Journal of Extension

Volume 54 | Number 6 Article 25

12-1-2016

Factors Affecting Stakeholders' Willingness to Pay to Prevent the Spread of Aquatic Nuisance Species

Thomas W. Blaine
Ohio State University

Frank R. Lichtkoppler
Ohio State University

Journal of Extension
www.joe.org

December 2016
Volume 54
Number 6
Article # 6FEA5
Feature

Factors Affecting Stakeholders' Willingness to Pay to Prevent the Spread of Aquatic Nuisance Species

Abstract

Physical separation of the Great Lakes and Mississippi River basins has been identified as the most effective method for preventing the transfer of aquatic nuisance species, particularly Asian carp, from the Mississippi River Basin to the Great Lakes. The U.S. Army Corps of Engineers selected Extension to conduct a study of a key stakeholder group, Great Lakes charter captains, as a first step in assessing public opinion on the issue. Results reveal that the charter captains overwhelmingly support basin separation. Expanded educational outreach related to aquatic nuisance species, basin separation, and so forth would improve the ability of clientele to make informed decisions regarding separation of the basins.

Thomas W. Blaine
Associate Professor
Ohio State University Extension
Columbus, Ohio
blaine.17@osu.edu

Frank R. Lichtkoppler
Professor Emeritus
Ohio Sea Grant/Ohio State University Extension
Painesville, Ohio
lichtkoppler21080@gmail.com

Introduction, Problem Statement, and Objective

The potential threat to the Great Lakes ecosystem from Asian carp (*Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis*, and *Mylopharyngodon piceus*) has been a concern expressed in both the popular media and the scholarly literature for some time (Allington, 2012; Duhaime-Ross, 2014; Rasmussen, Regier, Sparks, & Taylor, 2011). Aquatic nuisance species (ANS), also known as aquatic invasive species (Van Den Berg & Dann, 2008), in general, and more recently Asian carp in particular, have been identified as a critical threat to Great Lakes commercial, recreational, and tribal fisheries (Hansen, 2010; Michigan Sea Grant, 2007; Ohio Sea Grant, 2010). Interested parties have discussed numerous strategies for preventing the movement of Asian carp from the Mississippi River Basin, where they are now ubiquitous, to the Great Lakes Basin, where their presence could devastate fisheries. The proposed closure of the Chicago Area Waterway System (CAWS), which links the two basins, is one such strategy.

The U.S. Army Corps of Engineers analyzed the feasibility of physically separating the GL-MR basins in accordance with the Great Lakes and Mississippi River Interbasin Study (U.S. Army Corps of Engineers [USACE] Chicago District, 2010, 2014). Because it physically connects the GL-MR basins, the CAWS is a potential pathway for the transfer of Asian carp and other ANS between the two basins. Many have called for the CAWS to be closed (Great Lakes Commission and Great Lakes and St. Lawrence Cities Initiative, 2012; Rasmussen et al., 2011). The

Great Lakes and Mississippi River Interbasin Study has resulted in baseline economic reports on key stakeholder groups in the Great Lakes that could be affected by the transfer of ANS between the basins, including commercial fisheries, pro-tournament fisheries, treaty and subsistence fisheries, recreational fisheries, and the charter fishing industry (USACE Chicago District, 2012a, 2014).

Much of the controversy concerning separation of the GL-MR basins involves the high cost of the actual separation infrastructure and the much higher costs of addressing numerous flooding, water quality, and transportation issues that basin separation would entail. Policy makers wanted to begin to assess public opinion on this topic by first gauging the views of key stakeholder groups prior to surveying the general public (USACE Chicago District, 2010).

The Great Lakes charter fishing industry is one such stakeholder group. It provides recreational access, on-the-water experience, and information about the Great Lakes to thousands of anglers who may not have the craft, equipment, or knowledge needed to safely and productively venture onto the Great Lakes. In 2011, 1,904 active charter captains took more than 340,000 anglers on roughly 77,000 Great Lakes charter fishing trips, generating estimated sales of between $34.4 million and $37.8 million (USACE Chicago District, 2012b).

The Great Lakes Sea Grant Network has a long history of Extension outreach with key stakeholder groups, including charter captains (Dawson, Lichtkoppler, Kuehn, & Pistis, 1995; Kuehn, Lichtkoppler, & Pistis, 2005). With funding from the U.S. Army Corps of Engineers, the Great Lakes Sea Grant Network surveyed members of the Great Lakes charter industry, using a "payment card" version of the contingent valuation method (CVM), to assess their willingness to pay (WTP) to close the CAWS. Specifically, the objective of the study was to use CVM to assess the opinions of a key Great Lakes stakeholder group, charter captains, on closure of the CAWS to prevent the spread of Asian carp into the Great Lakes Basin.

In selecting Extension to carry out the study, the U.S. Army Corps of Engineers demonstrated a good deal of confidence in Extension's local knowledge, client connections, credibility, and competence in applying a sophisticated tool, CVM, to an urgent ecological problem. Indeed, CVM is not new to Extension (Blaine & Smith, 2006), and it has emerged as one of the primary methods used to estimate values of a host of publically provided (nonmarket) goods and services, including the eradication and prevention of ANS (Carson, 2012; García-Llorente et al., 2011).

Valuation of nonmarket goods and services has taken on a high profile in Extension in recent years (Allen, Bowker, Stamper, Owusu-Amankwah, & Davis, 2014; Haskell & Morse, 2015). CVM has been adopted as an important tool in assisting Extension agents, educators, and specialists in valuing a variety of program development and outreach projects (Lawrence & Mandal, 2016). This article provides extensive detail on how to obtain WTP measures from survey data and, therefore, models best practices for Extension professionals and others seeking to obtain measures of nonmarket, or public, value via CVM.

The Survey

The Great Lakes Sea Grant Network obtained lists of Great Lakes charter captains, and stratified sampling produced a set of 1,200 Great Lakes charter captains to receive surveys. A total of 52 surveys were returned as not deliverable. Using a modified Dillman (1978, 2000) approach, we made up to four contacts by mail in an effort to increase the response rate. This strategy resulted in a set of early respondents and a set of late respondents, enabling us to test for nonresponse bias. The data were entered in an Excel database and imported into IBM SPSS and STATA software.

The survey included a series of questions pertaining to basin separation and respondents' expectations for the future. (See the appendix for select survey items.) We asked respondents whether they used the CAWS in a typical year and whether they supported or opposed basin separation. We also asked about respondents' WTP related to their support of basin separation or lack thereof. Annual offer amounts (also called "bids") were listed on a "payment card" presented to respondents. Bid options were established by U.S. Army Corps of Engineers economists on the basis of previous work they had done with payment cards. Respondents also were asked whether they had enough information to make a sound decision about their WTP. We then asked respondents whether they thought ANS would affect their businesses in the subsequent 5 years. We also included questions about respondents' plans for the future. The questionnaire allowed respondents to indicate their plans for the subsequent 5 years, including by selecting from nine ways in which they might expand their businesses.

A key conceptual issue addressed by critics of CVM has been whether respondents reveal their true WTP on surveys or instead engage in "strategic behavior" (Carson, 2000). Strategic behavior refers to a respondent's giving a value that does not reflect his or her true preference because of a wish to influence survey results for some purpose. To overcome this problem, researchers should design CVM survey instruments that are "incentive compatible" (Champ, Flores, Brown, & Chivers, 2002), where respondents have an incentive to provide responses that represent their true preferences. One way of achieving incentive compatibility involves providing respondents with the opportunity to explain the WTP options they choose. In a list of possible reasons behind respondents' WTP bid selections, we included two options respondents could select that might account for strategic behavior: "that's what it is worth to me" and "I object to paying." Inclusion of these two variables is important because they can help account for "protest bids," where respondents answer a CVM survey with values that do not reflect their real preferences because they do not accept the premise of the survey. Respondents may be in protest because of a philosophical orientation around the idea that someone else should have to pay for the project (e.g., those who introduced a nuisance species in the first place, the government). The inclusion of these two variables in surveys on WTP can be seen as a kind of quality control mechanism. An extensive literature has emerged on the issue of protest bids in CVM and how they, along with ad hoc measures used by economists to deal with them, can produce biased valuation estimates. These variables allow respondents the opportunity to express a protest without discarding the survey or distorting their responses related to WTP (García-Llorente, Martin-Lopez, & Montes, 2011; Halstead, Luloff, & Stevens, 1992; Meyerhoff & Liebe, 2006).

Theory / Calculations

Estimating mean WTP values from payment card data is not as straightforward as one might initially think (Vaughan, Russell, Rodrigues, & Darling, 1999). This is because it is not known how specific WTP amounts might be distributed within the bid categories that have been chosen for the survey. The alternative to using categories is allowing an open-ended response. But the open-ended approach has many problems associated with it and is out of favor in CVM studies (Carson, 2000; Venkatachalam, 2004). Three primary techniques are used to measure mean WTP from categorical data: calculation of a Turnbull mean, calculation of a Kristrom mean, and calculation of a parametric mean obtained by way of a multiple regression procedure.

The Turnbull (1976) mean serves as a true lower bound estimate for mean WTP. Although it is the earliest of the standard measures of mean WTP to be developed, the Turnbull mean returned to favor after Hoehn and Randall (1989) showed that disaggregated CVM studies have a tendency to overstate WTP. The Turnbull lower bound mean is calculated as follows:

$$(1)\ LBM = \pi_0(p_0) + \sum_{i=1}^{k} \pi_i\ (p_i - p_{i-1}),$$

where π_i is the percentage of respondents who support a given bid amount p_i and k is the number of bids offered after the initial bid p_0.

An alternative to the Turnbull mean was suggested by Kristrom (1990). The Kristrom mean is an estimate that is less conservative than the Turnbull measure but likely to be more representative of actual mean WTP, particularly in a study such as the one described here, which has relatively large ranges within the bid categories offered to respondents. By calculating the Kristrom mean alongside the Turnbull mean, we had the advantage of estimating an alternative value for WTP instead of just a lower bound. The Kristrom mean is obtained as follows:

$$(2)\ Kristrom\ mean\ = LBM + \left(\frac{1}{2}\right) p_0(1 - \pi_0) + \sum_{i=1}^{k} \frac{1}{2}\ |\pi - \pi_{i-1}|\ (p_i - p_{i-1}) + \frac{1}{2}\ \pi_k(p^* - p_k),$$

where p^* is the estimated bid price where π falls to zero.

The third method we implemented for calculating mean WTP involves using the results from a regression equation that specifies the choices respondents make related to WTP as a function of a set of independent variables. It is calculated as follows:

$$(3)\ Parametric\ mean = B_0 + \sum B_j X_j,$$

where B_0 is the intercept and B_j is the parameter estimate on the jth independent variable whose mean is X_j.

Based on this framework, the regression we used to estimate WTP for basin separation (equation 3) included five independent variables: plans to expand the business, whether the captain believed he or she had enough information on the topic, expectations about the threat of ANS, the reasoning "I object to paying," and the reasoning "that's what it is worth to me."

Results and Discussion

The Returns and Tests for Nonresponse Bias

We received 342 usable completed surveys, yielding a response rate of 30%. Not all participants completed the survey instrument, but any completed questions from incomplete surveys were accepted for data analysis. A key question in survey research is whether the people who never responded differ in their views from those who did. This problem is referred to as nonresponse bias, and it may be especially suspected in a survey such as the one described here, where the response rate is relatively low. Researchers have developed various methods for determining whether nonresponse bias is present in a given survey.

The most common approach in Extension survey research involves statistical tests between early respondents and those who responded only after repeated follow-ups (referred to as late respondents). Studies have shown that late respondents are more like nonrespondents than early respondents are (Lindner, Murphy, & Briers, 2001; Lindner & Wingenbach, 2002; Miller & Smith, 1983). If nonresponse rate in a survey is a problem, it is quite likely

that statistical differences between early and late responses will be observed. To test for this, we conducted a series of statistical tests comparing early and late respondents. Chi–square tests for 30 variables revealed no statistical differences between the early and late responding groups ($p > .05$), indicating that nonresponse bias was absent from the survey.

Basin Separation and WTP

Only two (0.6%) of the respondents stated that they use the CAWS in a typical year. The vast majority of Great Lakes charter captains, even those who are in the Chicago area, do not operate in the CAWS. A total of 94.5% stated that they support basin separation, and 60.8% believed that ANS would impact their businesses within the subsequent 5 years. The number and percentage of respondents who selected each payment range related to WTP for basin separation are presented in Table 1.

Table 1.

Great Lakes Charter Captains' Annual Willingness to Pay (WTP) for Separation of the Great Lakes and Mississippi River Basins

Value range	No. of respondents[a]	% of respondents[b]
$2,500 to $4,999	0	0.0%
$1,000 to $2,499	2	0.6%
$750 to $999	5	1.6%
$500 to $749	6	1.9%
$250 to $499	19	5.9%
$100 to $249	55	17.2%
$50 to $99	54	16.9%
$1 to $49	55	17.2%
$0	124	38.8%
Total	320	100.1%

[a]Number of respondents selecting a value they are willing to pay annually. [b]Percentages do not sum to 100% due to rounding.

Data from Table 1 may be used to calculate respondents' mean annual WTP to close the CAWS. Note that the responses at the upper end of bid amounts taper to zero at the final category.

Reasons for responding to the WTP survey item are presented in Table 2.

Table 2.

Reasons Great Lakes Charter Captains Responded as They Did Regarding Amount They Would Be Willing to Pay Annually for Keeping the Chicago Area Waterway System Open or Closed

Reason	No. of respondents	% of respondents
It's worth more to me, but it's all I can afford to pay	125	38.0%
I object to paying	60	18.2%
Not enough information is provided	55	16.7%
Other reason	43	13.1%
I didn't want to place a dollar value	28	8.5%
That's what it is worth to me	18	5.5%
Total	329	100.0%

The results for the future plans of the captains are presented in Table 3. Over half of respondents (56.7%) said they planned to increase the number of charter trips they make annually. Almost 25% planned no major changes in the subsequent 5 years, and over 21% planned to quit the charter business in the subsequent 5 years (USACE Chicago District, 2012b). These results are similar to the percentages reported in Kuehn et al. (2005).

Table 3.

Great Lakes Charter Captains' Plans to Expand Their Businesses in the 5 Years Following the Survey (*N* = 342)

Type of expansion planned	% of respondents[a]
Increase number of annual trips	56.7%
Buy/operate a newer boat	16.7%
Buy/operate a bigger boat	14.0%
Branch out into other fishing-related business	12.3%
Hire additional first mate(s)	11.1%
Expand into multiactivity and/or nonfishing charters	10.8%
Hire additional charter captain(s)	9.9%
Buy/operate an additional boat	8.5%
Buy your own charter boat	3.2%

Note. Adapted from U.S. Army Corps of Engineers, Chicago District. (2012b). *Great Lakes charter fishing industry—Baseline economic assessment.* Chicago, IL: Author.
[a]Percentages sum to more than 100% due to multiple responses.

Using equation 1 and the cumulative percentages derived from the results in Table 1, the Turnbull mean WTP is as follows:

$LBM = 1.000(0) + .612(1 - 0) + .440(50 - 1) + .271(100 - 50) + .099(250 - 100) + .040(500 - 250) + .022(750 - 500) + .006(1{,}000 - 750) = \$67.57$. The standard error is 8.11, yielding a 95% confidence interval of \$52.04 to \$83.93.

Using equation 2 and the results from Table 1, the Kristrom mean is as follows:

Kristrom mean $= LBM + ½(0)(1 - .388) + ½|.172 - .388|(1) + ½|.169 - .172|(49) + ½|.172 - .169|(50) + ½|.059 - .172|(150) + ½|.019 - .059|(250) + ½|.016 - .019|(250) + ½|.006 - .016|(1500) = 67.57 + .108 + .074 + .075 + 8.475 + 5.00 + .375 + 7.50 = \$89.18$.

Note that the Kristrom mean WTP is approximately 32% higher than the lower bound mean. Calculation of confidence intervals for the Kristrom mean is very problematic and computationally intensive and requires a number of assumptions about the distribution of WTP (Kristrom, 1990). It is therefore omitted here. But it should be noted that the point estimate lies above the 95% confidence interval on the Turnbull mean. This is generally in line with previous comparisons of the two methods from other studies (Kristrom, 1990).

To calculate the parametric mean (equation 3), we undertook a regression analysis that specified the magnitude of WTP for basin separation as a function of the five independent variables discussed previously.

Since payment card WTP responses come by way of the categories of offer amounts, the data they generate are interval. Interval-level data contain more information than ordinal data but less than ratio data. Although most regressions involve ordinary least squares, some form of ordinal regression, or even dichotomous-choice regressions, the appropriate form of regression to use here is interval (Cameron & Huppert, 1989). Many statistical packages do not include an interval option. For this reason, we had to employ STATA instead of SPSS for this portion of the study. The results of the regression are presented in Table 4.

Table 4.

Results of Interval Regression with Willingness to Pay as Dependent Variable

Independent variable	Parameter	*SE*	*z*	*Pr>z*	95% *CI*
Constant	74.94	18.32	4.09	0.00	39.03 to 110.84
Plan to expand	11.24	5.24	2.15	0.03	0.97 to 21.51
Not enough information	−71.31	24.07	−2.96	0.00	−118.48 to −24.14
Object to paying	−94.13	22.94	−4.10	0.00	−139.08 to −49.18

That's what it is worth to me	98.93	38.91	2.54	0.01	22.66 to 175.19
ANS will affect business	43.57	17.65	2.47	0.01	8.97 to 78.17

Number of obs = 320
Log likelihood = −1,198.72
LR $X^2(5)$ = 44.90
Prob > X^2 = 0.00

Note. ANS = aquatic nuisance species.

The parametric mean from the interval regression is $94.15, with a standard error of 3.14 and 95% confidence interval of $87.98 to $100.32. Note that the Kristrom mean lies within the confidence interval but the lower bound mean does not.

The parameter estimate on expansion of the business indicates that for every additional type of business expansion planned, the captain's WTP for basin separation rose by $11.24. The range here is considerable, since planned expansion options in the data set varied from zero to eight. A respondent who was expecting to increase in eight areas was willing to pay $89.92 more than a respondent who planned no expansion.

The information factor is highly important. The parameter estimate associated with this variable implies that for those who said they did not have enough information to make a good decision, WTP was $71.31 lower than for those who believed they had enough information. The implication here is that outreach education concerning the details of ANS, basin separation, and related issues is extremely relevant and timely, presenting an opportunity for Extension.

The parameter estimate on the third variable indicates that those who objected to paying for basin separation showed a reduced WTP of $94.13 as compared to those who had no such objection. Charter captains, or at least a component of them, need to be convinced that others who have a stake in basin separation and suppression of ANS are also paying their "fair share" of the costs of the project. Sharing the costs in a fair manner could minimize the objections some captains have. The parameter for the variable "that's what it is worth to me" is 98.93, indicating that those who gave an answer representing their "true" WTP were in fact willing to pay $98.93 more than those who selected a value based on some other criterion. The inclusion of these two variables in the regression equation, along with the statistical significance of the parameters associated with them, provides an indication that protest bidding or nonresponse based on protest was unlikely.

Captains who expected that ANS would affect their businesses within the subsequent 5 years were willing to pay $43.57 (approximately 78%) more than those who had no such expectation. The average charter captain who did not expect ANS to affect his or her business was willing to pay $55.35 annually. Captains who expected that ANS would affect their businesses were willing to pay $98.92.

Conclusions

Given the enormous stakes involved in the potential spread of Asian carp from the Mississippi River Basin into the Great Lakes, research and outreach on various dimensions of the problem are critical. Extension can play key roles at different levels relating to this issue, including by interacting with stakeholder groups (Nagle, Usborne,

Stone, McCullough, & Sadof, 2014). The fact that the U.S. Army Corps of Engineers selected Extension to carry out the study described here is a testament to the perceived competence of Extension. We hope that the results presented here contribute to that legacy. Beyond this, we have presented technical details related to obtaining nonmarket WTP from survey data via CVM models to encourage best practices for Extension professionals and others.

We surveyed members of one small but significant segment of Great Lakes stakeholders: charter fishing captains. Charter captains are important for several reasons. First, they interact with a large and broad segment of people who participate in Great Lakes fishing. Second, their businesses depend on the quality of the fishing resource available. Finally, many captains believe that additional ANS invasions in the Great Lakes likely would negatively affect the quality of the fishery. Our purpose was to obtain charter captains' opinions and assess their attitudes related to paying for basin separation to reduce the possibility of ANS (primarily Asian carp) introduction in the Great Lakes. Three methods of estimating mean annual WTP were used (Turnbull, Kristrom, and parametric). The Turnbull method provides the most conservative estimate of WTP, establishing a true lower bound. In our study, the Kristrom mean was not statistically different from the parametric mean.

Key findings are as follows:

- Almost 95% of the charter captains supported separation of the GL-MR basins.
- Those who expected that ANS would affect their businesses were willing to pay approximately 78% more per year than those who did not.
- Captains looking to expand their businesses were willing to pay significantly more than those not expecting to expand.
- A significant percentage (18.2%) of captains objected to paying for separation of the GL-MR basins.
- A total of 16.7% of respondents said that they did not have enough information to appropriately determine their WTP, and these respondents were willing to pay 81% less than the mean respondent.

Our results suggest that more education on the costs and benefits of separation of the GL-MR basins is needed. Sea-grant and land-grant Extension as well as other educational organizations and environmental agencies can take these results as a strong signal that stepping up their education efforts on ANS topics among charter captains and very likely other users of the Great Lakes should be a priority now and in the future.

References

Allen, J. E., Bowker, S. F., Stamper, C. E., Owusu-Amankwah, E., & Davis, A. (2014). Resident valuation of Kentucky's Extension fine arts program. *Journal of Extension*, *52*(2) Article 2FEA10. Available at: http://www.joe.org/joe/2014april/a10.php

Allington, A. (2012). *Asian carp and the Great Lakes: Separating the basins (Part 1).* Michigan Radio Newsroom. 91.7 FM Michigan Radio Ann Arbor/Detroit. Retrieved from http://michiganradio.org/post/asian-carp-great-lakes-separating-basins-part-1

Blaine, T. W., & Smith, T. (2006). From water quality to riparian corridors: Assessing willingness to pay for

conservation easements using the contingent valuation method. *Journal of Extension*, *44*(2) Article 2FEA7. Available at: http://www.joe.org/joe/2006april/a7.php

Cameron, T. A., & Huppert, D. D. (1989). OLS versus ML estimation of non-market resource values with payment card interval data. *Journal of Environmental Economics and Management*, *17*(3), 230–246.

Carson, R. (2000). Contingent valuation: A user's guide. *Environmental Science & Technology*, *34*(8), 1413–1417.

Carson, R. (2012). *Contingent valuation: A comprehensive bibliography and history.* Northampton, MA: Edward Elgar Publishing Inc.

Champ, P. A., Flores, N. E., Brown, T. C., & Chivers, J. (2002). Contingent valuation and incentives. *Land Economics*, *78*(4), 591–604.

Dawson, C. P., Lichtkoppler, F. R., Kuehn, D., & Pistis, C. (1995). Great Lakes charter fishing industry: 1973–1994. In J. L. Thompson, D. W. Lime, B. Gartner, & W. M. Sames (Eds.), *Proceedings of the Fourth International Outdoor Recreation and Tourism Trends Symposium and the 1995 National Recreation Resource Planning Conference* (pp. 573–576). Saint Paul, MN: University of Minnesota, College of Natural Resources and Minnesota Extension Service.

Dillman, D. A. (1978). *Mail and telephone surveys: The total design method*. New York, NY: John Wiley and Sons.

Dillman, D. A. (2000). *Mail and Internet surveys: The tailored design method* (2nd ed.). New York, NY: John Wiley Company.

Duhaime-Ross, A. (2014). *America must kill this fish.* Retrieved from http://www.theverge.com/2014/3/21/5533054/asian-carp-american-waterways

García-Llorente, M., Martin-Lopez, B., & Montes, C. (2011). Exploring the motivations of protesters in contingent valuation: Insights for conservation policies. *Environmental Science & Policy*, *14*(1), 76–88.

García-Llorente, M., Martin-Lopez, B., Nunes, P. A. L. D., Gonzalez, J. A., Alcorlo, P., & Montes, C. (2011). Analyzing the social factors that influence willingness to pay for invasive alien species management under two different strategies: Eradication and prevention. *Environmental Management*, *48*, 418–435.

Great Lakes Commission and Great Lakes and St. Lawrence Cities Initiative. (2012). *Restoring the natural divide—Separating the Great Lakes and Mississippi River Basins in the Chicago Area Waterway System.* Retrieved January 30, 2015, from http://www.glc.org/caws/pdf/CAWS-PublicSummary-mediumres.pdf

Halstead, J. M., Luloff, A. E., & Stevens, T. H. (1992). Protest bidders in contingent valuation. *Northeastern Journal of Agricultural and Resource Economics*, *21*(2), 160–169.

Hansen, M. J. (2010). *The Asian carp threat to the Great Lakes*. Testimony to the House Committee on Transportation and Infrastructure Subcommittee on Water Resources and Environment. Great Lakes Fishery Commission. Ann Arbor, MI. Retrieved February 9, 2014, from http://www.glfc.org/fishmgmt/Hansen_testimony_aisancarp.pdf

Haskell, J. E., & Morse, G. W. (2015). What is your library worth? Extension uses public value workshops in communities. *Journal of Extension*, *53*(2) Article 2FEA1. Available at: http://www.joe.org/joe/2015april/a1.php

Hoehn, J. P., & Randall, A. (1989). Too many proposals pass the benefit cost test. *American Economic Review*, *79*(3), 544–551.

Kristrom, B. (1990). A non-parametric approach to the estimation of welfare measures in discrete response valuation studies. *Land Economics*, *66*(2).

Kuehn, D., Lichtkoppler, F., & Pistis, C. (2005). The Great Lakes charter fishing industry: 1973 to 2002. *Fisheries*, *30*(3), 10–17.

Lawrence, T., & Mandal, B. (2016). Valuing Extension programming at the county level. *Journal of Extension*, *54*(1) Article 1FEA3. Available at: http://www.joe.org/joe/2016february/a3.php

Lindner, J. R., Murphy, T. H., & Briers, G. E. (2001). Handling nonresponse in social science research. *Journal of Agricultural Education*, *42*(4), 43–53.

Lindner, J. R., & Wingenbach, G. J. (2002). Communicating the handling of nonresponse error in Journal of Extension research in brief articles. *Journal of Extension*, *40*(6) Article 6RIB1. Available at: http://www.joe.org/joe/2002december/rb1.php

Meyerhoff, J., & Liebe, U. (2006). Protest beliefs in contingent valuation: Explaining their motivation. *Ecological Economics*, *57*(4), 583–594.

Michigan Sea Grant. (2007). Aquatic invasive species in Michigan. Fact sheet 07-704 JD. Retrieved from http://www.miseagrant.umich.edu/files/2012/12/07-704-fs-AIS-MI.pdf

Miller, L., & Smith, K. (1983). Handling nonresponse issues. *Journal of Extension*, *21*(5). Available at: http://www.joe.org/joe/1983september/index.php

Nagle, A., Usborne R., Stone, A., McCullough, D., & Sadof, C. S. (2014). Power hours—Invasive species communication through collaborative webinars. *Journal of Extension*, *52*(2) Article 2IAW1. Available at: http://www.joe.org/joe/2014april/iw1.php

Ohio Sea Grant. (2010). Ohio Sea Grant 2014–2018 strategic and implementation plan. TB-096 Columbus, Ohio. Retrieved from http://ohioseagrant.osu.edu/_documents/publications/TB/TB-096%20Ohio%20Sea%20Grant%20Strategic%20and%20Implementation%20Plan%202010%202014.pdf

Rasmussen, J. L., Regier, H. A., Sparks, R. E., & Taylor, W. W. (2011). Dividing the waters: The case for hydrologic separation of the North American Great Lakes and the Mississippi River Basins. *Journal of Great Lakes Research*, *37*, 588–592.

Turnbull, B. W. (1976). The empirical distribution function with arbitrarily grouped, censored and truncated data. *Journal of the Royal Statistical Society*, *B38*(3), 290–295.

U.S. Army Corps of Engineers Chicago District. (2010). *Great Lakes and Mississippi River interbasin study.* Retrieved January 30, 2015, from http://glmris.anl.gov/aboutstudy/index.cfm

U.S. Army Corps of Engineers Chicago District. (2012a). *GLMRIS—Great Lakes and Mississippi interbasin study*. Retrieved November 6, 2013, from http://glmris.anl.gov/documents/docs/glmris_brochure.pdf

U.S. Army Corps of Engineers Chicago District. (2012b). *Great Lakes charter fishing industry—Baseline economic*

assessment. Chicago, IL: Author.

U.S. Army Corps of Engineers Chicago District. (2014). *GLMRIS Report.* Retrieved January 20, 2014, from http://glmris.anl.gov/glmris-report/

Van Den Berg, H. A., & Dann, S. L. (2008). Evaluation of an adult Extension education initiative: The Michigan conservation stewards program. *Journal of Extension*, *46*(2) Article 2RIB1. Available at: http://www.joe.org/joe/2008april/rb1.php

Vaughan, W. J., Russell, C. S., Rodriguez, D. J., & Darling, A. H. (1999). *Willingness to pay: Referendum contingent valuation and uncertain project benefits* (Reference No. ENV-130). Washington, DC: Inter-American Development Bank: Sustainable Development Department Technical Papers Series.

Venkatachalam, L. (2004). The contingent valuation method: A review. *Environmental Impact Assessment Rev*iew, *24*, 89–124.

Appendix

Select Survey Items

The Corps of Engineers is considering basin separation as a means of combating the transfer of aquatic nuisance species (ANS) between the Great Lakes and the river system connections. Basin separation would reduce the risk of ANS transfer but would not eliminate all transfer pathways. Basin separation could include closure of one or more of the locks in the Chicago Area Waterway System (CAWS). The following questions concern your opinion of these basin separation alternatives.

(1) Do you use the Chicago Area Locks in a typical year? (Please circle response.)

A. YES B. NO

If a physical barrier were erected on the Chicago Area Waterway System, there would be **both positive and negative effects**.

A) During high flow or flood conditions, storm water and/or treated sewage which currently flow toward the Mississippi River **could** remain lakeward of the barrier, potentially causing odors and deterioration of Lake Michigan water quality if water treatment is not improved.

B) Traffic between Lake Michigan and the Mississippi and Ohio River basins **could** be reduced or eliminated.

C) Risk of transfer of ANS between Lake Michigan and the Mississippi and Ohio River basins **could** be reduced.

(19) Please choose a response that best describes how you feel about a basin separation measure that would reduce the risk of transfer of Aquatic Nuisance Species (ANS) but have the possibility of adverse impacts. *(Please check your response.)*

_____ **I support a basin separation** _____ **I am opposed to basin separation.**

[19a] If it was necessary to impose a fee to support your response, what is the most you would be willing to pay **annually** to ensure that your choice is implemented and maintained? (**Please *select one value from the list below that represents the maximum amount you would be willing and able to pay annually to keep the waterways open or closed***.)

A. _____$2,500 to $4,999

B. _____$1,000 to $2,499

C. _____$750 to $999

D. _____$500 to $749

E. _____$250 to $499

F. _____$100 to $249

G. _____$50 to $99

H. _____$1 to $49

I. _____$0

[19b] Please choose the response that best describes your reason for the previous answer (*Please select **only one** response*):

A. _____ I didn't want to place a dollar value.

B. _____ I object to paying.

C. _____ That's what it is worth to me.

D. _____ Not enough information is provided.

E. _____ It's worth more to me, but it's all I can afford to pay.

F. _____ Other reason:

_____

(22) Do you think ANS will impact your business within the next five years?

YES _____ GO TO Question 22a

NO _____ GO TO Question 23

[22a] What percentage decline or increase in revenue do you think the ANS may have on your business in the next five years?

Fill in **the decline in revenue** if any

Percentage **DECLINE** _____%

Fill in **the increase in revenue** if any

Percentage **INCREASE**_____%

Aquatic nuisance species (ANS) are nonindigenous (not native to an area) species that threaten 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.

(23) Do you have plans to change your charter boat business operations over the next 5 years? ***Please check all that apply to your charter activities.***

A. Buy your own charter boat _____

B. Buy/operate a bigger boat _____

C. Buy/operate a newer boat _____

D. Buy/operate an additional boat _____

E. Hire additional charter captain(s) _____

F. Hire additional first mate(s) _____

G. Increase the number of charter trips made per year _____

H. Decrease the number of charter trips made per year _____

I. Branch out into other fishing related businesses _____

J. Quit the charter business _____

K. Expand into multi activity and/or non-fishing charters _____

L. No major changes planned in my charter business _____

M. Increase prices of charter services _____

N. Decrease prices of charter services _____

O. Other, please list _____
