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What Will Parents Pay for Hands-on Ocean Conservation and Stewardship Education?

ABSTRACT

Supported by the National Marine Sanctuary Foundation, the Ocean Guardian School (OGS) program is a federally funded grant program coordinated by NOAA's Office of National Marine Sanctuaries. OGS supports the educational goals of national marine sanctuaries (NMS) by funding hands-on ocean conservation and stewardship programs in both public and private schools. Schools apply for grants (up to $4,000) to implement school- or community-based conservation projects to educate students, while contributing to the health and protection of local watersheds and the world's ocean. This study is the first to estimate the value that parents have for their child's participation in an ocean conservation and stewardship program. Using a contingent choice survey, changes to student behaviour, parents' support for the OGS program and the non-market economic value to parents of the six program attributes are estimated.

The National Oceanic and Atmospheric Administration (NOAA) is an agency that enriches life through science. Our reach goes from the surface of the sun to the depths of the ocean floor as we work to keep citizens informed of the changing environment around them.

Within the agency of NOAA is the Office of National Marine Sanctuaries, a network of 13 national marine sanctuaries and two marine national monuments, encompassing more than 600,000 square miles of ocean and Great Lakes waters. We seek to protect the extraordinary scenic beauty, biodiversity, historical connections and economic productivity of these areas so they may continue to serve as the basis for thriving recreation, tourism and commercial activities that drive coastal economies. As stewards of these places, through domestic and international partnerships, we help ensure a healthier ocean, now and for future generations.

HIGHLIGHTS

- 88.5% of parents support their child's participation in the program. Only 0.4% did not support the program.
- Of the ten program benefits received by students participating in OGS, 86.1% of parents noted their child received at least one of the benefits.
- 72.2% of parents selected "increased responsibility towards the environment."
- For students, the greatest change involved "talking to others about ways to improve the environment": 35.6% were doing it before the program and 65.9% after participating in the program.
- Generally, the benefits of OGS exceed the costs.
- The most valuable program component was habitat, at $58.52 per child per year. Habitat includes learning about ocean-friendly gardens and habitats and participating in projects to create or improve school gardens and yards with eco-friendly practices and methods such as planting native species, reducing run-off and installing rain barrels.
- OGS can be designed so that benefits exceed the costs.

INTRODUCTION

The Ocean Guardian School (OGS) program is a federally funded grant program coordinated by NOAA's Office of National Marine Sanctuaries and supported by the National Marine Sanctuary Foundation. OGS supports the educational goals of national marine sanctuaries (NMS) by funding hands-on ocean conservation and stewardship programs in both public and private schools. Schools apply for grants (up to $4,000) to implement school- or community-based conservation projects to educate students while contributing to the health and protection of local watersheds and the world's ocean. As part of the grant's requirements, schools must connect their funded projects to one of the established five Ocean Guardian "project pathways." These pathways include hands-on projects for students. The pathways are:

- **Refuse/Reduce/Reuse/Recycle/Rot:** Students learn how to reduce waste within the school and/or community.
- **Marine Debris:** Students focus on how single-use plastics (such as plastic water bottles, bags, straws, flatware, etc.) make their way into our waterways and impact the health of marine environments.
- **Watershed Restoration:** Students focus on the watershed–ocean connection and how restoring the watershed helps to protect the ocean.
- **Schoolyard Habitat/Garden:** Students design/install/maintain ocean-friendly gardens and/or habitats with an emphasis on native/low-water plants, chemical-free gardening techniques, rain catchment systems, low-water irrigation systems, etc.
- **Energy Use and Ocean Health:** Students learn about how fossil fuel-based energy use impacts the health of the world's oceans.

The program monitors measurable outputs such as pounds of trash removed, number of recycling bins installed, number of reusable bags and bottles distributed to replace single-use bags and bottles, square feet of non-natives plants removed from school community sites, and the number of native perennials and fruit trees planted. Despite these measurable outcomes, the economic benefits to parents of children in the program have not been quantified.

Until this study, the value parents place on hands-on ocean conservation and stewardship education has been unknown. Using a contingent choice survey, the value parents have for each of the program pathways were estimated. This study is unique in that, to date, only one study has sought to use stated preference techniques to estimate the value of educational programs. Haefele et al. (2016) estimated the value to respondents of National Park Service (NPS) educational programs.[1] However, unlike this study, Haefele et al's study did not estimate the marginal willingness to pay for specific attributes of educational programs. Further, no monetary value estimates for ocean conservation and stewardship education were found in the literature.

SURVEY DEVELOPMENT AND IMPLEMENTATION

They key component of the survey was the contingent choice questions.[2] Although this method has not been previously applied to education, its vast application to business marketing, healthcare and the environment justifies its application to education. Utilising this method allowed us to estimate parents' marginal willingness to pay for various features and opportunities the OGS program has to offer. Given the design of the OGS program, marginal values are more useful for a cost–benefit analysis. The schools are required to implement at least one of the OGS pathways, but not all five of the education pathways. Thus being able estimate the value for marine debris or watershed restoration in isolation is a more practical result.

The survey included seven attributes, in addition to the price attribute. Five of the attributes were the ocean guardian pathways: refuse/reduce/reuse/recycle/rot, marine debris, watershed restoration, schoolyard habitat/garden, and energy use and ocean health. Each of these attributes had two levels – either the student received hands-on education and experience or they did not. The sixth attribute was the level of involvement with persons outside of their grade level. This attribute had three levels: low (the student interacts with students and teachers in their grade), medium (the student interacts with students and teachers in their grade and other grades) and high – the student interacts with students and teachers in their grade and other grades and with local community actors such as small businesses, non-profits or local government officials.

Figure 1. Ocean Guardians Programme monitoring 2017, Photograph: Claire Fackler, NOAA.

Price was the seventh attribute and had six levels: $0, $20, $40, $70, $110, and $175. The method of payment would be through additional school supply and field trip costs assessed annually for each student. The dollar

Table 1. Variables Used and Number of Levels

Ocean Guardian Program (values)	Status Quo Definition (and value)	Improvement Definition (and value)
Chosen2 (0,1)	Dependent variable – respondent chooses status quo (0)	Dependent variable – respondent chooses an improvement to the status quo (1)
Asc (0,1)	Alternative specific constant (0)	Alternative specific constant (1)
restoration[1] (0,1)	Does not receive restoration education and hands-on experience (0)	Learning about local watersheds and participating in projects to improve the local watershed, such as removing invasive species, planting native species or improving fish habitat (1)
habitat[1] (0,1)	Does not receive habitat education and hands-on experience (0)	Learning about ocean-friendly gardens and habitats and participating in projects to create/ improve school gardens and yards with eco-friendly practices and methods such as planting native species, reducing run-off, installing rain barrels (1)
energy[1] (0,1)	Does not receive energy education and hands-on experience (0)	Learning about how fossil fuel-based energy use impacts the ocean; participating in projects to reduce energy use and/or implementing renewable energy projects such as wind or solar (1)
recycle[1] (0,1)	Does not receive recycling education and hands-on experience (0)	Learning how to reduce waste and implement programs to reduce their waste within the school (1)
marine debris[1] (0,1)	Does not receive marine debris education and hands-on experience (0)	Learning how to reduce one-time use plastics (such as plastic water bottles) and participating in projects to reduce trash entering the ocean (1)
involve_med (0,1)	Your child would interact with students and teachers in their grade, as they normally do (0)	In addition to interacting with students and teachers in their grade, your student would also interact with *students and teachers in other grades* (1)
involve_high (0,1)	Your child would interact with students and teachers in their grade, as they normally do (0)	In addition to interacting with students and teachers in their grade and other grades, your student would also interact with *local community actors,* such as small businesses, non-profits or local government officials (1)
Cost ($20, $40, $70, $110 or $175)	Free – $0	$20, $40, $70, $110 or $175 This amount would be paid by you through additional school supply and field trip costs next school year

1 A value of 0 represents the status quo and means that this child does not receive this educational component in school

amounts were determined by looking at the total grant amounts awarded to each school, divided by the number of students exposed to OGS at each school. This gave a range of dollar values that were then used to determine the price attribute levels.

A full factorial experimental design resulted in 2^5*3*6 =576 possible combinations. Consequently, a fractional factorial design was used. The SAS macros, 'choiceff' and 'mktex' were used to develop an orthogonal and balanced design.[3] The resulting design assigned five choice questions to each respondent. The status quo, no pathways or interactions outside the student's grade level, with a cost of zero was always given to the respondent. In addition to the status quo, respondents could choose from two alternatives in each choice question.

The survey was finalised in March 2016 after receiving approval from the Office of Management and Budget. Prior to final approval, the survey was reviewed by several staff members involved in OGS and some staff members who were not familiar with the program. Additionally, the survey was translated to Spanish, at the request of several OGS teachers.

The survey was implemented in April and May 2016. ONMS utilised OGS teachers at each participating school. The schools surveyed were located in the state of California. The OGS teacher at each school sent e-mails with a link to complete the survey online, or sent paper versions of the surveys home to parents to complete. An initial contact letter to parents, an initial survey letter to parents and a reminder survey letter to parents enclosed with the survey were sent to the parents over the course of two weeks. The final response rate of schools that surveyed parents was 19.7%.

SURVEY RESULTS

Although estimation of the non-market value of the OGS program was the primary goal of this survey, there were other research questions: what are the preferences parents have for environmental education programs, and are students changing their behaviour to be more environmentally conscious?

This study found 88.5% of parents support their child's participation in the OGS program, while 7.4% of parents were unsure. Parents reported the benefits they believed their child was receiving. Six was the median number of benefits and skills selected by parents. The majority of parents (86.1%) felt their child received at least one benefit from the OGS program, and 12.2% of participants selected every benefit from the list. A small minority, 2.2%, selected "No benefits." The most frequently chosen benefits and/or skills acquired by the OGS program were "Increased responsibility towards the environment" (72.2%), "Increased understanding of how people interact with the environment" (66.7%) and "Positive environmental change" (66.3%). Other notable benefits included "Development of self-esteem and self-confidence" (37.4%) and "Experience working with peers as part of a team" (55.9%).

The OGS program seeks to promote ocean conservation and stewardship. One way to accomplish this goal is to have lasting impacts on the behaviour of students. Five behaviours were measured before and after exposure to OGS: recycling, minimising water use, minimising single-use plastics, encouraging others to make more eco-friendly decisions, and talking to others about ways they can improve the environment. For most of the categories, approximately 22% of students' behaviours

for each category were positively influenced. This means 23.7% of parents thought their child was either now recycling or recycling more; 22.2% of parents reported a positive change towards using less water; 21.5% of parents reported their children were making improvements towards using less single-use plastics; and 21.9% of parents felt their children had improved in the area of encouraging others to make more eco-friendly decisions.
The largest change was that 65.9% of students are either now talking to others about ways they can improve the environment, or are talking to others more. Parents reported their students were talking to family, friends and outside community members and using social media to tell others how they can improve the environment.

WILLINGNESS TO PAY MODELS

The general form of the model used is:

$$V_{ij} = ASC + \Sigma\beta_k X_{kn}$$

Where *i* = the individual,

j = option,

V_{ij} = the observable component of latent utility that consumer i has for option j,

β_k = the coefficient for the kth attribute, and

X_{kn} = the value of the kth attribute in choice n.

This equation form was applied to three econometric models that were used to develop the results. The multinomial logit (MNL), nested multinomial logit (NML) and mixed logit or random parameters (RP) models were each estimated. The results presented here are the average of the three models. The models were averaged to account for the strengths and weaknesses across each of the various techniques.

Although the MNL failed to pass the Hausman-McFadden independence of irrelevant alternatives (IIA) test, it should not prohibit the model from being used provided the alternatives "can plausibly be assumed to be distinct and weighted independently in the eyes of each decision maker."[5] Given the survey was intentionally developed to be balanced and orthogonal, it is reasonable to accept this model specification. The MNL and RP were also estimated. One of the benefits of using these two models is they allow for heterogeneity and address the independent and identically distributed (IID) violation of constant variance.[6]

In addition to the above attributes being independent variables in the model, an alternative specific constant (ASC) was also used in the modeling. The ASC is a new attribute that takes the value of 1 for the alternatives and zero otherwise. In other words, for the option of status quo, where all pathway variables and the interaction variable takes on the value of zero, the ASC also is coded as zero. The ASC takes up variation in the choices that cannot be explained by the attributes or socioeconomic variables.[7]

The resulting models are presented below. For further details of other model specifications, readers are directed to the Technical Appendix to this research.[8] STATA Version 14 was used to estimate all models. Although other variables were tested – such as whether or not parents thought it was important to protect wildlife and the level of impact the parents thought the project had on the environment – they were not significant in a majority of the specifications, and thus not included.

Further, the medium level of involvement (the student interacts with teachers both inside and outside of their grade) was not significant. Only the high level of involvement was significant and included in the final model specifications seen here.

Table 2. MNL Final Model Specification

Variable	Coefficient[1]	Standard Error	Z	P-Value	95% Confidence Interval	
Asc	0.7372	0.2227	3.3100	0.0010	0.3006	1.1737
restoration	0.3745	0.0881	4.2500	0.0000	0.2018	0.5473
habitat	0.4968	0.0820	6.0600	0.0000	0.3361	0.6575
energy	0.3104	0.0819	3.7900	0.0000	0.1498	0.4710
recycle	0.2083	0.0879	2.3700	0.0180	0.0360	0.3807
debris	0.2130	0.0801	2.6600	0.0080	0.0561	0.3699
involve_high	0.1615	0.0888	1.8200	0.0690	-0.0125	0.3355
cost	-0.0092	0.0018	-5.2100	0.0000	-0.0126	-0.0057
observations	2,901					
clusters	203					
pseudo log likelihood (full)	-932.926					
pseudo Log likelihood (null)	-1029.30					
Chi-square (24)	118.14					
Chi-square Significance	0.00					
pseudo R^2	0.122					
Adj. pseudo R^2	0.084					

1. Variables in bold are statistically significant at a 95% confidence level or higher.

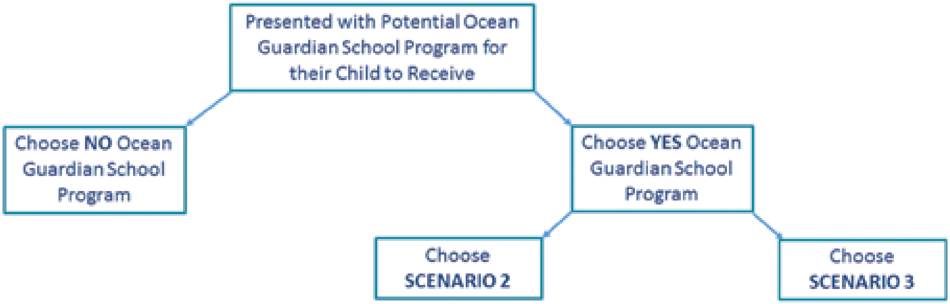

Figure 1. Nested Structure.

The nested logit model is commonly used when the IIA is violated, as in this case. The NML is a generalised version of the MNL that repeatedly applies the model in a tree structure reflecting the assumed correlation causing violations to the IIA.[9] The tree structure used in this model is shown below. The initial choice the parent makes is whether to choose the OGS program, and if they choose it then they must then choose the mix of OGS program pathways the child receives.

Table 3. Nested Logit Tree Structure
NML Specification

Variable[1]	**Coefficient**	**Standard Error**	**z**	**P-Value**	**95% Confidence Interval**	
asc	0.3789	0.4112	0.9200	0.3570	-0.4271	1.1849
restoration	0.4964	0.1719	2.8900	0.0040	0.1596	0.8333
habitat	0.6457	0.1884	3.4300	0.0010	0.2764	1.0151
energy	0.3990	0.1362	2.9300	0.0030	0.1320	0.6660
recycle	0.2718	0.1349	2.0200	0.0440	0.0075	0.5362
debris	0.2843	0.1217	2.3400	0.0190	0.0458	0.5228
involve_high	0.1976	0.1211	1.6300	0.1030	-0.0398	0.4350
cost	-0.0108	0.0027	-3.9200	0.0000	-0.0162	-0.0054
Dissimilarity parameters						
/status_quo_tau	1.0000					
/other_tau	1.3431	0.3798			0.5986	2.0876
observations	2,901					
clusters	203					
pseudo log likelihood (full)	-932.30					
Chi-square (22)	80.89					
Chi-square Significance	0.00					

1. Variables in bold are statistically significant at a 95% confidence level or higher.

The RPM is also used in the case of an IIA assumption violation and when heterogeneity in attributes might exist. All the attributes are treated as random, except for the cost variable, which was considered a fixed parameter.

Table 4. RP Specification

Variable[1]	**Coefficient**	**Standard Error**	**z**	**P-Value**	**95% Confidence Interval**	
Mean						
asc	0.8024	0.3061	2.6200	0.0090	0.2025	1.4024
restoration	0.7568	0.1940	3.9000	0.0000	0.3766	1.1370
habitat	0.9845	0.1842	5.3400	0.0000	0.6234	1.3456
energy	0.5357	0.1664	3.2200	0.0010	0.2095	0.8618
recycle	0.2979	0.1980	1.5000	0.1320	-0.0902	0.6859
debris	0.4294	0.1701	2.5200	0.0120	0.0960	0.7627
involve_high	0.566963	0.1763	3.2200	0.0010	0.2214	0.9125
cost	-0.0164	0.0023	-7.2300	0.0000	-0.0209	-0.0120
Standard Deviation						
restoration	1.6705	0.2198	7.6000	0.0000	1.2398	2.1012
habitat	1.5840	0.2130	7.4400	0.0000	1.1666	2.0015
energy	1.1221	0.2370	4.7400	0.0000	0.6576	1.5865
recycle	1.7403	0.2436	7.1400	0.0000	1.2628	2.2177
debris	1.3951	0.2277	6.1300	0.0000	0.9488	1.8414
involve_high	0.610465	0.3756	1.6300	0.1040	-0.1258	1.3467
observations	2,901					
pseudo log likelihood	-837.92					
Chi-square (22)	190.01					
Chi-Square Significance	0.00					

1. Variables in bold are statistically significant at a 95% confidence level or higher.

In all models, the cost variable was statistically significant. Further, parents are willing to pay for their student to receive the energy, debris, restoration and habitat pathway. Recycling was significant at the 95% level in all models except the RP. Although the high level of involvement (with community actors outside of the school) was not significant at the 95% level for all models, it was significant at the 90% level in all models.

RESULTS

The results are more meaningful when they are translated into dollar values. The marginal willingness to pay of each attribute can be calculated using the following equation:

$$\text{Part-worth} = -\,((\beta_{\text{non-marketed attribute}} / \beta_{\text{monetary attribute}})$$ [10]

Using this equation, and averaging the models, Table 5 presents the marginal willingness to pay for each attribute as it changes from the status quo to receiving the pathway or involvement.

Table 5. Average Willingness to Pay Across Selected ML, NLM, RP Specifications

	Status Quo to Receive Education with High Interaction
asc	\$52.78
restoration	\$44.79
habitat	\$58.52
energy	\$34.26
recycle	\$21.41
debris	\$25.50
involve_high	\$25.48

In all the models, the highest valued attributed was habitat: learning about ocean-friendly gardens and habitats and participating in projects to create/improve school gardens and yards with eco-friendly practices and methods such as planting native species, reducing run-off and installing rain barrels. The averaged willingness to pay is \$58.52 per student for the year. The second highest valued attribute was restoration: learning about local watersheds and participating in projects to improve the local watershed. The annual value to parents for this education pathway is \$44.79.
The information estimated here can be used in a cost-benefit analysis of the program. The costs of the program used are the grant amount. (The cost here does not include in-kind contributions that may be made by the school or teachers.) The costs per student vary, based on the grant amount the school receives and the number of students participating in the program at each school. The average cost per student ranges from \$12.11 to \$56.64. In all cases, if the habitat pathway is offered to students, benefits exceed costs. It is also possible to create a mix of pathways (energy and debris or high involvement with energy) so that the benefits exceed costs.

CONCLUSIONS

Based on the non-market value alone, parents are willing to pay for their child's involvement in the program. The value they place on their child's participation exceeds the cost of the program. Given that the majority of the funding for the Ocean Guardian School program is supported by taxpayer dollars via the Bay Watershed Education and Training program to support meaningful watershed educational experiences, this research demonstrates that the Ocean Guardian School program can be designed so that benefits to the public exceed public costs. Once considerations of the economic impacts and the value of the students' projects are included, it is likely the benefits will further exceed costs.

Further, this project supports providing environmental education to groups that are typically underserved and underrepresented in the sciences. Forty-four percent of the OG school's surrounding populations identify as a race other than white, while 31.2% of the OG school's surrounding populations identify as Hispanic or Latino. Further, many of the schools that participate in the OGS program are Title 1 schools (44.8% who have high percentages of students that come from low-income families.

This research focuses solely on the non-market values of the Ocean Guardian School program. It does not seek to quantify the market impacts of the program (such as how the associated spending on the program leads to jobs, output, and income and value-added. Nor does it seek to quantify the market value of the projects the students participate in, such as removal of invasive species, planting gardens, reducing energy consumption, reducing single-use plastics or planting native species. All of these activities create value to the community and local watersheds. More research and analysis is needed to quantify these economic contributions of the program.
In the spring of 2018, a project to estimate the equivalent market value of the students' work is planned. This work will consider the market rate and costs for the projects the students complete; in other words, if a company or business was hired to complete the work, what would that cost?

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