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# Valuing US Marine Habitats: Fantasy or Fact?

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## Abstract

Data generated by a direct choice experiment with over 1,000 US residents was used to estimate their mean willingness to pay for maintaining or enhancing future use or option value, existence and indirect use values. We term these three values the *fantasy value* of marine habitats, to mimic what some consider these values to be. Iconic fish taxa were used as proxies to represent coral reef, seamount, estuarine and other marine habitats, so that the mean willingness to pay could be apportioned to the various habitats. Participants were willing to accept a mean increase in the price of fish of between $1.31/pound ($2.88/kg) for salmon to $8.58/pound ($18.88/kg) for shrimp. The resulting total fantasy values for each of the habitats, based on the mean willingness to pay, ranged from $511/km$^2$ for seamounts to $5695/km$^2$ for estuaries. These values are of the same order of magnitude as the direct use values that were estimated as part of a larger study, and they provide further justification for careful management of these habitats

Keywords: contingent valuation; direct choice; total economic value; willingness to pay

## Introduction

Recent US studies such as the Pew Ocean Report (Pew Ocean Commission 2003) and the Presidential Oceans Commission (U.S. Commission on Ocean Policy 2004) have emphasized the importance of marine habitats for delivering ecosystem services with accompanying social and economic benefits to the American people. These benefits hold both market and non-market values. In addition, the demand for goods and services derived from marine ecosystems is predicted to continue to rise, and therefore the decisions on how to allocate finite marine resources must be based on a sound economic understanding of current and option (future) value of marine habitats, both market and non-market.

The current and option values (and especially the non-market values) of marine habitats such as coral reefs, estuaries and seamounts are not well understood. While specific habitat studies have been conducted on the values of coral reefs (Cesar and Chong 2004), mangroves (Ruitenbeek 1994) and estuaries (Robinson 2001), these and other studies (Ledoux *et al*. 2001) focused on market values. They have dealt primarily with direct use values based on specific areas and did not capture non-market or non-use values such as indirect use, existence and option values (which are collectively termed *fantasy values* in this study). Many studies have focused on specific habitats such as coral reefs, which are globally threatened and hold considerable charismatic interest for researchers and users (Cesar and Chong 2004). In addition, few studies have considered the values of multiple habitat types in a single study. This makes comparisons between habitat values difficult, since the estimated values in single habitat studies are based on different sampling frames and questions.

Estimating non-use values such as existence and option use values for natural resources is challenging (Constanza *et al*. 1997; Howarth and Faber 2002; Loomis *et al*. 2000). Chee (2000) summarized contemporary economic valuation techniques into four groups: production function analysis, replacement cost, travel cost and hedonic pricing. Cesar and Chong (2004) also included damage cost techniques in their review of valuation techniques for coral reefs. Some of these techniques, which include production function analysis, replacement cost and damage cost, are directly and easily applied to valuing marine habitats, while others such as travel cost and hedonic pricing are not as easily applied or as relevant. In marine systems, especially those that are further offshore or unrelated to people's experiences such as deep-water reefs and seamounts, estimating indirect and fantasy values is an even more difficult task. The currently used methods have been criticized for double counting (El Serafy 1998), poor response reliability and validity, and the actual willingness of the respondents to pay the amounts indicated (Loomis *et al*. 2000).

New approaches are evolving and existing ones are expanding to address some of the above criticisms faced by the currently used techniques (Ledoux *et al*. 2001). Many new methods used in natural resource valuation are drawn from marketing techniques such as discrete choice conjoint experiments and modified contingent valuation studies. Cesar and Chong (2004) consider contingent valuation methods to be the most commonly used valuation technique to estimate the non-use value of coral reefs.

A valuation study conducted in late 2004 estimated the direct, indirect and fantasy values of marine habitats in the continental United States and Alaska. This paper presents the study's estimates of the fantasy value for major marine habitats using discrete choice conjoint experiments and a contingent valuation study associated with major marine habitats in the continental United States. The overall indirect use, option use and existence values for marine habitats in general were also investigated using a modified contingent valuation technique. The fantasy values of estuaries, coral reefs, seamounts, deepwater and other habitats were estimated at US$5,694, $1,211, $511and $623 per $km^2$, respectively.

## The Concept of Marine Ecosystem Fantasy Values

The term *fantasy* can refer to "fiction featuring imagery world and magical or supernatural event" (Simpson and Weiner 1993). Some economists and policy makers consider estimating intangible values such as indirect, option, existence and bequest values impossible and hold it that any estimate is a fantasy estimate. In this study, fantasy value refers to all of the values from marine ecosystems that exist but not traded in the market. We choose this term ironically, to make the point that even though these values are not traded in the market and could be considered intangible, they are actually real. Many people fantasize about how they might use these marine habitats, or how the habitats may be used in the future by them or future generations with real consequences in terms of costs and benefits traded in the market.

In light of the above reasoning, the fantasy value includes (i) indirect use value, (ii) option value, (iii) bequest value and (iv) existence value. *Indirect use* value is value that is not directly traded in the market. The potential that the ecosystem will provide currently unknown valuable goods and services in the future is known as *option value*. *Bequest value* captures the willingness to pay to preserve a resource for the benefit of one's descendants (future generations). *Existence value* is the value conferred by humans on the ecosystem regardless of its use value. An environmental good may be valuable merely because one is happy that it exists, quite apart from any future option to consume it, visit it or otherwise use it. This value may arise from aesthetic, ethical, moral or religious considerations.

## Method

### *Survey Design*

The estimation of the fantasy values of marine habitats is part of a larger valuation study that is described in detail in Sumaila *et al.* (in prep.). The online survey design with a discrete choice conjoint experiment, described more fully in Alder *et al.* (in prep.), was used to capture willingness to pay (WTP) information for residents of the continental United States, and it was also used to calculate the value of specific marine habitats in the United States. A discreet choice conjoint experiment was designed around seven iconic taxa that were of high value or that were easily recognized by the residents of the United States and that were found in one or more of the marine habitats included in the valuation study. Sawtooth software (www.sawtoothsoftware.com) was used to apply the discrete choice experiment to respondents. In addition to the discrete choice conjoint experiment, the survey included questions on the overall willingness to pay, the state of marine resources and habitats, consumption, visitation and the use of marine and coastal areas as well as demographic information.

*Willingness to Pay*

Willingness to pay was measured by increasing the retail price of fish and shifting tax dollars from funding non-essential programs to funding programs that ensured better management of the iconic fisheries and associated habitats. Respondents indicated whether they were willing to pay more for fish at the store or restaurant (based on price per pound) with a randomly selected price increase presented based on a percentage (0, 25, 50, 75 or 100%) of the current price for that taxa; “yes” was recorded as 1, and “no” was recorded as 0. The random selection procedure is part of the Sawtooth software program used in the study. Respondents were also presented with the option of shifting the priority spending of their tax dollars by a randomly selected amount from other similar programs such as wildlife protection and even other state spending in the areas of road construction, economic development, education, etc. A value ($3, 5, 7, 10 or 15) was randomly selected, and the respondents were asked to either accept or reject it. WTP for the various taxa based on these two variables was estimated using a logit regression model described below.

The discrete choice conjoint experiment used seven attributes (see Table 1). Each respondent was presented with a panel of choices six times for each taxa. Each panel contained four random combinations of the seven attributes and the null option (see Figure 1, panel example). Each respondent completed six panels for at least three of the seven iconic taxa, and 11% of the respondents rated four taxa.

### *Contingent Valuation*

The contingent valuation component of the study was based on Loomis *et al.* (2000), which adapted the contingent valuation method as described by Mitchell and Carson (1989). Three questions were included in the survey to elicit respondents' overall WTP for option, indirect and existence values based on shifting tax dollars as described above (see Table 2) for US marine habitats in general. Each value was defined and described prior to presenting the question to each respondent. These three WTP values were estimated using logit regression analysis, as described below. Bequest value was not included in the survey. Since it is close to existence and option values we calculated the average of the values estimated for these and assumed this to be the bequest value (John Dixon, pers comm.).

### *Survey Implementation*

The online survey was administered to 1,122 respondents through the Greenfield Online (www.greenfieldonline.com) in late November 2004. Respondents for this online research panel and programming service were randomly selected from a pool of potential respondents previously recruited by Greenfield Online. All respondents were given the choice of participating or not participating in the survey. If they chose to participate, the respondents were given one week to complete the survey. The survey could be completed in a single session or in multiple sessions. For the purposes of this study, the biases associated with online respondents were considered to be the same as with respondents using other communication media (e.g. telephone or mail-out survey).

Two pilot surveys were conducted prior to full implementation of the survey to ensure that the questions were clear and easily understood by the respondents. The first pilot survey of approximately 20 respondents selected among work colleagues was used to identify any ambiguities in the questions and the survey completion process. The second pilot survey included 102 respondents from Greenfield Online and was conducted to ensure that the questions were clarified and that the length of time to complete the survey was not excessive. To further verify the validity of the results, all respondents to the final version of the survey were asked to indicate their perceived levels of question clarity, complexity, difficulty and confusion upon the completion of the survey.

## WTP Models

### *Iconic Taxa*

A qualitative choice model has been used to estimate the willingness to pay for the iconic taxa. The basic relationship is:

$$\Pr(AP) = 1 - \{1 + \exp[B_0 - B_1(\$X)]\}^{-1} \quad (1)$$

where Pr(AP) is the probability of accepting a given price increase, $B_o$ is the constant and $B_1$ is the coefficient of the logit regression slope and *$X* is either the increase in the price of fish or the shift in tax dollar allocation. The minimum equation contains at least the coefficient of the amount the respondent was willing to pay. Other coefficients could include perceptions of the state of marine environments, seafood buying and consumption patterns, use of marine environments, attitudes and demographic characteristics such as membership in environmental groups, income, etc.

The final models for each iconic taxa can be expressed as:

$$\frac{\ln(accept)}{(1 - accept)} = B_0 - B_1(price\ increase) + B_i \quad (2)$$

where *accept* is the dependent variable. Either 1 or 0 is recorded, depending on whether the amount is accepted or rejected, respectively.

Data for the WTP estimates for each taxon were extracted from the discrete choice conjoint experiment described above. The WTP model used only the choices where the respondents were presented with options that improved habitat and fisheries regulations, and that improved or maintained socio-economic conditions, option use options and biodiversity. If more than one of the above choices was available to a respondent, a single choice was randomly selected. If the respondent accepted a choice, 1 was recorded as the answer, and if the respondent rejected a choice, 0 was recorded. Retail price increases and shifts in tax dollars were also recorded. This provided sample sizes for each taxa ranging from 222 respondents for lobster to 257 respondents for shrimp. These were analysed using a logit regression with factors relating to perceptions about marine resources and habitats, consumption, use and demographic variables (Sumaila *et al*. in prep.) Estimates for option value, indirect use and existence value were used directly in the logit model described above.

The total value of each iconic taxon was calculated based on the average WTP using the retail price increase of fish and fish consumption in the United States. Total consumption for each iconic taxon was estimated based on mean consumption expressed as gram/day/person (EPA 2002) and the total population of approximately 293 million people. The iconic taxon value was then disaggregated into each habitat based on the association of each iconic taxon to coral reefs, estuaries, seamounts and similar deepwater habitats and other habitats (see Table 3).

Disaggregation of value by habitat was based on the predicted relative abundance of the taxa in each of the habitat types. Firstly, habitat-associations of each commercial taxon included in the iconic taxa are represented by an index of habitat association, which is based on qualitative descriptions of the frequency of occurrence and density of the taxa in a particular habitat in databases or literature. For instance, if a taxon is described as always occurring in coral reefs, it would have a degree of association to coral reefs equal to 1. Likewise, if a taxon is described as sometimes occurring in coral reefs, it would have the degree of association to coral reefs equal to 0.25 (see Cheung *et al*. in prep.; http://www.seaaroundus.org/doc/saup_manual.htm#5 for details). Using a rule-based model that combined the habitat association index with other attributes on the occurrence of each taxon (e.g. latitudinal and depth ranges), spatial distributions of relative abundance of commercial taxa in the US EEZ were predicted in 30 min latitude x 30 min longitude grids (for details, see Watson *et al*. 2004, Cheung *et al*. in prep., http://www.seaaroundus.org/doc/saup_manual.htm#5). The total value for each habitat was estimated by dividing the total value of each iconic taxon according to the predicted relative abundance in each habitat. The estimated values by habitat were then adjusted for the total area of each habitat to provide $/km$^2$ estimate of the average retail price increase that the respondents were willing to accept for the better management of US marine habitats.

*Option and indirect use and existence values*

Estimates of the option and indirect use as well as existence values were also based on Equation 2, which was adapted from Hanemann (1989):

$$Mean\ WTP = \frac{1}{B_1}\ln(1+\exp[B_0]) \qquad (3)$$

The final model used can be expressed as:

$$\frac{Ln(accept)}{(1-accept)} = B_0 - B_1(tax\ shift) + B_1 \quad (4)$$

where *accept* is the dependent variable. If the amount of tax shift was accepted, 1 was recorded, and if the amount of tax shift was not accepted, 0 was recorded.

The data for this analysis was provided directly by the responses to the three questions described in Table 2.

The logit routines in the STATA software package (Stata Corp. 2003) were used to estimate the WTP values described above.

## Results

A full model that used all the variables was initially estimated for all seven taxa: option value, indirect use values and existence values. However, only estimates of average WTP based on models whose independent variables were significant at the 0.05 level or better (see Table 4) are presented in this paper. Several seafood-specific variables (such as seafood purchasing, health of marine life and locations of seafood consumption) and demographic variables (such as visitation levels, trip length, overnight stay, spending, education, genders and race) were consistently insignificant. These were not included in the final models.

*Iconic taxa models*

Table 5 lists the variables used in the final models. Appendix A offers a detailed description of the variables used in the final models for each taxon and of the variables listed in Table 4.

The variables used in the final models vary across taxa for both retail price increases and tax dollar shifts (see Table 5). The coefficients for the models also behave differently. The relationships between price increases and tax dollars shift and other independent variables are detailed below:

*Ocean condition change*

Ocean condition change was negatively and significantly correlated with the dependent variables at the 5% level for salmon, grouper and scallops. The negative sign indicates that respondents who thought that the ocean had gotten better over the last few years were less likely to agree to pay a higher retail price for the fish.

*Seafood consumption*

Seafood consumption was significant at the 5% level for a single iconic taxon, scallops, and the positive relationship suggests that those respondents who consumed higher amounts of scallops were more likely to support an increase in the retail price of scallops.

*Seafood meals*

The relationship with the number of seafood meals was negative and significant at the 5% level for shrimp only. This indicates that respondents who consumed more meals of seafood per week were less likely to support an increase in the retail price of shrimp.

*Sailing*

The relationship was significant at the 5% level for shrimp, with respondents who sailed frequently being less likely to support an increase in the retail price of shrimp.

*Sunbathing*

Respondents who sunbathed were more likely to support an increase in the retail price of fish to improve the management of salmon fisheries and habitats. This variable was significant at the 5% level.

*Boating*

Respondents who went boating were more likely to support an increase in the retail price of Pollock, as indicated by a positive and significant relationship (5%) for this species.

*Recreational fishing*

The relationship was negative and significant (5% level) for recreational fishing from a boat for pollock and positive and significant (5%) for recreational fishing from the shore for grouper. The negative coefficient for pollock indicates that respondents were less likely to pay more for fish to support better management, while the positive coefficient for grouper suggests that fishers were willing to support an increase in the retail price of fish.

*Aquarium visitation*

Visiting an aquarium was a significant (5%) factor in this survey. Respondents who visited an aquarium in the last 24 months were more willing to accept an increase in the retail price of fish if it led to a better management of the fisheries and associated habitats.

*NGO membership*

NGO membership was positively related to respondents' willingness to pay for an increase in the retail price of fish for shrimp and salmon, indicating that the respondents were willing to pay more for shrimp and salmon to support management of these fisheries and fish habitats.

*Income*

The negative and significant relationship for salmon suggests that respondents with higher income were less likely to pay for improved management of the fishery and associated habitats.

*Age and zip code*

The positive and significant relationship between willingness to pay and age or zip code for grouper indicates that people who are older or who live in a coastal area (determined based on their zip code) were willing to pay more for management of grouper and associated habitats.

*Willingness to pay estimates for iconic taxa and habitats*

Equation 3 was used to estimate the mean WTP at the mean of the other independent variables (see Table 4). The resulting mean WTP price increase per person (or tax shift) varied between $1.30 per pound for salmon to $8.58 per pound for shrimp (see Table 5).

The mean WTP based on an increase in the retail price of fish fell well within the range of the prices presented to the respondents in this study. No significant factors other than price were found to affect the WTP for lobster and rockfish significantly, and both estimates were within the price ranges for both taxa. The logit curves were well balanced, and no ‘fat tails’ were evident for the maximum price increase. However, the mean WTP based on shifting the priority spending of tax dollars was not within the range of the tax shifts presented to the respondents in this study. For most taxa, the estimate was often close to or exceeding the maximum value presented to the respondents. The mean WTP based on tax dollars was not considered reliable enough for subsequent estimations of the habitat values.

Using 1994-1998 consumption data (EPA 2002), the total additional value of the retail price for improved management for the iconic taxa used in this survey was $4.2 billion dollars (see Table 6). The increase in the value for each habitat varied from $511/km2 for seamounts to $5,700/km2 for estuaries (see Table 7).

*Option, indirect use and existence use models*

Table 8 lists variables in the final models as indicated in Equation 4. Appendix A offers a detailed description of the variables used in the final models for each taxa and the variables listed in Table 8.

The variables used in the final models vary over the three values, except for visiting an aquarium, which is significant at the 5% level (see Table 8). As per the iconic taxa models, regression coefficients also behave differently, with perceptions of ocean conditions being significant and negatively correlated with option and indirect use values, but not with existence. The coefficients of the "fisher" factor are negative, indicating that people associated with the fishing industry are not in favour of shifting more of their tax dollars to improving or maintaining the option values of marine habitats. However, this result is based on a small sample of respondents (n=5). Similarly, those who think that the current or future ocean conditions are healthy or improving are not in favour of shifting more of their tax dollars to improving or maintaining the indirect use or existence values of US marine habitats. The most interesting result is that visiting an aquarium positively relates to one's willingness to increase the amount of tax dollars going towards maintaining or improving all three values.

*Willingness to pay estimates for option, indirect existence and bequest values*

The WTP estimates for option and indirect use and existence values were outside of the value range presented to respondents (see Table 9). The minimum choice of the tax dollar shift was \$3 and the maximum was \$15. This indicates that the logit curve was not well behaved, with the flat curve resulting in an over-estimate of the acceptable tax shift that was greater than the maximum tax shift (\$15) presented. The same logit curve behaviour was observed in the tax shift in the iconic taxa analyses. However, the WTP values calculated for the option, indirect and existence values were based on broad or general definitions of these values and were not associated with any taxa. Bequest value was assumed to be the average of option and existence values. Thus, they may provide an indication of the relative importance of the four values.

**Discussion**

US residents value their marine habitats and are willing to pay higher retail prices for fish in order to improve management of marine habitats associated with iconic fish taxa in this study. If we accept that the iconic taxa represent marine habitats, then some general observations can be made about how US residents value marine habitats. The WTP estimates in this study fall within the range of other studies of habitats and related fisheries such as coral reefs (\$3,000 to \$506,000/$km^2$ based on Cesar 1996), estuaries (\$1,418 to \$14,180/$km^2$ based on Bockstael *et al*. 1989) and coastal wetlands (\$3,051 to \$3,277/$km^2$ based on Lal 1990). Although other studies focus on either fisheries in general or specific areas (Ledoux *et al.* 2001), the results are consistent, despite different information collection methods.

The fantasy values vary across habitats, with estuaries emerging as the most valuable in this study. These differences may in part reflect how people value the iconic taxa used in this study. However, the most valuable iconic taxa (in particular lobster and grouper) are associated to coral reefs. Other factors not measured in this study, such as respondents' awareness of marine or fisheries conservation issues, their long-term experiences and connections to specific habitats and their attitudes towards resource management, may have influenced their responses and the value they placed on the taxa or fish habitats. However, seamounts, which are not readily known to most US residents, and fish products from seamounts, which are not abundant on the consumer market, were valued similarly to other habitats. The values were also similar to the direct values estimated as part of a larger study (Sumaila *et al*. in prep.). The results of this study may also be confounded by the difference (if any) between the perceived habitat association of the iconic taxa and the "real" association. Moreover, values are appropriated simply by the predicted relative abundance of the taxa on the habitat, while the importance of the habitat to their life cycle or survival is not considered. Thus, the appropriations of estimated values of the iconic taxa to their associated habitat are likely to be conservative. Finally, the estimated values are affected by the accuracy of the underlying predicted taxa distributions.

The validity of the WTP estimates (that is, whether respondents would in fact be willing to pay more for fish) is justified by looking at the price of fish. On the world market, the real price of fish has been steadily increasing, while the price of beef, poultry and pork has been declining (Delgado *et al*. 2002). Similarly, consumers have been willing to pay extremely high prices for fish. Consumers in the US have been increasing fish consumption by 0.5% per annum since 1973; similarly, the price index for most fish and seafood has increased from 0.8 in 1980 to 1.8 in 2000 (Delgado *et al*. 2003) For example, over the 20 years, between 1980 and 1999, the price of grouper (*serranidae*) has steadily increased by over 65% in real terms (Sumaila *et al.* 2005).

It was not possible to attribute specific option, indirect and existence values to each habitat because the estimates for these values based on a modified contingent valuation survey were not considered reliable. The modified contingent valuation component was based on a shift in tax dollars, and questions over its reliability centred on respondents not appreciating the impact of the difference between $3 and $15 of their tax dollars in terms of shifting from one program to another, although the shifts in the tax dollar amounts were based on current budget allocations for a number of coastal states. A shift in the tax dollar amount was considered a better metric, because the survey was conducted close to the 2004 US presidential election, when tax increases were particularly unpopular with the US electorate. Another problem related to this metric was the absence of the ‘no change’ option. Together, these may account for the flatness in the WTP curve. However, if the relative difference between these three estimates is considered, then respondents’ value of option use is nearly twice as high as those of existence and indirect uses.

## Conclusion

This study used a discrete choice conjoint experiment to obtain information on the non-market value of marine habitats within the exclusive economic zones (EEZ) of the continental United States and Alaska. An online survey was used to randomly sample over 1,000 residents (coastal and non-coastal) of the continental United States. US marine habitats hold more than just direct use values. The fantasy values of coral reefs, seamounts, estuaries and other habitats were estimated using commercially important and easily recognizable iconic seafood products to estimate the willingness of residents to accept an increase in the retail price of fish in return for improved management of the fish and associated habitats. Some habitats, such as estuaries and coral reefs, hold a higher fantasy value than seamounts. Willingness to pay for improved management ranged from $511/km^2 to $5,696/km^2. The willingness to pay for two iconic products, lobster and rockfish, was affected by price only. The other iconic taxa were affected by a range of factors including perceptions on the ocean condition, activities undertaken on the ocean or beach, age, income and NGO membership, seafood consumption and visiting aquaria.

This study illustrates the potential use of discrete choice conjoint experiments to value marine habitats. Although the study used iconic taxa to infer the values of specific habitats, the values derived in this study are similar to estimates from similar market and non-market valuation studies. Studies using discrete choice conjoint experiments to value marine habitats can be improved by increasing the number of respondents (especially those affiliated with the fishing industry), better descriptions of the impact of shifting tax dollars for the respondents, and comparisons with using other iconic taxa or seafood products. The limitations of this study are as follows: the results are only applicable to continental US and Alaska; habitats such as kelp forests, mangroves and mud flats are not valued; and the individual habitats in this study represent the total non-market value made up of option, indirect and existence values could not be estimated from the contingent valuation component of this study.

The study tried to estimate option, indirect and existence use values separately using a contingent valuation study, but with limited success. The contingent valuation based on respondents' willingness to shift tax dollars provides a preliminary estimate of the individual values. Additional surveys are needed to confirm or improve on the three estimates for marine habitats in general as well as for specific habitats. In the contingent valuation study, visiting an aquarium within the last 24 months of the study was a significant factor in the relationship between willingness to shift tax dollars and improved marine management.

This study is the first of its kind for the United States' marine ecosystems; it is a broad analysis of how US residents value their marine habitats, and the values produced can be used to argue for improved habitat management at the strategic policy level. Nevertheless, studies targeting specific areas or habitats are still needed, and the approaches taken in this study have the potential to provide reliable and compelling information to policy makers for improved habitat management.

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**Appendix A**: Descriptions of the variables used in the final logit regression model.

<table>
<tr><td>Variable</td><td>Description</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Price change</td><td>The additional price consumers pay retail for a pound of shrimp relative to the current price of a pound of shrimp. Shrimp can be purchased two ways: farm raised or wild caught. The prices here refer to the price of wild shrimp.</td></tr>
<tr><td>Ocean condition change</td><td>Over the past few years, do you think the condition of our oceans has gotten better, stayed about the same or gotten worse?<ul><li>Gotten better</li><li>Stayed about the same</li><li>Gotten worse</li><li>Not sure</li></ul></td></tr>
<tr><td>Future ocean condition</td><td>If current management of the oceans continues, do you think the conditions of our oceans will get better, stay the same or get worse?<ul><li>Get better</li><li>Stay the same</li><li>Get worse</li><li>Not sure</li></ul></td></tr>
<tr><td>Seafood consumption</td><td>About how often would you say you eat fish or other seafood at home or in restaurants?<ul><li>Never</li><li>Once a year</li><li>A couple of times a year</li><li>Once a month</li><li>Once every couple of weeks</li><li>Once a week</li></ul></td></tr>
</table>

| | |
|---|---|
| | • More than once a week<br>• Not sure |
| Seafood meals | How many meals of fish or seafood (of all types) did you personally consume in the last 7 days? ________# ENTER NUMBER THAT IS YOR BEST ESTIMATE |
| | In which of the following activities have you yourself actively participated over the past twelve months: |
| Sailing | Sailing in the ocean 1=Yes; 2= No; 3=Don't Know |
| Sunbathing | Sunbathing on an ocean beach 1=Yes; 2= No; 3=Don't Know |
| Boating | Motor boating/using personal watercraft on the ocean 1=Yes; 2= No; 3=Don't Know |
| Recreational fishing (boat) | Recreational or sport fishing from a boat in the ocean 1=Yes; 2= No; 3=Don't Know |
| Recreational fishing (shore) | Recreational or sport fishing from the shore or dock 1=Yes; 2= No; 3=Don't Know |
| Aquarium | Visited an aquarium 1=Yes; 2= No; 3=Don't Know |
| NGO member | Are you a member of any environmental group and/or have you contributed to any environmental groups within the past year? Yes, No, Not sure. |
| Fisher | Are you or is any member of your immediate family employed in the commercial fishing industry? Yes, No, Not sure. |
| Income | Which of the following ranges includes your total annual household income before taxes?<br>• Below $25,000<br>• $25,000 to $49,999<br>• $50,000 to $74,999<br>• $75,000 to $124,999<br>• $125,000 or more<br>• not sure |
| Trip | Over the past 2 years, how many times would say you have visited one of the nation's coastal areas? __-# (DK) |

Table 1: Attributes used in the discrete choice conjoint experiment

| Attributes | Levels |
| --- | --- |
| Habitat regulation | increase, maintain, decrease habitat quality |
| Fishing regulation | increase, maintain, decrease health of populations |
| Increase retail price<br><br>($/pound) | No change, 25%, 50%, 75%, 100% increase |
| Shift tax dollars | No change, $3, $5, $10, $15 |
| Economic/social impacts | positive, no impact, negative |
| Option use (future value) | increase, same, fewer opportunities |
| Biodiversity | increase, maintain, decrease |

Table 2: Questions used to estimate overall option use, indirect use and existence values of US marine habitats.

| **Value** | **Question**: Would you favor or oppose shifting (3, 5, 10, 15) of your tax dollars annually from spending in other areas … |
|---|---|
| Option use | to ensure future generations can develop new opportunities from marine habitats? |
| Indirect use | to maintain indirect uses of marine habitats such as water quality and biodiversity preservation? |
| Existence | to maintain the existence of marine habitats? |

Table 3: Appropriation of total value of each iconic taxa value to habitats (based on Cheung *et al*. in prep.). The values are based on the total abundance of the taxa in each habitat. The small values in coral reefs is resulted from their small area.

| Taxa | Reefs | Estuaries | Seamounts | Other marine habitats |
|---|---|---|---|---|
| Shrimp | 0.0002 | 0.0797 | 0.0020 | 0.9195 |
| Salmon | 0.0000 | 0.1465 | 0.0000 | 0.8591 |
| Lobster | 0.0059 | 0.0435 | 0.0035 | 0.9560 |
| Pollock | 0.0000 | 0.0478 | 0.0000 | 0.9521 |
| Rockfish | 0.0000 | 0.0606 | 0.0024 | 0.9370 |
| Grouper | 0.0000 | 0.0298 | 0.0145 | 0.9680 |
| Scallops | 0.0001 | 0.0725 | 0.0034 | 0.9293 |

Table 4: Logit regression model of probability for paying a higher retail price for fish. All co-efficients are significant at 5% or less using Z score.

| | Shrimp | | Salmon | | Lobster | | Pollock | | Rockfish | | Grouper | | Scallop | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Factor | Co-eff | Mean | Co-eff | Mean | Co-eff | Mean | Co-eff | Mean | Co-eff | Mean | Co-eff | Mean | Co-eff | Mean |
| Constant | -0.342 | 1 | -0.021 | 1 | -0.021 | 1 | -0.319 | 1 | -0.869 | 1 | -1.646 | 1 | -0.765 | 1 |
| Price change | .097 | 6.739 | 0.281 | 3.095 | 0.281 | 2.823 | -0.188 | 1.159 | 0.061 | 2.838 | -0.117 | 2.876 | -0.010 | 3.771 |
| Change in ocean condition | | | -0.897 | 2.620 | | | | | | | -0.286 | 2.528 | -0.126 | 2.581 |
| Seafood consumption | | | | | | | | | | | | | 0.067 | 3.784 |
| Seafood meals | | | | | | | | | | | | | 0.039 | 1.507 |
| Sailing | -0.382 | 0.087 | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sunbathing | | | 0.906 | 1.683 | | | | | | | | | | |
| Boating | | | | | | | 1.521 | 0.148 | | | | | | |
| Recreational fishing (boat) | | | | | | | -1.167 | 0.091 | | | | | | |
| Recreational fishing (shore) | | | | | | | | | | | 0.819 | 0.204 | | |
| Aquarium | | | | | | | | | | | | | 0.964 | 0.438 |
| NGO member | 0.485 | 1.322 | 0.351 | 1.430 | | | | | | | | | | |
| Income | | | -0.135 | 3.430 | | | | | | | | | | |
| Age | | | | | | | | | | | 0.403 | 2.918 | | |
| Coastal zipcode | | | | | | | | | | | 0.695 | 1.506 | | |

Table 5: WTP estimates based on an increase in retail prices and shifting tax dollars and factors that were significant in the logit regression; values in brackets for WTP based on retail price increase are the maximum amount presented to respondents; the maximum shift in tax dollars is $15 for all taxa.

| Taxa | WTP retail price increase | | WTP shift tax dollars ($) | Significant variables |
|---|---|---|---|---|
| | per pound | per kg | | |
| Shrimp | 8.58 (10.00) | 3.90 (4.55) | 7.11 | sailing, NGO, distance* |
| Salmon | 1.30 (7.00) | 0.60 (3.18) | 9.92 | sunbathing, NGO#, income |
| Lobster | 2.43 (12.00) | 1.10 (5.45) | 16.99 | price only |
| Pollock | 3.19 (3.00) | 1.45 (1.36) | 55.24 | recreational fishing in a boat, boating |
| Rockfish | 5.76 (8.00) | 2.62 (3.64) | 8.72 | Price only |
| Grouper | 6.00 (13.00) | 2.73 (5.91) | 17.33 | Change in ocean condition#, recreational fishing from a dock or shore, age, coastal |
| Scallop | 5.40 (8.00) | 2.45 (3.64) | 9.63 | seafood consumption, meals of seafood, change in ocean condition, aquarium visit |

*only for tax shift; # only for price increase

Table 6: Total consumed value of iconic taxa in the US 1994-1998 (based on EPA 2002)

| Taxa | price change $/kg | US total consumption ($10^3$ tonnes) | Total value (millions USD) |
|---|---|---|---|
| Shrimp | 3.90 | 174 | 3291.02 |
| Salmon | 0.60 | 109 | 313.92 |
| Lobster | 1.10 | 17 | 89.54 |
| Pollock | 1.45 | 30 | 207.81 |
| Rockfish | 2.62 | 4 | 46.58 |
| Grouper | 2.73 | 3 | 33.95 |
| Scallop | 2.45 | 16 | 188.22 |

Table 7: The estimated value (millions USD) for each taxa: habitat combination, total habitat value, total habitat area in the continental USA and Alaska and value per unit area ($km^2$) for each habitat

| Taxa | Coral reefs | Estuaries | Seamounts | Other habitats |
|---|---|---|---|---|
| Shrimp | 0.7 | 262.4 | 6.6 | 3026.1 |
| Salmon | 0.0 | 46.0 | 0.0 | 269.7 |
| Lobster | 0.5 | 3.9 | 0.3 | 85.6 |
| Pollock | 0.0 | 9.9 | 0.0 | 197.9 |
| Rockfish | 0.0 | 2.8 | 0.1 | 43.6 |
| Grouper | 0.0 | 1.0 | 0.5 | 32.9 |
| Scallop | 0.0 | 13.7 | 0.6 | 174.9 |
| | | | | |
| Total million $ | 1.2 | 339.7 | 8.1 | 3830.7 |
| Area[1] ($km^2$) | 1028.4 | 59640 | 15900 | 6152713 |
| Value $/$km^2$ | 1212 | 5695 | 511 | 622 |

[1] Coral reef and estuary area available at www.seaaroundus.org; seamount area calculated as total lateral area for the 160 known seamounts each with an assumed average diameter of 5 km and height of 5 km

Table 8: Logit regression model of the probability that respondents would accept a shift in tax dollars for improved management; all coefficients listed are significant at 5% or less using Z scores.

| | Option value | | Indirect use | | Existence | |
|---|---|---|---|---|---|---|
| | Coefficient | Mean | Coefficient | Mean | Coefficient | Mean |
| Constant | 3.39 | 1.00 | 2.71 | 1.00 | 2.92 | 1.00 |
| Tax shift | -0.09 | 8.28 | -0.09 | 8.26 | -0.11 | 8.28 |
| Seafood consumption | | | | | 0.27 | 1.41 |
| Ocean condition change | | | -0.41 | 2.60 | | |
| Future ocean condition | -0.57 | 2.41 | | | | |
| Aquarium | 0.76 | .45 | 0.63 | 0.45 | 0.46 | .45 |
| Fisher | -0.45 | .004 | | | | |
| Trip | | | -0.10 | 2.98 | | |
| NGO | | | 1.12 | 1.30 | | |
| Income | | | | | -0.20 | 3.31 |

Table 9: Mean willingness to pay (WTP) based on tax dollar shift

| Value | WTP estimate (tax dollars shift) |
|---|---|
| Option use | 58.01 |
| Indirect use | 31.95 |
| Existence | 26.82 |
| Bequest[1] | 42.25 |

[1] estimate is based on the average of option and existence use values