Area, Lake Erie/Presque Isle Bay, Kinzua Reservoir).

Data Collection/Sampling Information: A systematic sample of every 20th registered boat owner in Pennsylvania with a boat in the range of the 16 feet or longer was sent a mail questionnaire in 1994 (r.r. = 27.9%, n=2731). Boat owners were asked to provide travel cost information for their most recent trip including location, expenditure and length of stay. In addition, boaters were asked to report the total number of boating trips taken to the site each year. About 76% of the total boat trips reported were taken to seven major sites and 36% of the reported trips involved fishing.

Reported Values: The estimated net value per trip (in $2012) was $104 (Three Rivers), $178 (Lake Erie/Presque Isle), and $144 (Kinzua Reservoir).

Assessment of Study and Relevance to GLMRIS: The modeling in this study was at a minimal level and the presentation was incomplete (see technical details in Chapter VI). Given these shortcomings, the main contribution of this study is to point out the possibility of double counting between fishing and boating in creating an aggregate value, as 36% of the boat trips taken involved fishing.

This study is not is not relevant to GLMRIS, in part because not enough information is available to assess the overall quality of the reported net values.

Connelly et al. (CV 2005)

Location: Lake Ontario and the St. Lawrence River

Data Type, Date of Data Collection: Motor boating; CV; Primary data collection in 2002.

Project sponsors: International Joint Commission.

Publications: Connelly et al. (2005, Project Report)
Connelly et al. (2007, Journal Article)

Summary: The objectives of this study were to show how the net value of recreational boating can be assessed and how net value for recreational boating can be linked to water levels. Water levels affect the ability to launch boats from docks, marinas, boat ramps etc. The review here focuses only on the net value estimates for the conditions taken on a typical trip and does not include the Canadian portion of the study.

Data Collection/Sampling Information: A stratified sample (accounting for boat length and geographical region) was drawn from registered boaters who indicated on their license application that their county of principal use was one of the eight counties bordering the study site. A telephone screening was used to identify those who had boated on Lake Ontario or the St. Lawrence River in 2002. A mail survey was sent to those telephone respondents who agreed to participate (r.r. =70%, n=2388).

Boaters' WTP was measured through the mail questionnaire by asking about the length of a typical trip, expenditures made on such a trip, and then an open-ended CV question regarding the maximum amount that the boating group would have been willing to pay for a typical trip before they would they have decided not to go.

Reported Values: The mean net value per day per boat was $87 ($2012). If one assumed that "the estimated value was distributed equally among people on the boat, a rough estimate would be" almost $29 ($87/3). Comparison of values across access methods suggest that the net value per day is higher for boaters who make use of a marina, yacht club or private pier. There is also some spatial variation, with Eastern Lake Ontario and the St. Lawrence River having an average estimated net value per day that is 13% higher than that of Western Lake Ontario. Finally, reported WTP values per boating day ($2012) vary across boat lengths: $79 (<16 feet), $87 (16 feet – 25 feet), $127 (26 feet – 39 feet), $102 (40 feet or more).

Assessment of Study and Relevance to GLMRIS: This is a very straightforward study with close attention paid to sampling design. The results are important in that they demonstrate that net value varies by location and boat size category.

The results of this study could serve as inputs to the GLMRIS study for estimating the net value of boating. However, CU would not recommend extending a single state study to estimating net values for the entire Great Lakes and UMORB. Although changes in net value associated with changes in water level were estimated, this does not pertain to ANS. Therefore, this study is not relevant to the GLMRIS project for estimating changes in value due to ANS.

Synthesis of Recreational Boating Net Values

In contrast to recreational fishing and beachgoing, CU does not provide a summary table of net values of boating. Only the Hellerstein (TCM 1991) and the Connelly et al. (CV 2005) studies provided net values per recreational day that could be used to calculate aggregate net value. These average net values are $12 (canoeing) and $29 respectively in $2012.

The timing of the Connelly et al. (2005, 2007) study is fairly close to the John Glenn Great Lakes Basin (USACE 2008) recreational boating study that gathered activity patterns for recreational boaters in 2003-2004. This study estimates that about 17 million boat days occurred on the Great Lakes and connecting waters in 2003 and provides breakdowns by state, whether a boat is in a marina or not, and boat length. However, CU would not recommend multiplying this estimate of days by the value from only one study in one state to get an estimate of aggregate net value because conditions vary too widely across the study area.

Beyond net value estimates, the values reported in these various studies suggest that there is substantial variation in net values across different boating activities and locations. This suggests that future research intended to provide information about the total net recreational boating value in the GLMRIS, should estimate values for each boating activity as well as values for different boating classifications within a specific activity. To achieve a total net value for boating each of these values would have to be matched with an estimate of total effort for that activity.

The existing body of research does not address changes in values that might be linked to ANS.

VI. Technical and Econometric Details of Studies Reviewed

This chapter provides additional information about technical details for many of the recreational valuation studies reviewed in Chapters II-IV. The order of presentation follows the ordering in those chapters

Recreational Fishing Studies: Chapter II

Loomis and Richardson (ABT 2007): Technical Econometric Details.

There are no technical features that merit attention for this report.

Rosenberger and Loomis (ABT/MA 2001): Technical Econometric Details.

There are no technical features for the average benefits transfer portion of the study that merit attention for this report.

The meta analysis includes 701 net value estimates from 131 studies of 21 recreation activities from 1967 to 1998. An ordinary least squares model of a linear form was used to estimate the meta regression. Focusing only on the results relevant to this review, the meta regressions finds that the valuation method, region, and water body were significant explanatory factors. The coefficient on fishing, however, was not significantly different from general recreation.

A separate meta regression was not run for fisheries data by itself and net value estimates are derived from the broader model.

Boyle et al. (MA 1999): Technical Econometric Details.

The data used were not the complete population of studies available at the time. Because of resource constraints, data collection was truncated at 150 of the 250 or so studies identified in the literature.

An ordinary least squares model of a linear form was estimated. Coefficients that were significant in the full sample model included the type of fish, the water body, valuation technique and method used to elicit values (e.g. a mail survey).

Of relevance to this review are the two hypothetical policy scenarios, assuming a travel cost method, for Great Lakes Salmon and Great Lakes Bass Fishing. The respective estimated total day values in $1996 were $62.06 ($48.50) and $75.10 ($48.61) with the standard deviation of the estimates provided in the parentheses. As such, the estimated values are relatively imprecise with coefficients of variation of 1.28 to 1.55. Hence, utilization of these net value estimates should be conducted with caution.

Lyke (TCM 1993): Technical, Econometric Details.

The TCM data were estimated using various random utility modeling specifications. It was found that a two-level nested logit model was estimable and performed best amongst alternatives considered. The two nesting levels were mode (charter fishing, fishing from a private boat, stream fishing or another kind of fishing) and destination (defined as a fishing area in relation to a location). Estimated coefficients on trip cost and time were negative. Coefficients for catch rates were positive.

There are several technical concerns with this study. The data collected from the Wisconsin Great Lakes (WGL) and Wisconsin Sportfishing (WSF) surveys are distinct in the sense that no site-specific data is collected on inland fisheries activities in the WGL. Within the inland questionnaire, the locational data is collected for only two of the most visited sites, raising questions about the completeness of the site choice set and subsequent biases. Further, it is not clear how alternative sites were identified and included into the analyses. These limitations on spatial resolution hamper consideration of substitution effects between Great Lakes and Inland Waters, and uncertainty about how site alternatives were handled raises concerns about the overall econometric analyses. Variation in catch rates is significant in the model, but is based on self-reported catch data which has been argued against in the literature because of endogeneity. Finally, there is a lack of clarity in the dissertation explaining how values were derived, which complicates external assessment of the quality of the analysis.

Jones and Sung (TCM 1993): Technical, Econometric Details.

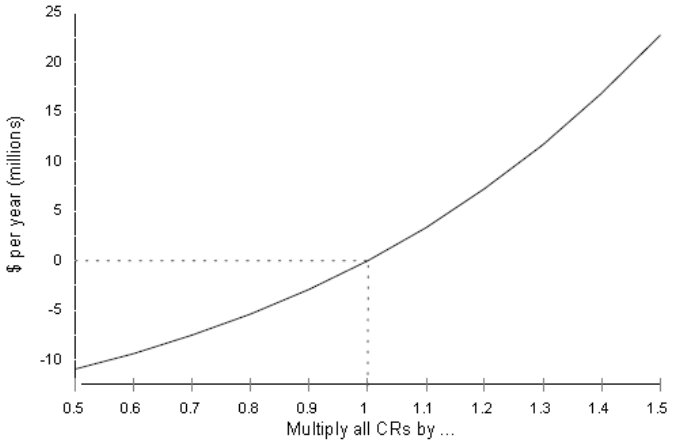
The authors developed a random utility model (RUM) of demand for recreational fishing, covering all water bodies and all species types throughout all 83 counties in the state. A nested multinomial logit RUM was used for the site choice model. Three levels of choices were modeled for each choice occasion: type of trip (single day or multiple day), fish product line (type of fish pursued), and destination site. A major innovation in this study was the use of “product lines”, drawn from an earlier factor analysis study of the 1983-84 fishing season that identified distinct fishing experiences across license holders (Kikutchi 1986). The resulting product lines incorporate distinctions among type of water body (Great Lake, tributaries, and inland rivers/streams) and type of fish species (warm water and cold water). The inclusive values of the nested RUM model lie within the expected utility theoretic range, indicating that the product line groupings represent an improvement over models without such groupings. Within the product lines, the coefficient on the trip cost was negative, and quality measures tended to be positive. While a participation model was estimated, its acceptability is hampered by the lack of trip frequency data and is not discussed here.

Jones and Lupi (2000) find that a 10% decrease in catch rates creates a decline in aggregate fisheries use-value that is 7% to 14% lower than the increase in aggregate fisheries use value associated with a 10% increase in catch rates. For a 50% change in catch rate, the value associated with a decrease is 34% to 45% lower that the corresponding value for an increase. In conjunction with the MSU (TCM 1996) study discussed below, this provides evidence that there is an asymmetry between gains and losses in catch rates.

MSU (TCM 1996): Technical, Econometric Details.

The basic structure of the nested multinomial logit model followed that of Jones and Sung (1993). Three levels of nested decisions were modeled: trip length (single day versus multiple day), product line (Great Lakes (GL) cold water fishing, GL warm water fishing, Inland lakes (IL) warm water fishing, IL cold water fishing, Rivers and Streams (RS) cold water fishing, RS warm water fishing, and Anadromous Runs), and destination site choice within each one of these trip length/product line decision branches. A difference from the Jones and Sung (1993) model is that the panel data allowed MSU to model 63 choice occasions across the season in which the probability of taking a trip and, if a trip is taken, the series of nested probabilities leading to the destination choices were estimated. Thus, the total number of trips taken during the season can be modeled. Site quality for the GL warm water, GL cold water and the anadromous product lines are calculated using Michigan Department of Natural Resources creel data for each county and vary by month. IL stream and river miles were aggregated and categorized as described in the Jones and Sung (1993) above. The quality measures were generally statistically significant and positively correlated with the probability of being chosen. The coefficient on trip costs was negative, and varied between single day and multiple day trips. The inclusive values for each nest were consistent with utility theory, and support the nesting structure over a non-nested model.

The MSU analyses allow for the possibility of estimating changes in catch rates across a broad range of percentage changes. The figure below demonstrates and important result from this study, that because of entry and exit, willingness to pay for a change in catch rates (CR) is non-linear (source: Source: Lupi and Hoehn, 1997, Figure 4)



The reason for this asymmetry in a recreational fishery travel cost model is discussed by Lupi and Hoehn (1997):

> "it is clear that the estimated gains from increasing catch rates exceed the estimated losses for an equivalent decrease in catch rates. The reason for this is due to the role of site and activity substitution embodied in the recreational demand model. When the quality of the Great Lakes trout and salmon fisheries decreases (increases), anglers substitute out of (into) this fishery. Thus, for decreases in quality, anglers who are taking trips to fish for Great Lakes trout and salmon experience losses, but the magnitude of these losses is limited by the utility they could receive from switching to their next best alternative. Their next best alternative could be fishing for a different species, fishing at a different site, or fishing less. Because the values being measured are use-values, once an angler switches sites, they do not experience any further losses if quality at a site they are no longer visiting continues to decrease. Conversely, when the quality of a site increases, anglers who are currently using the site experience benefits. In addition, some anglers are induced to switch to the site where quality increases, and these additional users also benefit from the increase in quality. Thus, site substitution in travel cost models plays a dual role, mitigating losses and accentuating gains relative to models that ignore such substitution possibilities." (p. 13)

Phaneuf et al. (TCM 1997): Technical, Econometric Details.

The authors develop a utility-theoretic Kuhn-Tucker modeling approach for recreational modeling in which many site choices have zero observations. As noted above, the Great Lakes portion the Lyke (TCM, 1993) study provides for adequate information about substitute Great Lake activities but not information about inland product lines. The extension of Kuhn-Tucker

modeling to recreation is a contribution. However, such a modeling approach is appropriate only for limited numbers of site choices, and is not extendable to more extensive choice settings. The use of only the Great Lakes data set from the Lyke study preempts concerns about substitutes mentioned in that review.

The coefficients of trip price and catch rate are negative and positive, respectively.

Upneja et al. (TCM 2001)

An ordinary least squares regression strategy was used for the identified trip and the total number of trips taken in the previous 12 months. While the coefficient on trip cost was negative, the significance levels of the coefficient are not provided. There is no correspondence between the trip cost and the total number of trips taken. Substitute sites are not accounted for in the model, leading to possible omitted variable bias in the estimates.

Besedin et al. (TCM 2004): Technical, Econometric Details.

A random utility, site choice model was estimated using a multinomial logit model. Choice sets included up to 74 randomly selected sites per angler within 120 miles from the angler's home zip code. Since socioeconomic data was not collected, median household income by zip code from the 2000 census was used as an income variable. The authors attempted to estimate a nested logit model with separate nests for warm water and cold water species. However, in contrast to the Jones and Sung (TCM, 1993) and the MSU (TCM 1996) studies, nested models are reported not to fit as well, with the authors suggesting that the poorer fit was due to overlap between warm water and cold water fishing sites. In addition, data was not available on the number of trips by mode, so that welfare estimates were based only on the total number of trips. The coefficients in the resulting model have the expected signs: notably the coefficient on travel cost is negative and coefficients on catch rates are positive.

The modeling does not account for a trip participation model for the Great Lakes, "because the required data were not available" (US EPA 2004, G4-9). Due to entry and exit into the fishery with changes in catch rates, a net economic benefits are expected to be a convex function of catch rates. This issue is discussed further in the MSU 1996 Technical Details in this chapter.

Murdoch (TCM 2006): Technical, Econometric Details.

This research argues that the use of quality in travel costs models captures many other site characteristics. Hence, the estimates of the coefficients for site are likely biased. An alternative two-stage method of analysis is developed that simply uses binary variables for each county and then regresses the county specific coefficients on quality varaibles.

Because of econometric complications which results in an incorrect coefficient on travel cost, illustrative policy values for a 10% increase in walleye and musky catch are reported in miles rather than dollars. The proposed modeling approach provided WTP estimates for changes in quality that are notably larger, up to a factor of four, than when estimated with traditional modeling approaches.

Kelch et al. (TCM 2006)

Although individuals were contacted at different streams, the model was estimated like a single site count model. Site specific dummy variables were used to account for potential unobserved characteristics across sites. Corrected and uncorrected negative binomial count models were estimated. The coefficient on travel cost was negative and significant. Quality data were not collected and hence were not included in the model.

Milliman (CV 1986):

Respondents answered a dichotomous choice question which was modeled using a logit random utility model. The probability of a yes response declined significantly with the dollar value, but was not significantly related to catch rate or average size.

Connelly and Brown (CV 1990)

A linear demand function was mentioned but not reported. WTP values were derived from the demand estimate.

Lyke (CV 1993)

Simple logit random utility models were estimated for the dichotomous choice responses with only the cost value as a covariate. The coefficient on costs was negative.

Connelly et al. (CV 1997)

A linear demand function was mentioned but not reported. WTP values were derived from the demand estimate.

National Survey of Fishing, Hunting and Wildlife Associated Recreation – NFHWAR (CV 2006)

There are no technical features that merit attention for this report.

Breffle et al. (RP/SP 1999)

The authors estimated what they refer to a as a minimal RUM that they identified as being appropriate for estimating compensatory values in Natural Resource Damage Assessment for unique settings in which the quality varies only at one site. This model used a complete data set in the sense that all alternative fishing sites, and the alternative of not fishing, were included in the choice set. However, details about the individual fishing sites were not utilized. Instead fishing at all other sites was combined with all the nonfishing alternatives. The authors recognized that such a model will not suffice if one wants to value changes at multiple fishing sites or how much demand at another site will drop when one site is improved. This model combined travel costs and choice experiment data to value improvements relative to the current level of contamination.

Estimated coefficients on catch rates and indicators characterizing the level of fishing advisories were significant and corresponded to directional expectations.

Beachgoing Studies: Chapter III

Loomis (ABT, 2005)

There are no technical features that merit attention for this report.

Atiyah (ABT, 2009)

A multiple regression meta-analysis was conducted using each value per recreation day estimate (converted to $2007) as a function of methodology (TCM vs. CVM), type of value (averaged or marginal value), state (CA, FL or other), author (dummy variables to explore effect of prolific authors) and year of the study. Travel cost estimates were significantly higher than contingent valuation estimates. Average values (from integrating under a demand curve) were found to be higher than marginal values, California had lower values (attributed to more frequent visits) and certain authors had higher values and estimated values were found to grow across years. Simple OLS regression methods were used without clustering observations by study (R^2= 0.98).

Sohngen et al. (TCM 1999)

Single site models were estimated, including both continuous (linear and log linear) and discrete (Poisson and Negative Binomial). Costs to one (Maumee) or two (Headlands) substitute sites were included. The coefficient on travel cost was always negative. The coefficient on the price of the substitute sites was generally positive, indicating that visitation rates rise with costs of going elsewhere, but the significance levels were mixed. While,

substitute sites were accounted for in the estimation, reducing concerns about biases in the coefficients, the exploration of substitute sites in the modeling was rather limited.

Sohngen et al. (TCM 2001/2006)

Using only the single day data, WTP per day trip and total beach trips was estimated using a nested RUM site choice model linked to a Poisson count model. The coefficient on travel costs is negative. Visitation significantly increased with water quality, desirable sand composition and beach facilities, and declined with the number of zebra mussel shells observed on the beach and the slope of the beach.

Yeh et al. (2006) used data from the same survey exercise, but added an additional trip length nest (single-day or multiple-day) in a manner that accounts for multiple objectives of longer trips. Single and multiple day trips had significantly different coefficients on the travel cost parameter. Inclusive values for trip length were consistent with utility maximization and lend support to nesting by trip length.

Shaikh (TCM 2006):

A count data (corrected negative binomial) model was estimated for number of beach trips taken per season. Regression statistics were not reported. Price elasticity was negative, as was the elasticity with respect to the number of swim mans at that beach.

The single-site method of this study is appropriate to the extent that this study models all Chicago Beaches as one beach and no beaches outside this area are viewed as substitutes. The lack of substitutes would not broadly hold across the entirety of the Great Lakes and UMORB, and hence the day values reported in this study are not extendable to the Great Lakes as a whole. Opportunities for benefits transfers would primarily be to similar urban settings.

Song et al. (TCM 2010)

A two-level nested RUM was estimated with the first nest being the GL water body and the second nest being beach sites geographically proximate and sharing the same characteristics (143 groups). The coefficients on travel cost and closure days were negative and significant, while the beach length coefficient was positive and significant. The number of closure advisory days separate from actual closures was not significant. Inclusive variables were consistent with utility theory and improved the model.

With respect to valuing changes in quality, this study shows that impacts of ANS will depend fundamentally on the spatial porousness of their impact, i.e. whether effects are concentrated or are periodic along a coastline.

It should be noted that Frank Lupi and colleagues at Michigan State University are in the process of implementing a statewide follow up to Song et al. (2010) study that will not only account for multisite decision choices but will also explore the decision to participate in beach recreation and the total number of beach visits across the season of those that participate in beach recreation.

Boating Studies: Chapter V

Rosenberger and Loomis (MA 1998): Technical, Econometric Details.

Net value per person per day per activity was estimated as a linear function of binary methodological, site and activity variables. The model had an adjusted R^2 of 27%.

For motorboating there was only one observation in the northeast, and the coefficient on the binary variable for Motorized Boating was not significant. For float boating there were four observations from three studies, and the coefficient on float boating was significant and positive. Due to the small sample size and the age of the data used, CU does not recommend the estimated values for inclusion in the GLMRIS program. CU discusses one of these studies (Hellerstein, 1991) in Chapter IV.

Hellerstein (TCM 1991): Technical, Econometric Details.

Data for this model was aggregated into the 1,396 counties within 1000 miles of the Boundary Waters Canoe Area. Income, population, employment, poverty, education, and age distribution were taken from county statistics. The author argues that the adding up properties of the Poisson and the negative binomial models used in this analysis facilitate the use and interpretation of these aggregated data in count data models. About half of the counties had zero visits.

Poisson and negative binomial models were estimated and a semilog ordinary least squares model with zero trip observations dropped was used for comparative purposes. CU focuses our attention on the Poisson and negative binomial models for which the aggregate numbers of visits from the country served as the dependent variable. In addition to social demographic variable listed above, the travel cost to Algonquin Provincial Park, as substitute site in southern Ontario was included in the estimated models.

The hypothesis of equality between expected visits and variance of expected visits was rejected, suggesting the use of the negative binomial model. The own price coefficient in the model is negative and significant and the sign on the coefficient of the substitute price is positive as theoretically expected.

Bowker et al. (TCM 1997): Technical, Econometric Details.

Truncated Poisson and negative binomial count data models were estimated for the travel cost data (n=180). The estimated coefficient on travel cost was negative, and the number of visits was positively correlated with income and previous experience. Substitute sites were apparently accounted for (but were not significant in the model), but that variable is not adequately defined in the paper.

The authors incorporate site characteristics in the model, showing that price response and consumer surplus are likely affected by site characteristics.

The estimated net value per trip were $256 ($1993) to $352 ($1993) for a guided rafting trip using a truncated Poisson model. The net values varied based on whether reported or imputed costs were used and whether the wage rate was set to 25% or 50% of the wage

Out of sample transfer models were not successful: 60% of these transfers "were resounding failures based on statistical test of congruence" (Bowker et al., p. 11). In-sample models had an 80% success rate. The authors conclude that benefits transfer is problematic if extended to beyond the range of available data.

Bhat et al. (TCM 1998): Technical, Econometric Details.

This study differs from the other TCM studies reviewed in this document in the sense that the other research has sought site specific values in which recreationists travel varying distances to a single site or set of sites. Here the perspective is "population specific" in which the research studies and models trips made by a population or community to all sites.

Separate truncated Poisson count data models were estimated for several recreational activities. Models included trip cost, distance and time costs to the nearest substitute site for the same activity, annual household income, and a binary variable to differentiate between local and non-local participants.

For motorboating and water skiing in the Northeast and Great Lakes ecoregion (sample size not available) the coefficient on travel costs was negative, the coefficient on distance to the nearest substitute from the individual's origin of activity was positive and significant, and the nonlocal effect was positive and significant. The authors indicate that this later value suggests a difference in consumption behaviors of local and nonlocal visitors, i.e. ceteris paribus this indicates that nonlocal visitors have a higher visitation rate. CU has not seen this variable in other travel cost analyses and are concerned about possible biases it might introduce in the estimated net value measure.

Shafer et al. (2000): Technical, Econometric Details.

Simple ordinary least squares models were estimated for each site. While the coefficient on logged trip cost was negative, the significance levels of the coefficient are not provided. Substitute sites are not accounted for in the model, leading to possible omitted variable bias in the estimates. Differences in boat lengths are not accounted for in the net value estimate.

Connelly et al. (2005): Technical, Econometric Details.

Average net value was estimated by averaging the open-ended CV responses, broken out into various groupings.

Appendix: On Net Economic Value, Expenditures and Economic Impact Analysis

The purpose of this appendix is to provide an non-technical discussion of net value vis-à-vis expenditrues and net economic impact. The interested reader is also referred to Scodari (2009) and Aitken (2009) for additional discussions using supply and demand graphs.

When an individual takes a trip away from home to engage in a recreational activity such as a day spent fishing, boating, or going to the beach, the *total value* to the recreationist of the trip is defined as the largest amount of money he or she would be willing to pay to go on that trip to do that activity. The amount the individual actually spends to take that trip is called the recreationist's *expenditures* for the trip. Expenditures would include money spent on such things as gasoline, lodging, entry fees, and food at the recreation site.

An individual will only go on a recreational trip if the benefit they get from doing so (their total value) is larger than the cost to them of the trip (the expenditures). The *net value* from the trip is defined as the recreationist's total value for the trip minus the expenditures for the trip. Net value is also commonly referred to as the *consumer surplus* that the individual gets from engaging in the activity – it is the surplus value they receive from the activity over and above what they actually have to pay for the activity. If a recreational opportunity were somehow lost, recreationists would lose this net value.

One point of clarification is necessary. Our definition of net value of the resource includes only the value that recreationists place on participating in the activity - the so-called "use value" from the activity, or the "all-or-nothing value" of taking the trip (Talhelm , 1988). Many people who do not use water resources recreationally still may care about the quality of those resources. This review will not address these so-called "nonuse values."

CU defined expenditures as the amount that recreationists actually spend on products and services for each trip. Studies will often report expenditures made by recreationists in a region as an indication of the importance of recreational resources to local or regional communities. Studies will also commonly use information on recreational expenditures to help calculate the regional *economic impact* from the activity. When visitors from outside a region spend money in that region while on a recreational visit, some of those new expenditures induce local businesses and households to spend more money themselves. For example, when a visiting recreationist purchases food at a local restaurant, that local restaurant may purchase

some of its food from the local grocery store. Similarly, the server at the restaurant will spend some of his or her tip money inside the region. There is therefore a multiplier effect, where the regional economic impact from recreational expenditures is larger than the initial expenditure.

Information on the magnitude of recreational expenditures and their resulting regional economic impact is often of great interest to local officials and business owners. However, expenditures and economic impacts do not represent benefits from a NED perspective. There are two reasons why. First, recreation expenditures do not take into account the cost of providing the goods and services that recreationists purchase. For example, if a fisherman or boater spends $40 for gasoline for his boat, the marina will have to purchase that gasoline from a wholesale supplier, and that gasoline is no longer available for someone else to use for another purpose. Second, when recreationists spend money in a region where they go to recreate, that is money they can no longer spend in other regions or on other activities. Recreation expenditures and economic impacts represent transfers of income from recreationists to local businesses, from one activity to another, and from one region to another, rather than an added value to the economy. This point was emphasized in a recent background document on issues surrounding the Chicago Area Waterway System: the Congressional Research Service noted that economic impact measures "cannot be used to estimate changes in social welfare, to assess trade-offs among public policy alternatives, or to conduct benefit-cost analysis" (Buck et al., 2010, p. 7)

Glossary of Acronyms

ABT – Average Benefits Transfer
ANS – Aquatic Nuisance Species.
CATI – Computer Assisted Telephone Interviewing
CPI – Consumer Price Index
CR – Catch Rates
CU – Cornell University
CV – Contingent Valuation
GLMRIS – Great Lakes and Mississippi River Interbasin Study
MA – Meta Analysis
NED – National Economic Development
r.r. – Response Rate
TCM – Travel Cost Method
UMORB – Upper Mississippi and Ohio River Basins
USACE – U.S. Army Corps of Engineers
USFWS – U.S. Fish and Wildlife Service
WTP – Willingness to Pay

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