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The Value of Improved Water Quality to Chesapeake Bay Boaters

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Introduction

Despite the fact that it is one of the most important water-dependent recreational activities in the United States, little is generally known about the value of recreational boating and specifically about the effects of water quality on boating value. According to statistics available from the National Marine Manufactures Association, there were approximately 17.4 million boats in use in 2002, and almost 72 million people participated in some form of recreational boating. Voluntary participation of marina owners in Clean Marina programs demonstrates that some industry members recognize that clean waterways are an important facet of the boating experience. However, in a major national assessment of eutrophication in estuaries, boating was not even listed as a potential impaired use due to poor water quality, although boating-dependent uses such as recreational fishing, swimming, and tourism were mentioned (Bricker *et al.* 1999).

In a comprehensive review of outdoor recreation studies from 1968–88, Walsh, Johnson, and McKean (1992) listed five studies on the value of motorized boating and eleven on non-motorized boating. Subsequently, in looking at studies that specifically relate the value of boating to water quality, Freeman (1995) found only two that matched this criterion. Two recent revealed preference studies indicate that boater value may be an important component of total societal benefits from water quality improvement. Lipton and Hicks (1999), using a multinomial logit to model choice of state of principal use by documented vessel owners, demonstrated that the state chosen was significantly affected by the boat owners' perception of overall boating quality in a state. Thomas and Stratis (2002), using a random utility model, determined the welfare loss to boaters of new speed limit regulations designed to protect manatees. While neither study directly address water quality, the results indicate that boaters respond in significant ways to changes in the attributes of their boating experience.

We used the opportunity of a recreational boating economic impact study funded by the Maryland Department of Natural Resources (MDNR) and the Marine Trades Association of Maryland (MTAM) to conduct a pilot study on the value of water quality improvements to recreational boaters (Lipton 2001). Limited resources and the constraint of a mail survey necessitated a contingent valuation study with a relatively simple format (see Whitehead, Haab, and Huang 1998), as opposed to the

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more complex and expensive approach such as that suggested by the NOAA Panel on Contingent Valuation (Arrow *et al.*, 1993). In particular, the willingness-to-pay for improved water quality was elicited with an open-ended question as part of the mail survey, as opposed to a referendum format elicited in an in-person interview. Open-ended questions have fallen out of favor with many practitioners of contingent valuation (Haab and McConnell 2002), although any of the payment elicitation methods—open-ended, dichotomous choice, payment card, *etc.*—are subject to their own set of issues as to how the elicitation method affects the response and how the responses are interpreted by the researcher (Halvorsen and Saelensminde 1998).

Contingent Valuation Survey of Boating Water Quality

We assume that boaters maximize their utility from boating trips taken, conditioned on their perception of the water quality they experience, subject to a budget constraint:

$$u(b, q_0, z) \quad \text{s.t. } m = p_b b + z, \tag{1}$$

where $u()$ is the utility function, b is the number of boating trips, q_0 is the perception of water quality, z is a composite of all other goods, m is the budget constraint, and p_b is the cost of boating normalized on the price of the composite good. The indirect utility function can be written as $v(p_b, q_0, m)$. The compensating variation is the amount of money (y) that satisfies:

$$v(p_b, q_0, m) = v(p_b, q_1, m - y), \tag{2}$$

where q_1 is the boater perception of improved water quality.

Questions for the survey were developed in consultation with a panel of eight industry experts affiliated with the MTAM. The boaters surveyed were asked to provide a percentage breakdown of their boating activity in four categories: cruising, fishing, swimming/skiing/tubing, or other activity. They were also asked what percentage of their boating activity was conducted on the Chesapeake Bay or its tributaries as opposed to other water bodies such as inland lakes, coastal bays, or the Atlantic Ocean. In order to focus on Chesapeake Bay water quality issues, only boaters who used their boats 50% or more of the time in the Chesapeake Bay and its tributaries were included in the following analysis.

Boaters were presented with an ordinal ranking of water quality on a scale of 1 to 5 in relation to the extent it impacted their boating activities. The text of the water quality ranking question with potential responses is given below:

Q9. Please rate the water quality related to your boating and boating-related activities: (Note: Water quality refers to level of pollution, not to natural nuisances such as jellyfish.)

1. Poor, my boating activity is severely curtailed due to water quality conditions.
2. Fair, my boating activity is restricted and I avoid many areas.
3. Good, there are areas I actively avoid, but with some effort, I can do whatever I want.
4. Very good, I rarely have to worry about water quality conditions.
5. Excellent, I have no concerns about water quality where and whenever I go boating.

To determine what it was about the water quality that concerned boaters, they were asked whether or not they altered their boating behavior and activities due to water quality conditions and what the primary concern was.

Q10. If you avoid some areas due to your concerns about water quality, what issue concerns you THE MOST in those areas:

1. I do not avoid areas due to concerns about water quality.
2. The water is unpleasant for swimming and other contact, but does not pose a health threat.
3. I'm afraid that someone in my party will get sick from contacting or swallowing the water.
4. I'm concerned about long-term health effects from toxic chemicals that may be in the water or sediments.
5. I'm concerned that *Pfiesteria* or some harmful algal bloom is likely to be present in those waters.

The contingent valuation question, which required an open-ended response, was worded as follows:

Q11. Suppose Maryland was able to implement a new pollution-reduction program that would improve the water quality one step from how you ranked it on Q9, *e.g.*, an improvement from 3-Good to 4-Very good. What is the maximum amount you would be willing to pay per year in state or local taxes for such a program?

Surveys were sent to a random sample of 2,510 out of 220,800 records from the boater registration database maintained by the MDNR. Overall, in four waves of data collection, 1,163 completed surveys were collected for a response rate of 50%.

Survey Results

We estimated a censored regression, or tobit model (Tobin 1958), that takes into account the type of boater (*i.e.*, power or sail) the perception of water quality, and the concern about water quality effects on health. A censored model is used because negative responses to the contingent valuation question are not realized. In the tobit model:

$$\hat{y}_i = x_i'\beta + \varepsilon_i \tag{3}$$

$$y_i = \begin{cases} \hat{y}_i \ if \ \hat{y}_i > 0 \\ 0 \ if \ \hat{y}_i \leq 0 \end{cases},$$

where y_i is the observed contingent valuation bid by individual i, $\hat{y}_i$ is the latent measure, x_i' are the independent variables, β is a vector of parameters, and ε_i is the error term distributed as independent normal with mean 0 and variance σ^2.

The explanatory variables in the regression model are a dummy variable for whether or not the boat is trailered or kept in water at a marina or residence, a dummy variable for whether the vessel is a sail or powerboat, and a set of variables that represent a cross between the inverse of the water quality rating with a set of dummy variables regarding the type of concern about water quality. Demographic variables, such as income levels and education, were not collected as part of the expenditure survey, so they were not available for inclusion in the model. The expectation is that boat owners who keep their boats in the water during the season (non-trailered) will have a higher willingness-to-pay for a general improvement in water quality than trailered boat owners who have more flexibility in choosing areas to use their boats. We have no *a priori* expectation about the influence of power or sail on the willingness-to-pay, but included this because we anticipate a difference in preferences between the two groups. The set of variables that cross water quality rating with the type of health concern are expected to increase willingness-to-pay for water quality improvements, as the severity of concern about health increases relative to the poorer they believe the water quality to be. The null case for comparison of these latter parameters is for the boaters who indicated that water quality had no impact on their boating behavior. Colinearity between type of health concern and ranking of water quality necessitated combining these effects in one term rather than looking at them separately. Thus, boaters who had major health concerns from contact with water tended to rank water quality lower.

Results from the regression analysis are given in table 1. All estimated parameters had the expected sign and were significant at the 95% confidence level. Sailboaters had a significantly higher willingness-to-pay for improved water quality than power boaters, and as expected, owners of boats kept in the water during the season had higher willingness-to-pay for improvements in water quality than boat owners who mainly trailered their boats. Willingness-to-pay for water quality improvements were greatest amongst those boat owners who were concerned about exposure to toxic chemicals, whereas there was not a significant difference between those concerned with appearance of the water or short-term illness issues. The lowest willingness-to-pay for water quality improvements was among those owners who indicated they were concerned about health effects from *Pfiesteria* or harmful algal bloom exposure.

Table 2 summarizes the willingness-to-pay by type of boater for an improvement in Chesapeake Bay water quality. These numbers are extrapolated to statewide figures after adjusting for multiple boat ownership and areas where boats are used. For sailboats, in-water power boats, and trailered power boats, the total annual willingness-to-pay for a one-step improvement in water quality was approximately $7.3 million. The present value of the willingness-to-pay for a relatively permanent water quality improvement, assuming a 5% discount rate, is approximately $146 million.

Table 1
Parameter Estimates from Tobit Regression

Parameter	Estimate	Standard Error
Intercept	–66.7504	17.6539**
In-water boat	56.1019	20.3185**
Sailboat	43.6381	19.3502**
Unpleasant X WQR^{-1}	174.5405	38.7345**
Illness X WQR^{-1}	176.3481	63.2389**
Toxic X WQR^{-1}	191.2109	48.2093**
Pfiesteria X WQR^{-1}	179.5581	63.1095**
N = 755		
Log Likelihood	–3,303	

Notes: WQR^{-1} = inverse of water quality ranking, ** indicates significance at 95% confidence level.

Table 2
Average and Total Willingness-to-pay from Tobit Model
for Improvements in Water Quality By Type of Boat Owned

	Number	Mean Willingness-to-Pay	Total Willingness-to-Pay
Sailboat owners	12,250	$93.26	$1,142,398
Trailered powerboat	69,431	$30.25	$2,100,294
In-water powerboat	52,513	$77.98	$4,094,948
TOTAL	134,194	$54.68	$7,337,640

Note that this amount only includes the value to boat owners, and not family members and others that also engage in boating. The total value may also be higher because the sample only includes boat owners and not potential boat owners who would choose to participate in boating if they perceived improvements in water quality conditions. Finally, the boaters excluded from the sample who use their boats less than 50% of the time in Chesapeake Bay might have a positive willingness-to-pay, as would boaters registered in other states that use the Chesapeake Bay for some part of their boating activities.

Our results can be compared to Thomas and Stratis (2002) who found that annual compensating variation for boaters ranged from $353–$424, depending on the marginal wage rate, for reducing access to boating from 37 sites to 19 due to speed limit changes. Although their figures are higher than the $55–$93 range we obtained for water quality improvements in Chesapeake Bay, the average number of trips taken per boater is about twice as high in their Florida sample compared to the Maryland sample.

Conclusions

An open-ended contingent valuation experiment has provided reasonable evidence that boaters are willing to pay for improvements in water quality. The improvement in water quality is based on the boaters' current perceptions regarding water quality levels and the type of impact that water quality has on their boating activities. In general, the poorer the boater feels current water quality is, the more they are willing to pay to see an improvement in that quality. Additionally, the more serious the concern about the impacts of water quality on health, the more the boater is willing to pay for an improvement.

Water quality, the focus of much of the restoration activities for the Chesapeake Bay, is a public good that mostly serves as an input to the production of goods and services valued by Bay users. Boating activity is one of the more obvious and potentially measurable of these services, yet it has not been studied in terms of boater response to changes in water quality. The evidence presented here is that water quality does impact the enjoyment of boating and that boaters would benefit by a significant amount if it were to improve. Water quality improvements would also have benefits to other Chesapeake Bay users and non-users as well, and these benefits would have to be accounted for in a complete cost/benefit accounting of any policy or program that addresses water quality improvements.

Directed studies on water quality and boating, as opposed to the limited study described here, are needed to obtain better information about boater perceptions of water quality and their willingness-to-pay for improvements. Hopefully, the results obtained here will help convince others of the need to invest in more rigorous studies on the value of boating that include in-person interviews and alternative elicitation formats with appropriate testing. Additionally, revealed preference studies of boater behavior similar to Thomas and Stratis' (2002) prediction of boater response to changes in the boater speed limit can provide useful information regarding a neglected component of the value of water quality.

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