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Whale Watching in Channel Islands National Marine Sanctuary: A Stated Preference Study of Passengers' Willingness to Pay for Marine Life Improvements

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Cover photo: Two blue whales swimming side by side at Channel Islands National Marine Sanctuary. Photo: NOAA

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Report Availability

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Table of Contents

Abstract

This report presents the methods used to estimate the consumer surplus for natural resource attribute improvements among for-hire whale watching passengers in Channel Islands National Marine Sanctuary (CINMS), along with the results of this analysis. Understanding what users are willing to pay for natural resource improvements (such as increases in the number of whales and other marine mammals) helps to inform management and policy decisions. Information on the benefits of improving resource conditions informs cost-benefit analysis of potential policy and management changes. This report is one of two methods papers that document the approach used to collect and analyze the data. Through the development and implementation of a survey and sampling design, original data were collected and then analyzed. Results include the economic contribution (jobs, income, value-added, and output) of whale watchers, the characteristics they find most important and are most satisfied with, the number of whale watching days and trips they make to the region, the types of wildlife viewing animals they most like, and the focus of this report, non-market valuation of resource attribute improvements. The findings of this research will used to support the CINMS management plan review, inform education and outreach efforts related to whales, and provide additional information to for-hire wildlife viewing operations about their passengers and economic contributions to the region.

Key Words

Channel Islands National Marine Sanctuary, whale watching, consumer surplus, non-market valuation

Executive Summary

From May to November of 2018 (summer season) and December to April of 2019 (winter season), students from the University of California, Santa Barbara Bren School of Environmental Science and Management intercepted whale watching passengers on the return portion of a whale watching trip. At the dock upon return, they asked passengers to complete an on-site screener survey and recruited them into a longer return survey administered via mail or Qualtrics, an online survey platform. Of the 1,270 people who participated in the screener for the winter season, 547 people answered the return survey for a response rate of 43.1%. In the summer season, 779 people participated in the screener survey, and 314 people responded to the return survey for a response rate of 40.3%.

The goal of the survey was to provide up-to-date data to support Channel Islands National Marine Sanctuary's marine wildlife conservation and management goals. The survey asked respondents questions regarding their expenses, importance and satisfaction levels for different characteristics associated with their whale watching experience, and the activities they participated in while in the region. However, this report focuses on their responses to a series of contingent choice questions.

The contingent choice analysis controlled for key variables, such as household income, and measured environmental attitudes through a series of 15 questions called the "new ecological paradigm" (NEP). Many respondents were reluctant to give an answer for their income category, therefore this report also compared two models used to predict household income. The first model was a negative binomial regression and the second was a multinomial logistic regression, which is a more conventional model used to forecast income categories. The multinomial logistic regression outperformed the negative binomial regression, and therefore was used to predict income for the final contingent choice analysis.

Including all of the NEP questions in the contingent choice model is somewhat cumbersome due to the large number of questions, as well as the fact that many collinearity issues exist within the question set. In order to account for this, a factor analysis, followed by a cluster analysis, was conducted. The analysis revealed that only one factor and one cluster exist within the NEP data. Therefore, an index (referred to as the NEP index) was created based on the NEP questions and used in the contingent choice model. Index values for each respondent varied, however most have pro-environmental attitudes. This was not surprising given that the respondents actively sought recreational experiences that rely on the natural environment.

Respondents were given three choice sets (also referred to as scenarios), and each scenario had three options with different resource levels (conditions of resources) as well as an accompanying price. Three different models were tested to perform a contingent choice analysis based on the responses to the contingent choice questions. The three models tested were a conditional logit model, a mixed effects logistic model, and a nested logistic model. Ultimately, the conditional logit model was chosen as the primary model. An examination of the data revealed that the assumption of the independence of irrelevant alternatives (IIA) was not violated. The mixed

effects logistic model and the nested logistic model were considered unnecessary given that their purpose is to help relax this assumption. The results of both models are presented in Appendix A.

The results of the contingent choice analysis showed that respondents had a consistently positive marginal willingness to pay (MWTP) for improvements for large baleen whales. These willingness to pay values ranged from $181 to $221 per household, depending on the amount of improvement. Comparatively, the cost of a whale watching ticket in the region ranges from $38 to $99 per person (for the 2018–2019 seasons). MWTP values for all of the other species in the analysis were not statistically different from zero or significantly negative. Overall, improvements to large baleen whales were most valuable to whale watchers, and people appear to have a higher MWTP for higher improvement levels, although not all levels were statistically significant.

The model also showed that people with higher income and more pro-environmental values (as measured by the NEP index) had higher willingness to pay (WTP) values for resource improvement. Using the MWTP for large baleen whales along with the number of whale watching passengers in the region, total willingness to pay for improvement to large baleen whales was roughly $5 million dollars among for-hire whale watching passengers from operations that visit the sanctuary.

Chapter 1: INTRODUCTION

Channel Islands National Marine Sanctuary (CINMS) protects 1,470 square miles of ocean waters around the Northern Channel Islands: Anacapa, Santa Cruz, Santa Rosa, San Miguel, and Santa Barbara islands. A special place for endangered species, sensitive habitats, historic shipwrecks, and cultural resources, the sanctuary provides protection through research, education, conservation, and stewardship. The Santa Barbara Channel region is heavily transited by large commercial vessels traveling into and out of the ports of Los Angeles and Long Beach, two of the nation's busiest ports. Thousands of cargo ships transit through the region each year. The presence of vessels overlaps the summer aggregations of endangered blue, fin, and humpback whales. Ship strikes on endangered whales is a leading cause of mortality compromising the recovery of these endangered species.

Whale watching in and around Channel Islands occurs in two seasons. The spring/summer season (referred to as summer season) starts around May 15 and continues until November 15. The winter season begins around the end of December and continues through April. The exact start and end date of the seasons are determined by the presence of whales, driven by their migration patterns and location/availability of food. The winter whale watching season focuses on gray whales, but also includes opportunities to see seals, sea lions, several species of dolphins (such as Risso's and common), and occasional orca whale pods. The summer whale season provides an opportunity to see larger baleen whales, such as blue, humpback, orca, and finback whales. Throughout the year, the occasional great white shark has also been seen. Winter whale watching trips are shorter, lasting 2–4 hours, as the whales tend to be closer to shore. The summer whale watching trips are longer, lasting 5–6 hours on average.

Ecosystem services are benefits that people receive from the environment. This report focuses on the value of whales relative to recreation and tourism through wildlife viewing. Whales, however, provide many other ecosystem services, such as contributing to sense of place, education, research, and climate regulation through carbon storage. By absorbing carbon dioxide from the atmosphere, whales can accumulate up to 33 tons of carbon dioxide and also support populations of microorganisms that also absorb carbon dioxide from the atmosphere. Given all of the benefits that they provide, the value of an average great whale (such as baleen and sperm whales) is estimated at around $2 million over its lifetime (Chami et al., 2019). However, this report only focuses on the value of whale watching in and around CINMS to the United States and local economy, respectively.

Whales contribute to sense of place (as defined in NOAA Office of National Marine Sanctuaries Condition Reports), which is the aesthetic attraction, spiritual significance, and location identity of a place, including its level of recognition. The Chumash recognize humpback whales as a culturally significant endangered species. The loss of culturally significant species threatens the ability to practice culture and connect to a place, heritage, and ancestors (NOAA Office of National Marine Sanctuaries, 2019). Looking beyond CINMS, but still within the sanctuary system, whales have historically provided food through subsistence harvest to some communities, such as the Makah Tribe in the Olympic Coast National Marine Sanctuary region. Subsistence harvest practices provide a way for tribal members to connect to their heritage.

Education focused on whales may occur both on the water and on the land. Channel Islands Naturalist Corps (CINC) volunteers are trained to provide interpretation about Channel Islands National Marine Sanctuary and Channel Islands National Park on local whale watch vessels, island hikes, and at community outreach events. One hundred fifty CINC volunteers donate nearly 30,000 hours annually, reaching thousands of visitors, community members, and schools. The CINC volunteer program involves a robust citizen science component that supports NOAA's ship strike prevention efforts, as well numerous research partners. CINC volunteers are trained to collect marine mammal sightings and whale photo IDs using the Whale Alert Spotter Pro app.

Whales provide research opportunities. Research centered around whales includes:

- Tagging and tracking
- Aerial and boat based monitoring
- Acoustic tracking with underwater hydrophones that ‘listen’ for whales
- Identifying prime whale habitat and predicted presence through modeling
- Citizen scientists sharing whale sightings via Whale Alert and Spotter Pro, custom apps

Abundance of humpback and fin whales has been increasing off the U.S. West Coast while that of blue whales has been stable (based on photo ID mark-recapture) or even declining (based on line-transect estimates from the 1990s to more recent years) (Calambokidis & Barlow, 2004, 2013). The reason for the lack of increase in blue whales has been debated in recent years, especially in light of a recent analysis that suggested blue whale abundance may never have been high in this region and may already be back at historical pre-whaling numbers.

Overall abundance of fin whales is higher than that of blue whales. Both species are still listed as endangered under the Endangered Species Act (ESA). In the mid-2000s, overall humpback whale abundance in the North Pacific was estimated at around 20,000, but was about 2,000 in the distinct feeding areas off California and Oregon (Barlow et al., 2011; Calambokidis et al., 2008; Calambokidis & Barlow, 2013). NOAA recognizes distinct population segments for humpback whales based on breeding area under the ESA. Southern California represents the primary feeding area for humpback whales breeding in Central America (Calambokidis et al., 2000, 2008).

CINMS, NOAA’s National Marine Fisheries Service (NMFS), and many partners have invested over a decade in management, outreach, research, and policy development to minimize the risk of fatal ship strikes on endangered whales. To date, shipping lanes have been adjusted and additional spatial management options to separate ships and whales are underway. Vessel speed reduction programs, both voluntary and incentive based, are employed May through November. CINMS conducts regular and extensive outreach and engagement with the shipping industry, conservation community, and other affected stakeholders.

In addition to ecosystem services, it is also worth considering the ways in which people support whale conservation and stewardship. Education and research allows people to provide services to the environment. In support of both whales and the whale watch industry, CINMS is a member of the NMFS West Coast Stranding Network. In this role, the sanctuary responds to entangled whales in the region and provides training related to whale entanglement and stranding.

This report presents the results of a stated preference survey. Specifically, willingness to pay for improvements to resource conditions (such as large baleen whales) among whale watching passengers was estimated. Further, other variables (income, environmental attitudes) were analyzed to assess their influence on willingness to pay. Results of this study can aid in decision making relative to whale conservation and stewardship by providing information on the costs and benefits of improvements to the condition of whales in the CINMS region.

Past studies have examined the economic benefits of whale watching. A study by O'Connor et al. (2009) found that California has the longest established whale watching industry in the world. They found that in 1998 there were 1,774,700 whale watching passengers and in 2008 there were 1,371,467 passengers in California. Although the number of passengers decreased from 1998 to 2008, the number of operators increased from 65 to 73. Further, total whale watching expenditures increased from roughly $64.3 million in 1998 to $82.9 million in 2008. The southern region of California (which includes Santa Barbara, Ventura, Los Angeles, Orange, and San Diego County) attracted slightly less than 387,000 passengers in 2009. Additionally, there were 25 land-based locations identified for whale watching in the southern region of California. The present study does not include land-based whale watchers and only considers three operations that are known to visit the sanctuary regularly.

This research builds on work already completed in and around the Channel Islands. Students at the University of California, Santa Barbara Bren School of Environmental Science and Management conducted a national contingent valuation survey asking about household willingness to pay to fund whale conservation. The researchers found that the average annual willingness to pay for whale conservation was roughly $70 (Bone et al., 2016). The present study focuses specifically on whale watching passengers in CINMS. In addition to the results presented here on the contingent choice experiment, a companion report presents the results the remainder of the survey. The companion report includes findings on whale watching demographics, importance and satisfaction scores, expenditures, and economic contributions (Shea et al., 2020).

Chapter 2:
SURVEY METHODS

Documentation of the non-market economic value of whales and other marine animals, and how that value changes with the condition of whale and other marine animal populations, was the primary research goal. Estimates of the marginal value of changes in whale populations will be used in a decision-support tool for assessing shipping management strategies in the Channel Islands region. These estimates could also be used in damage assessments.

The method selected for this study is commonly referred to as a stated-preference conjoint analysis (Louviere et al., 2000). For economic valuation of attributes, the method is also referred to as multi-attribute utility theory (Adamowicz et al., 1998). This method asks respondents to choose among five attributes with four condition levels (low, medium, medium high, and high) each. The possible combination of attributes to form options (bundles of attributes) is equal to four to the fifth power, or 1,024. In most of the literature, price or the dollar bid amounts for each bundle of attributes are also treated as an attribute when selecting a random sample of all possible combinations. Six levels of dollar bid amounts would result in 6,144 possible combinations. Because this is impossible to implement, a fractional factorial design was used (Louviere et al., 2000).

The SAS program code provided by Johnson et al. (2007) was used to generate an optimal design and test the efficiency of the design. Two decisions were made: 1) the number of choices any one respondent has to make and 2) the number of different versions of the survey. The number of choices any one respondent had to make was limited to three choices with each choice including the status quo option (A) plus two other options (B and C). The status quo (A) cost the household $0, but resulted in all attributes remaining in low condition. Other options were mixes of low, medium, medium high, and high conditions. The status quo option is often referred to as the “opt-out option” in the literature and provides the basis on which other options are evaluated.

Initial runs of the programs indicated that an optimal design would require at least 48 alternatives/options to achieve an orthogonal (attributes are uncorrelated) design. An optimal design ensures the marginal effects or marginal values of each attribute for the main effects can be estimated. The design of this choice experiment included three choice questions per respondent blocked into 16 versions of the survey. After running the SAS program several times with different numbers of attributes, the optimal design was determined to be 5 attributes (4 levels each) plus price (6 levels).

After the randomization in fractional factorial design was completed, the match-ups in the choices (B and C options) were reviewed. It was necessary to review the match-ups of B and C options to ensure they made sense. That is, an option with higher levels of attributes must have had a higher price than an option with lower levels of attributes. All of the choices in the design met this criterion.

Finally, the choice sets were checked for dominant options/alternatives. It is possible that some question sets may have an alternative that is substantially superior to the other two alternatives thus all respondents would select that option. Such options provide no information in comparative choices (Louviere et al., 2000) Prices were assigned based on the optimal design and included the level of the price (there were six price levels).

Sampling Methodology

Survey Versions and Recruitment

The population surveyed was individuals who participate in for-hire whale watching boat tours in the Channel Islands region. There are two main whale watching seasons: Winter—Gray Whales (December–April) and Summer—Big Whales (May–November).

Data collection had two components: 1) an on-site boat screener survey and 2) a longer return survey administered online or by mail[1]. The on-site survey was used to get information about the respondent's socio-demographic characteristics, non-market economic value of whales and other marine animals, environmental attitudes, and preferences for marine mammals. The on-site survey used an intercept method. Students from the University of California, Santa Barbara Bren School of Environmental Science and Management intercepted whale watching passengers on the return portion of a whale watching trip and at the dock upon return to complete the on-site survey and recruit them into the longer return survey.

The target population for this study was whale watching passengers. Researchers requested and secured permission from whale tour operators to conduct surveys of passengers at the site of the operator's business and worked with operators to schedule on-site interview activities. At the request of whale tour operators, interviewers intercepted passengers after the whale watching trip as opposed to during the trip to minimize inconvenience to passengers and avoid potential impacts to passenger experience with operators. The three collaborating whale watching operations consented to provide access to passengers. These operations were selected as they were known to frequent CINMS. For each passenger group intercepted, the person with the most knowledge of the expenditures was asked to complete the on-site and longer return survey.

The longer return survey was completed via a mailback survey or an online survey platform (based upon the respondent's preference). The longer survey was used to get information about the respondent's expenditures, their importance-satisfaction ratings for 17 natural resource attributes, facilities and services, and demographics. The return survey was provided to intercepted respondents who agree to participate in the study.

Determination of Minimum Sample Size

The present study used the following formula from Orme (1998) to determine the minimum sample size required for the study:

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[1] Full-length copies of on-site screener and longer return surveys are available upon request to the corresponding author.

$$N = 500 \times \frac{NLEV}{NALT \times NREP}$$

where N is the minimum sample size required, NLEV is the largest number of levels in any attribute (6, for number of prices), NALT is the number of alternatives (options) per choice set (not including the status quo; 2), and NREP is the number of choice sets per respondent (3).

Thus, the minimum sample size required for statistical efficiency in the present study was equal to 500. The planned sample size was 600 per season, so the sample sizes were sufficient to not only meet minimum requirements, but provide added safety for margin of error.

In addition to the above, as a general rule, six observations are needed for each attribute in a bundle of attributes to identify statistically significant effects (Bunch & Batsell, 1989; Louviere et al., 2000). Since the present study included five attributes plus price, a total of 36 observations per version were needed. The study design included 16 versions, for a minimum sample size of 576. Because the approach developed allowed for 600 survey completions each season, there were 37 observations per version in each sample, which meets the requirements for effective statistical analysis.

Response Rates

Of the 2,049 people who agreed to participate in the return survey, 861 completed the survey for a response rate of 42.0%. A majority of the respondents chose to take the survey online instead of by mail. The mailback and online surveys had similar response rates with the mailback surveys having a response rate of 37.6% and the online surveys having a response rate of 39.1%.

Table 2.1. Screener response rates.

Screener Type	Total Asked	Total Completed	Response Rate
Winter Screener	1,365	1,270	93.04%
Summer Screener	891	779	87.43%
On-Site Screener Total	2,256	2,049	90.82%

Table 2.2. Return survey completion by type.

Return Survey Type	Total Completed	Percent
Paper	62	7.2%
Online	799	92.8%
Total	861	100%

Table 2.3 shows the distribution of respondents' age by return survey type. In general, respondents to the mailback survey tended to be older; 50% of mailback respondents were over the age of 60. The mailback survey also had a larger percentage of people between ages 41 to 50. The online survey had a larger percentage of respondents in every other age category.

Table 2.3. Participation in online and mailback surveys by age.

Age Group	Online	Mail	Percent of Online Participants	Percent of Mailback Participants
18–30	97	2	14.8%	4.0%
31–40	72	5	11.0%	10.0%
41–50	107	10	16.3%	20.0%
51–60	156	8	23.8%	16.0%
Over 60	223	25	34.0%	50.0%
Total	655	50	100%	100%

Winter Season

The total response rate for the winter season was 43.1%, and the survey version with the highest response rate for the winter season was version 2 with a response rate of 52.9%. The version with the lowest response rate was version 5 with a response rate of 31.6%. Table 2.1 shows response rates across all versions. It is not clear why response rates varied by version, as the different versions were distributed in order until roughly 80 were given out per version. This means 80 copies of version 1 were given out, then version 2 was distributed, and so on until all survey versions were distributed.

Table 2.4. Response rates by survey version (winter season).

Version Number	Screener	Online/Mailback Survey	Response Rate
1	80	42	52.5%
2	85	45	52.9%
3	82	31	37.8%
4	79	36	45.6%
5	79	25	31.6%
6	80	35	43.8%
7	79	34	43.0%
8	79	37	46.8%
9	86	37	43.0%
10	79	32	40.5%
11	74	25	33.8%
12	78	30	38.5%
13	79	30	38.0%
14	78	37	47.4%
15	78	33	42.3%
16	75	37	49.3%
Total	1,270	547	43.1%

Summer Season

The total response rate for the summer season was 40.3%, and the version with the highest response rate for the summer season was version 2 with a response rate of 46.5%. The version with the lowest response rate was version 8 with a response rate of 23.8%. Not all survey versions were administered during the summer season. Due to logistics, there was a delayed start to surveying in the summer season, and the season ended earlier than expected due to the migration patterns of whales. Table 2.5 shows the full results. Not all versions were administered due to the delayed start and early ending of the whale watching season. Since survey results were analyzed for the whole year and not by season, the minimum number of surveys were still completed.

Table 2.5. Response rates by survey version (summer season).

Version Number	Screener	Survey	Response Rate
1	76	34	44.7%
2	71	33	46.5%
3	76	35	46.1%
4	76	33	43.4%
5	76	35	46.1%
6	76	30	39.5%
7	76	33	43.4%
8	21	5	23.8%
9	76	26	34.2%
10	61	23	37.7%
12	76	19	25.0%
13	18	8	44.4%
Total	779	314	40.3%

Chapter 3: KEY VARIABLES TO ESTIMATE WILLINGNESS TO PAY

Choice Levels

There were five attributes identified with four different levels each, in addition to the cost (also referred to as "price") incurred by a household. The price choices offered in the survey were $20, $40, $80, $175, $350, and $700. The price options had large variation to avoid the statistical problem of "fat tails" (everyone choosing the highest price for a given option [i.e., bundle of attributes] or everyone choosing the lowest price for a given option). Additionally, researchers wanted to ensure bid amounts were designed such that a higher price for a given option was not preferred over a lower price for a given option (i.e., it does not make economic sense to pay a higher price if you can get the good or service at a lower price). The range of bids used is critical for estimating the non-market value of whale watchers and how that value changes as whale and other marine animal population conditions improve or decline (i.e., marginal value of attributes). Prices used in this study are based on findings from existing scholarship and were recently used successfully in a similar type of valuation for the outer coast of the state of Washington to aid in marine spatial planning efforts (Leeworthy et al., 2017; Leeworthy & Wiley, 2003; Loomis & Larson, 1994). Graphing the proportion of respondents who selected improvement options for each price allows for an examination of whether or not the highest bid was large enough to avoid the fat tails issue. Figure 3.1 shows the percent of people who chose the options at each price. The curve in this figure is downward sloping and the percent of people who chose option with a cost of $700 (the highest bid) is less than 10%. This provides good evidence to support the fact that the fat tails issue was not a problem in the analysis and the correct bid amounts were chosen for the options presented.

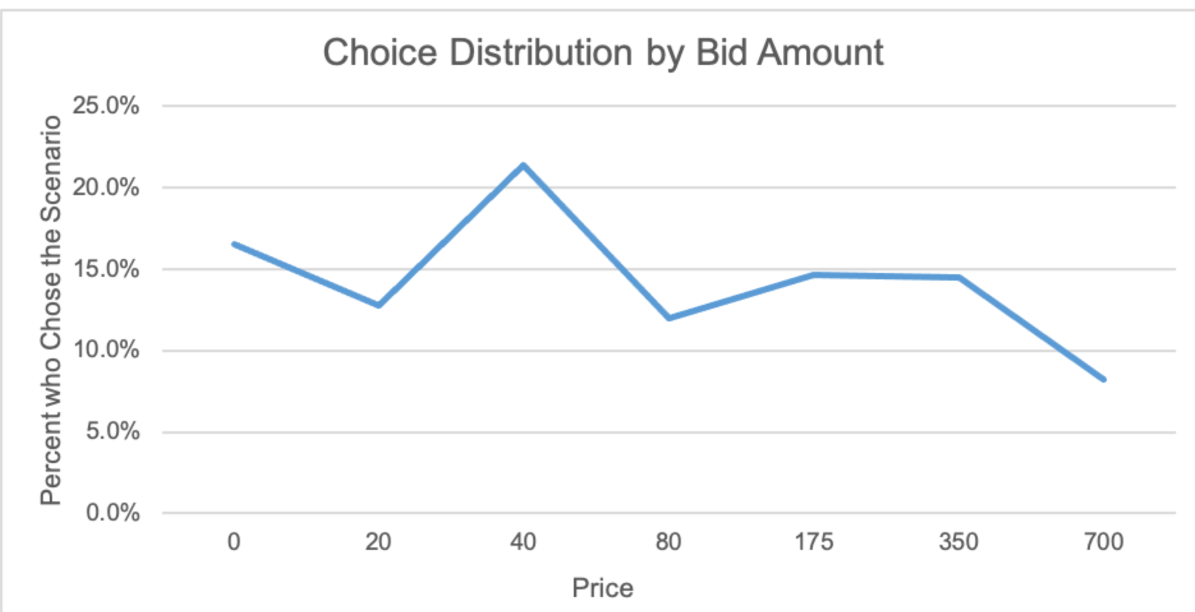

Figure 3.1. Choice distribution by bid amount.

To develop the willingness to pay choice sets, researchers worked with scientists and resource managers from CINMS to identify proposed management issues/objectives important to management and passengers, as well as to determine the status quo for natural resource attributes to be included in the willingness to pay scenarios. Each resource attribute in the survey had four different choice levels as shown in **Error! Reference source not found.** b elow. The attribute levels were converted to dummy variables to be used in the contingent choice models, and the "low" level of each category was the excluded. There are many other ways to code categorical variables, such as linear coding and other contrast coding approaches. Ultimately, the dummy variable approach was chosen for the final model in order to be consistent with past studies conducted by NOAA Office of National Marine Sanctuaries (Leeworthy et al., 2017, 2018). A choice model with linear coding is presented in **Error! R eference source not found.**.

Table 3.1. Choice levels offered in surveys of whale watching passengers. (Note: Minor formatting changes have been made to this table, but the content is the same as that presented to respondents.)

Low	Medium	Medium High	High
Large Baleen Whales			
Four to five whales are killed per year from any cause	One fewer whale is killed per year from any cause. Three to four whales are killed per year from any cause.	Two fewer whales are killed per year from any cause. Two to three whales are killed per year from any cause.	Three fewer whales are killed per year from any cause. One to two whales are killed per year from any cause.
Other Baleen Whales			
Two whale species (sei whale and N. Pacific right whale) are endangered	One species is endangered and one species is threatened.	No species are endangered and two species (sei whale and N. Pacific right whale) are threatened.	No species are endangered or threatened.
Toothed Whales, Dolphins, and Porpoises			
Two whale species (sperm whale and killer whale) are endangered. No dolphins or porpoises are endangered or threatened.	One whale species is endangered and one is threatened. No dolphins or porpoises are endangered or threatened.	Two whale species (sperm whale and killer whale) are threatened. No dolphins or porpoises are endangered or threatened.	No species are endangered or threatened.
Seals & Sea Lions			
One sea lion species (Steller sea lion) is endangered and one seal species (Guadalupe fur seal) is threatened	One sea lion species (Steller sea lion) is threatened and one seal species (Guadalupe fur seal) is threatened.	No sea lions are endangered or threatened and one seal species (Guadalupe fur seal) is threatened.	No species are endangered or threatened.
Seabirds & Shorebirds			

Low	Medium	Medium High	High
Of the 19 species that breed in the region, one species (California least tern) is endangered, one species (western snowy plover) is federally threatened, and 2 species (Scripps's murrelet and Guadalupe murrelet) are state threatened.	Of the 19 species that breed in the region, none are endangered, one species (western snowy plover) is federally threatened, and two species (Scripps's murrelet and Guadalupe murrelet) are state threatened.	Of the 19 species that breed in the region, none are endangered, none are federally threatened, and two species (Scripps's murrelet and Guadalupe murrelet) are state threatened.	No species are endangered or threatened.

The variables discussed in the following sections are referred to as case variables. Case variables are variables that do not vary by choice or choice set but instead vary by respondent. In order to account for these case variables, constants were generated for each choice set (choice sets are also referred to as "scenarios" in this report) and then new variables were created by interacting the case variables with these constants.

Estimating Household Income

Income is important to include in any model designed to elicit non-market value. Income may constrain how much a person is willing and able to pay for resource condition improvement. However, many respondents are reluctant to divulge their income category and therefore there are many missing values for the income variable. The following analysis explores two models used to estimate income categories, a negative binomial regression and a multinomial logistic regression, in order to maximize the number of valid observations[2]. The variables chosen to predict income were the number of days spent whale watching, gender, age, and country of residence. Due to the fact that certain countries had very few observations, the country of residence variable was recoded as a dummy variable to indicate whether or not that person was from the United States.

In the original survey, respondents were presented with 15 income categories, however for this analysis they were recoded to six categories with the following ranges: 1=$0–$24,999, 2=$25,000–$49,999, 3=$50,000–$74,999, 4=$75,000–$99,999, 5=$100,000–$149,999, and 6=$150,000 or more. This was done to so that each category would have enough observations to fit the requirements for a multinomial logistic regression and to make the income categories more evenly spaced.

Negative Binomial Regression

Previous NOAA Office of National Marine Sanctuaries studies have used a negative binomial regression to estimate income (Leeworthy et al., 2018). Although a negative binomial regression is typically associated with count data, strictly speaking, the regression is used when response

[2] All income models were run in Python 3.7 using the statsmodels and scikit-learn libraries. All graphs presented in this chapter were made using the matplotlib library.

data are nonnegative integers that follow a negative binomial distribution (NCSS Statistical Software, 2020). Looking at the distribution of this study's income categories in Figure 3.2, some of these conditions do apply and, therefore, a negative binomial regression may not provide the best prediction.

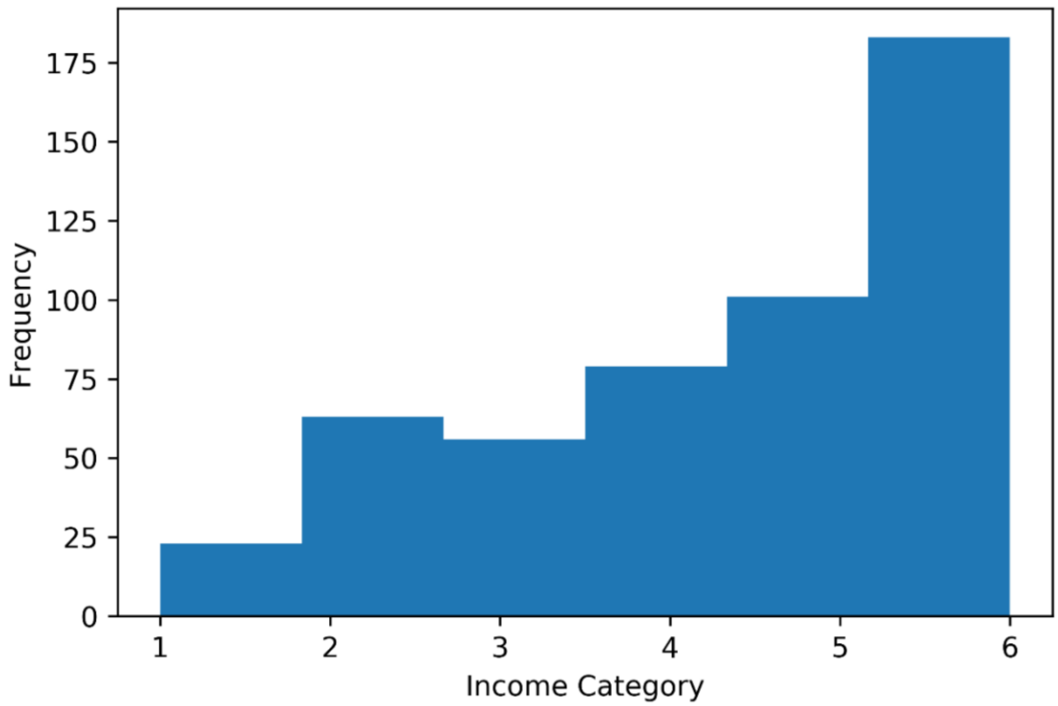

Figure 3.2. Response variable distribution for income categories.

The results for the negative binomial regression show that the model did a poor job of properly categorizing the data. The pseudo R2 for the regression was extremely low at 0.006 and only correctly predicted 73 out of 445 categories correctly for an accuracy of 16.4% (Table 3.2 and Table 3.3).

Table 3.2. Negative binomial regression results.

Variable	Coef.	Std.	z	P>|z|
days_watching	-0.00178	0.0008528	-2.09	0.037
gender_male	0.032127	0.0470322	0.68	0.495
m_age	0.002467	0.0014888	1.66	0.097
USA	0.099518	0.067906	1.47	0.143
_cons	1.272573	0.0937059	13.58	0
/lnalpha	-20.7596	--	--	--
alpha	9.64E-10	--	--	--

Observations = 445
Log likelihood = -867.825
Pseudo R^2 = 0.006

Table 3.3. Negative binomial regression confusion matrix.

		Predicted Category					
	Income Category	**1**	**2**	**3**	**4**	**5**	**6**
True Category	**1**	**0**	1	0	11	8	0
	2	0	**1**	1	35	17	0
	3	0	0	**0**	27	25	0
	4	0	0	0	**33**	40	0
	5	0	0	1	43	**39**	0
	6	0	0	1	71	91	**0**

Accuracy score = 0.164

Multinomial Logistic Regression

The multinomial logistic regression also did a relatively poor job of categorizing the data. The pseudo R^2 was only 0.0235, and the regression predicted 168 out of 445 categories correctly for an accuracy of 37.8% (Table 3. and Table). However, both the predictions and fit of the multinomial logistic regression were much higher than those of the negative binomial regression. The multinomial logistic regression's pseudo R^2 was higher at 0.0235, and its accuracy was more than twice as high.

Table 3.4. Multinomial logistic regression results.

inc_cats	Coef.	Std.	z	P>|z|
inc_cats=1	(base outcome)			
inc_cats=2				
days_watching	0.000984	0.00405	0.24	0.808
gender_male	0.775193	0.595145	1.3	0.193
m_age	-0.01025	0.017223	-0.6	0.552
USA	-0.51223	0.722437	-0.71	0.478
_cons	1.617224	0.974091	1.66	0.097
inc_cats=3				
days_watching	-0.00744	0.006274	-1.19	0.236
gender_male	0.289007	0.603445	0.48	0.632
m_age	0.013633	0.017338	0.79	0.432
USA	-0.15641	0.749093	-0.21	0.835
_cons	0.397847	1.012257	0.39	0.694
inc_cats=4				
days_watching	-0.04184	0.02977	-1.41	0.16
gender_male	0.373702	0.581069	0.64	0.52
m_age	0.016245	0.016664	0.97	0.33
USA	0.180423	0.735471	0.25	0.806
_cons	0.394709	0.985749	0.40	0.689
inc_cats=5				
days_watching	-0.00653	0.004946	-1.32	0.186

inc_cats	Coef.	Std.	z	P>|z|
gender_male	0.161876	0.578273	0.28	0.78
m_age	0.012686	0.016382	0.77	0.439
USA	0.36835	0.740001	0.50	0.619
_cons	0.495696	0.976704	0.51	0.612
inc_cats=6				
days_watching	-0.01192	0.006107	-1.95	0.051
gender_male	0.733877	0.548686	1.34	0.181
m_age	0.017742	0.015654	1.13	0.257
USA	0.311402	0.693479	0.45	0.653
_cons	0.781733	0.924603	0.85	0.398

Observations = 445
Log likelihood = -705.626
Pseudo R^2 = 0.0235

Table 3.5. Multinomial logistic regression confusion matrix.

		Predicted Category					
	Income Category	**1**	**2**	**3**	**4**	**5**	**6**
True Category	**1**	**0**	2	0	0	0	18
	2	0	**8**	0	0	1	45
	3	0	4	**0**	0	0	48
	4	0	3	0	**0**	0	70
	5	0	3	0	0	**0**	80
	6	0	3	0	0	0	**160**

Accuracy score = 0.378

The multinomial logistic regression outperformed the negative binomial regression, therefore, that was the model used to predict income for the contingent choice regressions. One potential issue is that the model tends to skew income toward the highest category. When running the choice models, a dummy variable was included to indicate whether or not the income value was predicted or not. The coefficient on the dummy variable was highly insignificant ($p > 0.5$) and none of the coefficients in the model changed by any significant amount. This implies that observations with predicted incomes are not changing the outcomes of the model by any noticeable margin.

New Ecological Paradigm

The New Ecological Paradigm (NEP) (Dunlap et al., 2000; Dunlap, 2008) was included in the survey questionnaire to remain consistent with past efforts to explain willingness-to-pay for outdoor recreation (Aldrich et al., 2007). Respondents were asked to indicate their level of agreement or disagreement with the 15 NEP statements. Responses were coded using a seven-point Likert scale. In the original survey scale, 1 corresponded to “strongly agree” and 5 corresponded to “strongly disagree.” However, for this analysis, the rating scale was reversed, since having higher agreement scores correspond to higher numbers made the analysis more intuitive. Agreement with eight particular NEP statements indicates endorsement of the NEP pro-environmental stance, whereas agreement with the remaining seven indicates endorsement of the Dominant Social Paradigm (DSP) or pro-development stance (see Dunlap et al. [2000] and Dunlap [2008] for more details on the NEP and DSP statements). Table 3.6 shows the full breakdown of the NEP ratings. The following NEP and DSP analysis is loosely based on Halkos and Matsiori (2017). All analyses were conducted in Python 3.7 using the statsmodels and matplotlib libraries.

Table 3.6. Summary of NEP ratings (n=861).

Item	Category	Mean	Standard Deviation	Response Rate
Despite our special abilities, humans are still subject to the laws of nature.	NEP	4.37	0.64	66.3%
Humans are seriously abusing the environment.	NEP	4.25	0.93	66.8%
Plants and animals have as much right as humans to exist.	NEP	4.11	0.97	66.7%
If things continue on their present course, we will soon experience a major ecological catastrophe.	NEP	4.08	0.97	66.7%
The balance of nature is very delicate and easily upset.	NEP	4.04	0.90	66.3%
When humans interfere with nature it often produces disastrous consequence.	NEP	4.02	0.96	66.7%
The Earth is like a spaceship with very limited room and resources.	NEP	3.77	1.02	66.2%
We are approaching the limit of the number of people the Earth can support.	NEP	3.63	1.1	66.7%
The Earth has plenty of natural resources if we just learn how to develop them.	DSP	2.93	1.17	66.1%
Human ingenuity will insure that we do not make the Earth unlivable.	DSP	2.79	1.03	66.2%
Humans have the right to modify the natural environment to suit their needs.	DSP	2.37	1.00	66.7%
Humans will eventually learn enough about how nature works to be able to control it.	DSP	2.34	0.95	66.3%
Humans were meant to rule over the rest of nature.	DSP	2.06	1.08	66.1%
The balance of nature is strong enough to cope with the impacts of modern industrial nations.	DSP	1.90	0.88	66.4%
The so-called “ecological crisis” facing humankind has been greatly exaggerated.	DSP	1.83	0.94	66.4%

Factor Analysis and Clustering

Although the NEP scale was originally designed to be one dimensional, previous studies have shown that it often contains multiple factors, although the exact number of factors remains unclear (Dunlap et al., 2000). Given this, a factor analysis was conducted on the NEP ratings to determine the number of dimensions that lie within the response data. Figure shows a scree plot for the factor analysis. The plot shows that only the first factor has an eigenvalue[3] above one, which means that only one factor is necessary to capture a majority of the variance within the data.

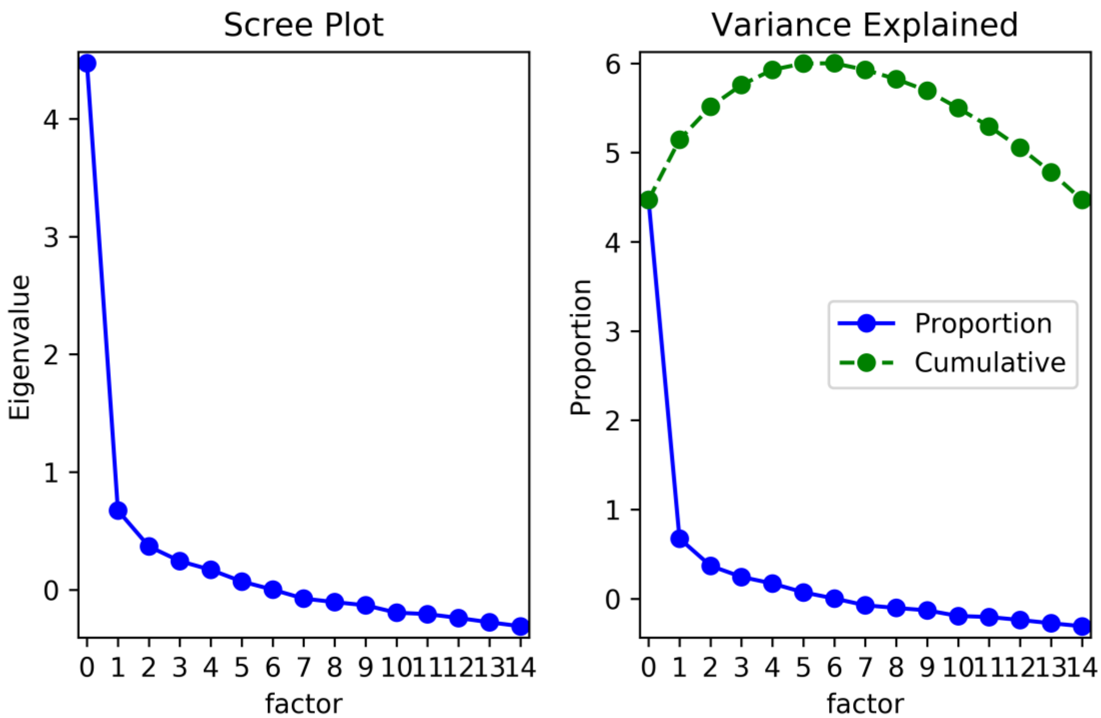

Figure 3.3. Factor analysis scree plot.

The factor loadings for a factor analysis with one factor are given in **Error! Reference source not found.**. The factor loadings indicate that all of the pro-environmental NEP ratings are positively correlated with each other and are all negatively correlated with the DSP ratings. Due to the fact that there only seems to be one underlying factor in the data, an overarching NEP index was created based on the factor loadings by taking the average rating of the pro-environmental NEP scores and subtracting the average rating of the DSP scores (DiStefano et al., 2009).

Table 3.7. NEP factor loadings.

Item	Factor Loadings
We are approaching the limit of the number of people the Earth can support.	0.5231
Humans have the right to modify the natural environment to suit their needs.	-0.4824
When humans interfere with nature it often produces disastrous consequence.	0.4632
Human ingenuity will insure that we do not make the Earth unlivable.	-0.4032
Humans are seriously abusing the environment.	0.5578

[3] For more information on eigenvalues and how they relate to factor analysis, see UCLA Institute for Digital Research and Education: Statistical Consulting (2020).

Item	Factor Loadings
The Earth has plenty of natural resources if we just learn how to develop them.	-0.3572
Plants and animals have as much right as humans to exist.	0.6054
The balance of nature is strong enough to cope with the impacts of modern industrial nations.	-0.6319
Despite our special abilities, humans are still subject to the laws of nature.	0.4557
The so-called “ecological crisis” facing humankind has been greatly exaggerated.	-0.6915
The Earth is like a spaceship with very limited room and resources.	0.5422
Humans were meant to rule over the rest of nature.	-0.5878
The balance of nature is very delicate and easily upset.	0.5947
Humans will eventually learn enough about how nature works to be able to control it.	-0.4438
If things continue on their present course, we will soon experience a major ecological catastrophe.	0.7119

After conducting the factor analysis, the next step was to determine the number of clusters based upon the factor score for each respondent. Due to the fact that these factor scores are one dimensional, the number of clusters was determined using a kernel density plot (Matioli et al., 2017). Any minimums in the plot indicate the potential for clustering. Figure shows the factor score distribution along with a kernel density plot. Both the distribution of the factors and the kernel density plot show that there was no clustering within the factor scores. A majority of respondents seemed to give higher ratings to the pro-environmental NEP items and lower ratings to the DSP items. While there are some respondents that deviated from this pattern, there were not enough for a separate cluster to form. This is not surprising; since the respondents were all whale watchers, they might have had some preferences for pro-environmental behaviors and beliefs.

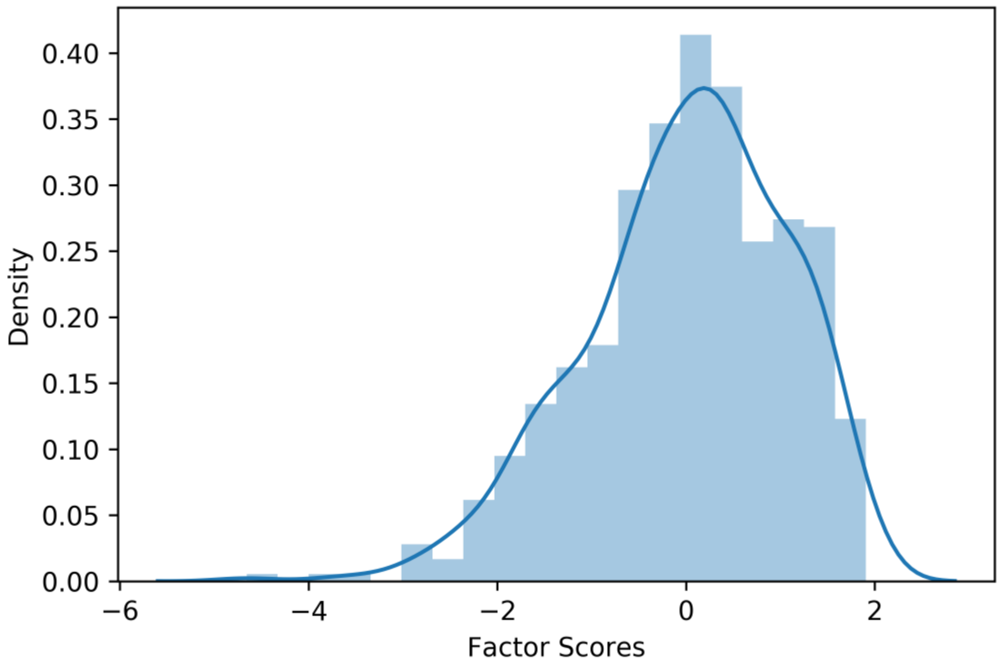

Figure 3.4. Factor score distribution and kernel density plot.

Analysis of the NEP ratings for whale watchers in CINMS shows that the data fit into one factor and one cluster. These findings are contrary to many previous studies conducted on NEP ratings. However, most of those studies dealt with much broader populations; whale watchers are a fairly unique group of people, therefore, it is not surprising to see more homogeneity among their environmental attitudes. Due to the fact that only one factor and one cluster seem to exist within the NEP data, the index created based on the factor analysis was the only variable related to NEP included in the contingent choice modeling.

Protest Bids

In stated choice modeling, it is important to identify "protesters". Protesters are respondents who reject something about the survey's scenario regardless of the value they have for the resource change. These individuals will not reveal their true willingness to pay and are often removed from the sample population. In order to identify these protesters, a thorough analysis was completed using questions that were included in the survey to elicit information on why people selected their choice using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Table 3.8 presents the results to Question 22 on the survey, which asked about the reason behind a respondent's choice. In conjunction with choosing the status quo, respondents were marked as a protester and excluded from the choice analysis if they rated one of the questions listed in Table 3.8 a 4 (agree) or a 5 (strongly agree).

In total, 32 of the 861 respondents were marked as protesters based on these criteria. Respondents who selected the status quo option but did not mark a four or a five for the protester statements may be behaving consistently with economic theory. For example, the utility increase that a respondent would experience from resource improvements was lower than the accompanying price increase and, therefore, the respondent chose to maintain the status quo.

Table 3.8. Percent of people who "agree" or "strongly agree" with the protester statements.

Question	Percent That Agree or Strongly Agree	Total Responses
There was not enough information for me to make informed decisions about doing more to protect and restore natural resources or expand and improve facilities and services.	30.6%	576
I was concerned the federal, state, and local governments cannot effectively manage the natural resources and facilities or provide the services.	23.2%	570
I should not have to pay more for maintaining or improving conditions.	69.8%	572
I do not believe the scenarios accurately represent the current or potential states of the environment.	46.0%	567

Chapter 4:
THE VALUE OF MARINE RESOURCE IMPROVEMENTS

Contingent Valuation Theory

Analysis of the choice sets for estimating non-market economic use values and how those values change with changes in resource attribute conditions and socioeconomic factors was conducted by first using a standard multinomial model based in random utility theory (Ben-Akiva & Lerman, 1985). To summarize, U = utility of household (well-being). U is a function of a vector zin of attributes for alternative i, as perceived by household respondent n. The variation of preferences between individuals is partially explained by a vector Sn of socio-demographic characteristics for person n.

$$U_{in} = V(z_{in}, S_n) + \varepsilon(z_{in}, S_n) = V_{in} + \varepsilon_{in}$$

V is known as indirect utility and ε is an error term treated as a random variable (McFadden, 1974), making utility itself a random variable. An individual is assumed to choose the option that maximizes their utility. The choice probability (P) of any particular option (Option A [status quo], Option B, or Option C) is the probability (Pr) that the utility of that option is greatest across the choice set (Cn):

$$P\,(i \mid C_n) = Pr[V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}\text{, for all } j \in C_n, j \text{ not equal to } i]$$

If error terms are assumed to be independently and identically distributed, and if the data fit a Gumbel distribution, the above can be expressed in terms of the logistic distribution:

$$P_n(i) = e^{\mu V in} / \sum e^{\mu V jn}$$

The summation occurs over all options in a choice set. The assumption of independent and identically distributed error terms implies independence of irrelevant attributes, meaning that the ratio of choice probabilities for any two alternatives is unchanged by addition or removal of other unchosen alternatives (Blamey et al., 2000). The μ term is a scale parameter, a convenient value that may be chosen without affecting valuation results if the marginal utility of income is assumed to be linear. The analyst must specify the deterministic portion of the utility equation V, with sub-vectors z and S. The vector z comes from choice experiment attributes, and the vector S comes from attitudinal, recreational, and socio-demographic questions in the survey. Econometrics software (Stata) was used to estimate the regression coefficients for z and S, with a linear-in-parameters model specification. These coefficients are used in estimating average household value for a change in one level to another level of a particular attribute for welfare estimation. Welfare of a change is given by:

$$Welfare = (1/\beta_c)[V^0 - V^1]$$

where β_c is the coefficient of cost, V^0 is an initial option, and V^1 is a change option (Holmes & Adamowicz, 2003).

The standard multinomial logit model and conditional logit model treats the multiple observations (choice experiment replications) from each household as independent. An alternative is to model these as correlated with a random parameters (mixed) logit model. Thus, a random parameters logit model was also tested using techniques described by Greene (2007):

$V = \beta_o + \beta_1$(Large Baleen Whales Individuals Change) + β_2(Other Baleen Whales Population Change) + β_3 (Smaller Whales and Dolphins & Porpoises Population Change) + β_4(Seals and Sea Lions Population Change) + β_5(Shorebirds and Seabirds Population Change) + β_6(Cost)

Choice of Model

Three different specifications were tested for the final contingent choice model: a fixed effects conditional logit model, a mixed effects logit choice model (MEL), and a nested logit model (NL). The latter two models are useful because they relax the assumption of independence of irrelevant alternatives (IIA). IIA assumes that when people are presented with a set of alternatives, their probability of choosing one alterative (A) over another alternative (B) does not depend on the presence of some other alternative (C). If the IIA assumption is violated, it means that the alternatives are correlated and, therefore, the interpretability of the results are jeopardized. If the IIA assumption is met, then the MEL and NL models may not be warranted and the fixed effects conditional logit model should be used. Hausman's specification test can be used to verify whether or not these data meet the assumptions. The likelihood-ratio test for IIA was also conducted for the NL model.

For the NL model, the respondent is assumed to first decide between the status quo and an improvement in resource condition. If they choose an improvement in resource condition, they then choose between the remaining options. To test for IIA using the Hausman test in the NL model, estimation was first run on the full set of alternatives and the estimates were stored. The estimation was run again, this time excluding the status quo alternative. The Hausman test was conducted between these two estimates; if the IIA assumption were violated the test would show that there is a systematic difference in the coefficients between the two estimates. The test returned a chi-square value of -19.20 (with 16 degrees of freedom); negative chi-square values are a common issue in the Hausman test, however, an easy fix is to use the absolute value of the chi-square statistic, which results in a p-value of 0.259 (Schreiber, 2008). The likelihood ratio test for IIA was also conducted for the NL model and returned a chi-square value of 4.70 (with two degrees of freedom) and a p-value of 0.096. These results imply that there was not sufficient evidence to reject the IIA assumption and therefore the use of the NL model was not warranted.

For the MEL model, a normal error structure was assumed. Price was fixed and all other variables were random. The Hausman test was conducted between the MEL model and the fixed effects conditional logit model to test whether mixed effects should be used. First, the MEL model was run and the estimates were stored. One important note about the MEL model is that the log-simulated likelihood was not concave and, therefore, convergence was not achieved.

Instead, the model was capped at 25 iterations, as there was no change in the log-simulated likelihood from iterations 25 to 65. Then, the fixed effects model was run and the Hausman test was conducted. The results of the Hausman test gave a chi-square value of 0.45, which returns a p-value of about 1. This means that there is a very small statistical difference between the coefficients of the mixed effects model and the fixed effects model. This result, as well as the fact that the MEL model did not converge, led to the conclusion that a fixed effects model was more appropriate for assessing the data.

Based on the results of the specification tests, a fixed effect conditional logit model was selected. Although the NL and MEL models were not chosen, their results, along with the results for the Hausman tests, can be found in **Error! Reference source not found.**. All specification tests a nd models were estimated using Stata Version 16 (StataCorp, 2019), and the specification tests were outlined based on the Stata manuals for the commands “hausman” and “nlogit,” respectively.

Final Model

The result of the fixed effects conditional logit model is shown in **Error! Reference source n ot found.**. The only animal that had consistently positive coefficients across all choice levels was “large baleen whales.”

Table 4.1. Fixed effects conditional logit model results

chosen	Coef.	Std.	z	P>|z|	95% Confidence Interval	
Option						
Price	-0.001***	0.000	-4.24	0.000	-0.002	-0.001
LargeBaleenWhales_H	0.260**	0.103	2.54	0.011	0.059	0.461
LargeBaleenWhales_MH	0.213**	0.102	2.08	0.037	0.012	0.414
LargeBaleenWhales_M	0.244**	0.111	2.20	0.028	0.026	0.462
OtherBaleenWhales_H	0.048	0.103	0.46	0.644	-0.155	0.251
OtherBaleenWhales_MH	-0.078	0.111	-0.70	0.484	-0.295	0.140
OtherBaleenWhales_M	-0.298**	0.120	-2.49	0.013	-0.532	-0.063
Toothed_whales_H	0.172	0.124	1.39	0.165	-0.071	0.416
Toothed_whales_MH	0.137	0.103	1.33	0.185	-0.065	0.339
Toothed_whales_M	-0.067	0.131	-0.51	0.609	-0.323	0.189
SealsSeaLions_H	0.099	0.103	0.96	0.338	-0.103	0.301
SealsSeaLions_MH	-0.116	0.117	-1.00	0.320	-0.345	0.113
SealsSeaLions_M	-0.079	0.114	-0.69	0.489	-0.301	0.144
SeabirdsShorebirds_H	-0.123	0.113	-1.09	0.276	-0.344	0.098
SeabirdsShorebirds_MH	0.088	0.111	0.79	0.427	-0.129	0.305
SeabirdsShorebirds_M	-0.215*	0.124	-1.73	0.083	-0.458	0.028
Option A	(base alternative)					
Option B						
nep_index	0.437***	0.112	3.88	0.000	0.216	0.657

chosen	Coef.	Std.	z	P>|z|	95% Confidence Interval	
inc_with_preds	0.156*	0.087	1.81	0.071	-0.013	0.326
summer_season	0.676**	0.312	2.17	0.030	0.064	1.288
_cons	-0.472	0.701	-0.67	0.500	-1.846	0.901
Option C						
nep_index	0.816***	0.137	5.96	0.000	0.548	1.085
inc_with_preds	0.223**	0.091	2.45	0.014	0.045	0.401
summer_season	0.404	0.332	1.22	0.224	-0.247	1.054
_cons	-1.057	0.718	-1.47	0.141	-2.464	0.351

Number of observations: 4,392
Standard errors adjusted for 503 clusters for respondent id
Pseudo R^2 = 0.204
*P<.10, **P<.05, ***P<.01

Model Interpretation

Error! Reference source not found. shows the odds ratios for the alternative-specific v ariables and the relative risk ratios for the case specific variables. If a choice level has an odds ratio above one, respondents are more likely to pick that option that includes that choice level (compared to the "low" choice level). If one of the case variables has a relative risk ratio above one, it means that if the case variable increases by one, then the respondent is more likely to pick the option it is interacted with. If the relative risk ratio is below one, then the respondent is less likely to pick the option it is interacted with.

Of the 15 choice levels (excluding the "low" option) given to respondents, eight had an odds ratio above one and seven had an odds ratio below one. Out of the eight items with positive odds ratios, three were statistically significant, and all of them were the choice levels associated with baleen whales. Only two out of the seven items with negative odds ratios were statistically significant: the "medium" levels for other baleen whales and seabirds and shorebirds.

The average odds ratio was 1.105 for the "high" choice level, 1.058 for the "medium high" choice level, and 0.937 for the "medium" choice level. This means that respondents tended to pick an option if it had a higher choice level, although there was some variation depending on the animal. Overall, this indicates that respondents had a preference for higher quality natural resource conditions.

The relative risk ratios on the NEP index and income category were significantly positive for options two and three. Since both options represent a resource improvement compared to the status quo (option one), this means that respondents are more likely to select a resource improvement if their NEP index or income category is higher.

Table 4.2. Odds ratios for contingent choice model.

chosen	Coef.	Std.	z	P>|z|	95% Confidence Interval	
Option						
Price	0.999***	0.000	-4.24	0.000	0.998	0.999
LargeBaleenWhales_H	1.297**	0.133	2.54	0.011	1.061	1.586
LargeBaleenWhales_MH	1.238**	0.127	2.08	0.037	1.012	1.513
LargeBaleenWhales_M	1.276**	0.142	2.20	0.028	1.027	1.587
OtherBaleenWhales_H	1.049	0.109	0.46	0.644	0.856	1.285
OtherBaleenWhales_MH	0.925	0.103	-0.70	0.484	0.744	1.150
OtherBaleenWhales_M	0.743**	0.089	-2.49	0.013	0.587	0.939
Toothed_whales_H	1.188	0.148	1.39	0.165	0.931	1.515
Toothed_whales_MH	1.147	0.118	1.33	0.185	0.937	1.404
Toothed_whales_M	0.935	0.122	-0.51	0.609	0.724	1.208
SealsSeaLions_H	1.104	0.114	0.96	0.338	0.902	1.351
SealsSeaLions_MH	0.890	0.104	-1.00	0.320	0.708	1.119
SealsSeaLions_M	0.924	0.105	-0.69	0.489	0.740	1.155
SeabirdsShorebirds_H	0.884	0.100	-1.09	0.276	0.709	1.103
SeabirdsShorebirds_MH	1.092	0.121	0.79	0.427	0.879	1.356
SeabirdsShorebirds_M	0.807*	0.100	-1.73	0.083	0.633	1.028
Option A	(base alternative)					
Option B						
nep_index	1.548***	0.174	3.88	0.000	1.242	1.930
inc_with_preds	1.169*	0.101	1.81	0.071	0.987	1.385
summer_season	1.966**	0.614	2.17	0.030	1.066	3.625
_cons	0.624	0.437	-0.67	0.500	0.158	2.461
Option C						
nep_index	2.262***	0.310	5.96	0.000	1.729	2.958
inc_with_preds	1.250**	0.114	2.45	0.014	1.046	1.493
summer_season	1.497	0.497	1.22	0.224	0.781	2.869
_cons	0.348	0.250	-1.47	0.141	0.085	1.421

*P<.10, **P<.05, ***P<.01

Table shows the marginal willingness to pay (MWTP) for resource improvement from the “low” level. MWTP is calculated by dividing the coefficient of the resource level by the negative coefficient of price. The p-value for each level is also shown to indicate if the MWTP for the item is statistically significant. The level with the highest willingness to pay is the “high” level for large baleen whales. However, the confidence intervals for the coefficients on large baleen whales (**Error! Reference source not found.** and **Error! Reference source not found.**) sh ow that the levels are not significantly different from each other. Therefore, it is unclear whether people are actually willing to pay more to increase conditions from the “low” level to the “high” level versus from the “low” level to the “medium” or “medium high” level. But, it is clear that people are willing to pay for some improvement to large baleen whales since all of the resource levels' coefficients were significantly positive.

The MWTP values in

Table represent the total amount that households are willing to pay to improve the condition of a given resource from "low" condition to the condition listed in the column labeled "Choice Levels" (note that these MWTP values represent a one-time payment). For example, the value of $220.51 for "large baleen whales, high" means that households are willing to make a one-time payment of $220.51 to improve the condition of large baleen whales from "low" to "high" condition.

No other levels had a significantly positive MWTP; the only other statistically significant items were "medium" levels for seabirds and shorebirds and other baleen whales, both of which were negative. Negative values for WTP pose many issues in non-market valuation and several different methods have been used to handle them. For this paper, these values were truncated to zero, a method that has been used and tested in previous research on the subject (Brown et al., 1996; Haab & McConnell, 1998). Although the negative values are presented in the tables, the subsequent analysis assumes that these values are equal to zero.

The fact that people are unwilling to pay for an improvement to birds is consistent with previous findings from NOAA Office of National Marine Sanctuaries. It is worth noting, however, that respondents were visiting to engage in whale watching, and it is likely that bird watchers would have a different willingness to pay (and consumer surplus) for various resource condition improvements. (It is also possible that the lack of responses to versions 13–16 created a bias.) When asked to give likeability scores to different animals, respondents ranked birds the lowest, which is consistent with past studies in Olympic Coast National Marine Sanctuary (Leeworthy et al., 2017) and Stellwagen Bank National Marine Sanctuary (Schwarzmann & Shea, 2020). Whale categories other than large baleen whales may have a negative or insignificant willingness to pay due to the fact that the whales in these categories are rarely, if ever, seen on whale watching trips. They are also not advertised on whale watching company websites, so respondents may not be familiar with them. It is possible that people may not be willing to pay to improve the conditions of species that they have never seen, are unlikely to see, or are unfamiliar with.

Table 4.3. Willingness to pay.

Choice Levels	Coefficient	MWTP ($)	p-value
Price	-0.001***	N/A	0.000
Large baleen whales, high	0.260**	220.51	0.011
Large baleen whales, medium high	0.213**	180.64	0.037
Large baleen whales, medium	0.244**	206.80	0.028
Other baleen whales, high	0.048	40.59	0.644
Other baleen whales, medium high	-0.078	-65.88	0.484
Other baleen whales, medium	-0.298**	-252.27	0.013
Toothed whales, high	0.172	146.10	0.165

Choice Levels	Coefficient	MWTP ($)	p-value
Toothed whales, medium high	0.137	115.93	0.185
Toothed whales, medium	-0.067	-56.63	0.609
Seals and sea lions, high	0.099	83.83	0.338
Seals and sea lions, medium high	-0.116	-98.36	0.320
Seals and sea lions, medium	-0.079	-66.66	0.489
Seabirds and shorebirds, high	-0.123	-104.18	0.276
Seabirds and shorebirds, medium high	0.088	74.45	0.427
Seabirds and shorebirds, medium	-0.215*	-182.22	0.083

Number of * indicate the significance level: *P<.10, **P<.05, ***P<.01

Chapter 5: CONCLUSION

Summary

Overall, it appears that respondents value improvements to large baleen whales more than any other species groups. Given that all choice levels for large baleen whales were significant, it seems that respondents are willing to pay for any level of improvement to this species group. The fact that birds have low MWTP values is consistent with previous findings by NOAA Office of National Marine Sanctuaries, which show that birds are consistently ranked low in likeability compared to other species. Other whale groups may also have relatively small MWTP values due to how rare it is to see many of those species, which may indicate that whale watchers are mostly interested in improving the condition of species that they are likely to see on a regular basis. Respondents also seemed to have larger MWTP values for higher resource levels, even if all are not all are statistically significant. Case variables such as household income category and environmental attitudes as measured by the NEP index were also important in determining a respondent's choice for resource improvement.

WTP for large baleen whales to move from low to high condition was found to be $220.50 per whale watching household. Using this information, along with the annual number of whale watching passengers in the region, total WTP (household WTP * number of passengers) is roughly $5 million. There are roughly 25,000 annual whale watching passengers from the three operations in this study area. A national survey found that willingness to pay for improvements to whales was $70 per household annually (a total willingness to pay of $8 billion when aggregated to all households in the United States) (Bone et al., 2016). Compared to these results, the estimate from the present study may seem low, however, the present study only surveyed whale watching passengers. Combined, these studies suggest that willingness to pay for whale conservation is higher among whale watchers, but even those who do not visit or engage in whale watching in the area are willing to pay to protect these majestic mammals.

Limitations

One limitation of these results is that they only represent the opinions of whale watching passengers. Whale watchers are a unique group of people and are not representative of the general population; therefore, these WTP estimates cannot be applied to the general population. This means that this study is not sufficient to estimate the true WTP for resource improvement in CINMS since other sanctuary users (and non-users) were not surveyed, and future research is therefore needed. The total WTP estimates for large baleen whales in this study are likely an underestimate, as it is reasonable to assume that members of the general population will have some level of WTP for resource improvement in CINMS. However, these results can serve a conservative estimate of non-market benefits in future cost-benefit analyses.

Future Research

Areas of future research include determining why birds are consistently ranked low in likeability relative to other species and seem to have a negative WTP value for some levels of improvement. Another outstanding issue is whether respondents are willing to pay more for animals they are familiar with or see often. The current hypothesis for why other whale species outside of the large baleen whales family had low WTP values is that they are not often viewed in the sanctuary and sometimes rarely seen in general. More research is required to test this hypothesis. It is also possible that this reasoning only applies to whale watchers, as they are specifically interested in seeing whales, whereas the general public may value whales regardless of their interest in seeing them. More work is required to determine WTP estimates for the general population in the Channel Islands region. The current WTP estimates only represent a niche group of households, and it is also important to determine how the general population feels about resource improvements in CINMS.

More research is also needed to address problems and questions that have arisen in this study. It is important to understand the implications of missing data as well as the effects of administering different sets of survey versions between sample groups. It is possible that these issues introduced some bias to the model results, however, it is impossible to isolate their effects given the current study design. Response rates for income continue to be a problem across NOAA Office of National Marine Sanctuaries surveys, and other variables in the survey do not provide a good indicator of income levels. It is worth testing whether or not other variables can be included in the survey that can serve as accurate predictors of income. This may allow future studies to more accurately predict respondent income and provide better measures of respondent WTP.

Case variables seem to be highly significant in the WTP models presented. Therefore, it may also be useful to test whether or not additional experiential data would have significant effects on the model. The resource levels for large baleen whales were described in terms of number of whales killed, while the other levels were described in terms of number of species endangered or threatened. It is possible that respondents had a stronger response to the description used for large baleen whales and therefore had a higher WTP for that species group. More research is necessary to test the type of effect that different descriptions of resource levels have on WTP estimates.

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Literature Cited

Adamowicz, W., Louviere, J., & Swait, J. (1998). Introduction to attribute-based stated choice methods. Report submitted to U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Damage Assessment Center, Resource Valuation Branch.

Aldrich, G., Grimsrud, K., Thatcher, J., & Kotchen, M. (2007). Relating environmental ethical attitudes and contingent values: How robust are methods for identifying preference heterogeneity. *Environmental Resource Economics*, *37*, 757–775.

Barlow, J., Calambokidis, J., Falcone, E. A., Baker, C. S., Burdin, A. M., Clapham, P. J., Ford, J. K. B., Gabriele, C. M., LeDuc, R., Mattila, D. K., Quinn, T. J., Rojas-Bracho, L., Straley, J. M., Taylor, B. L., Urbán R., J., Wade, P., Weller, D., Witteveen, B. H., & Yamaguchi, M. (2011). Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. *Marine Mammal Science*, *27*(4), 793–818.

Ben-Akiva, M., & Lerman, S. R. (1985). Discrete choice analysis: theory and application to travel demand. MIT Press.

Blamey, R. K., Bennett, J. W., Louviere, J. J., Morrison, M. D., & Rolfe, J. (2000). A test of policy labels in environmental choice modelling studies. *Ecological Economics*, *32*, 269–286.

Bone, J., Meza, E., Mills, K., Rubino, L., & Tsukayama, L. (2016). Vessel speed reduction, air pollution, and whale strike tradeoffs in the Santa Barbara Channel region. [Master's group project, University of California Santa Barbara].

Brown, T. C., Champ, P. A., Bishop, R. C., & McCollum, D. W. (1996). Which response format reveals the truth about donations to a public good? *Land Economics*, *72*, 152–66.

Bunch, D. S., & Batsell, R. R. (1989). A Monte Carlo comparison of estimators for the multinomial logit model. *Journal of Marketing Research*, *26*, 56–68.

Calambokidis, J., Steiger, G. H., Rasmussen, K., Urbán R., J., Balcomb, K. C., Ladrón de Guevara P., P., Salinas Z., M., Jacobsen, J. K., Baker, C. S., Herman, L. M., Cerchio, S., & Darling, J. D. (2000). Migratory destinations of humpback whales that feed off California, Oregon and Washington. *Marine Ecology Progress Series*, *192*, 295–304.

Calambokidis, J., & Barlow, J. (2004). Abundance of blue and humpback whales in the eastern North Pacific estimated by capture-recapture and line-transect methods. *Marine Mammal Science*, *20*(1), 63–85.

Calambokidis, J., Falcone, E., Quinn II, T. J., Burdin, A. M., Clapham, P. J., Ford, J., Gabriele, C., LeDuc, R., Matilla, D., Rojas-Bracho, L., Straley, J. H., Taylor, B. L., Urbán R., J., Weller, D., Witteveen, B. H., Yamaguchi, M., Bendlin, A., Camacho, D., Flynn, K., Havron, A., Huggins, J., Maloney, N., Barlow, J., & Wade, P. (2008). *SPLASH: Structure of populations, levels of abundance and status of humpback whales in the North Pacific*. Final report for contract AB133F-03-RP-00078, for U.S. Department of Commerce. Cascadia Research Collective.

Calambokidis, J., & Barlow, J. (2013). *Updated abundance estimates of blue and humpback whales off the U.S. West Coast incorporating photo-identifications from 2010 and 2011*. Final report for contract AB-133F-10-RP-0106. PSRG-2013-13R. Cascadia Research Collective.

Chami, R., Cosimano, T., Fullenkamp, C., & Oztosun, S. (2019). Nature's solution to climate change: A strategy to protect whales can limit greenhouse gases and global warming. *Finance & Development*, *56*(4), 34–38.

DiStefano, C., Zhu, M., & Mîndrilã, D. (2009). Understanding and using factor scores: Considerations for the applied researcher. *Practical Assessment, Research, and Evaluation*, *14*, 20.

Dunlap, R.E. (2008). The New Environmental Paradigm scale: From marginality to worldwide use. *Journal of Environmental Education*, *40*(1), 3–18.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). Measuring endorsement of the New Ecological Paradigm: A revised NEP scale. *Journal of Social Issues*, *56*(2), 425–442.

Greene, W. H. (2007). *LIMDEP version 9.0: user's manual*. Econometric Software, Inc.

Haab, T. & McConnell, K. (1998). Referendum models and economic values: Theoretical, intuitive, and practical bounds on willingness to pay. *Land Economics*, *74*, 216–229.

Halkos, G. & Matsiori, S. (2017). Environmental attitude, motivations and values for marine biodiversity protection. *Journal of Behavioral and Experimental Economics*, *69*, 61–70.

Holmes, T. P., & Adamowicz, W. L. (2003). Attribute-based methods. In P. A. Champ, K. J. Boyle, & T. C. Brown (Eds.), *A primer on nonmarket valuation* (pp. 171–219). Kluwer Academic Publishers.

Johnson, F. R., Kanninen, B., Bingham, M., & Özdemir, S. (2007). Experimental design for stated-choice studies. In B. J. Kanninen (Ed.), *Valuing environmental amenities using stated choice studies* (pp. 159–202). Springer.

Leeworthy, V. R., Conant, P., & Schwarzmann, D. (2018). *Non-market economic value by reef using visitors for recreation on Puerto Rico's coral reef ecosystems, an attributes approach: Policy/management scenarios*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries. https://www.ncei.noaa.gov/data/oceans/coris/library/NOAA/CRCP/NOS/ONMS/Other/pr_ecosystem_valuation/Nonmarket_Economic_Value_Policy_Management_Scenarios_accessible.pdf

Leeworthy, V. R., Schwarzmann, D., Reyes Saade, D. (2017). *Technical appendix: Non-market economic value of recreation use on the outer coast of Washington and the Olympic Coast National Marine Sanctuary, an attributes approach: Volume 5, 2014*. Marine Sanctuaries Conservation Series ONMS-17-9. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries. https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/docs/ocnms-rec-technical-appendix-non-market.pdf

Leeworthy, V. R., & Wiley, P. C. (2003). *Socioeconomic impact analysis of marine reserve alternatives for the Channel Islands National Marine Sanctuary*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service. https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/archive/science/socioeconomic/channelislands/pdfs/2003_analysis.pdf

Loomis, J. B., & Larson, D. M. (1994). Total economic values of increasing gray whale populations: results from a contingent valuation method. *Marine Resources Economics*, *9*, 275–286.

Louviere J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated choice methods: analysis and application*. Cambridge University Press.

Matioli, L. C., Santos, S. R., Kleina, M., & Leite, E. A. (2017). A new algorithm for clustering based on kernel density estimation. *Journal of Applied Statistics*, *45*(2), 347–366.

McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka (Ed.), *Frontiers in econometrics* (pp. 105–142). New York Academic Press.

NCSS Statistical Software. (2020). Chapter 326: Negative binomial regression. https://ncss-wpengine.netdna-ssl.com/wp-content/themes/ncss/pdf/Procedures/NCSS/Negative_Binomial_Regression.pdf

NOAA Office of National Marine Sanctuaries. (2019). *Channel Islands National Marine Sanctuary 2016 Condition Report*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/docs/2016-condition-report-channel-islands-nms.pdf

O'Connor, S., Campbell, R., Cortez, H., & Knowles, T. (2009). *Whale watching worldwide: Tourism numbers, expenditures and expanding economic benefits*. A special report from the International Fund for Animal Welfare, prepared by Economists at Large.

Orme, B. (1998). *Sample size issues for conjoint analysis studies*. Sawtooth Software, Inc.

Schreiber, S. (2008). The Hausman test statistic can be negative even asymptotically. *Jahrbücher für Nationalökonomie und Statistik*, *228*(4), 394–405.

Schwarzmann, D., & Shea, R. (2020). *Whale watching in Stellwagen Bank National Marine Sanctuary: understanding passengers and their economic contributions*. National Marine Sanctuaries Conservation Series ONMS-20-12. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries. https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/docs/20201103-sbnms-whale-watching.pdf

Shea, R., Schwarzmann, D., Leeworthy, V., Hasting, S., Knapp, L., & Tracy, S. (2020). *Whale watching in Channel Islands National Marine Sanctuary: understanding passengers and their economic contributions*. [Manuscript submitted for publication]. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries.

StataCorp LLC. (2019). Stata Statistical Software: Release 16.

UCLA Institute for Digital Research and Education: Statistical Consulting. (2020, July 9). A practical introduction to factor analysis: Exploratory factor analysis. https://stats.idre.ucla.edu/spss/seminars/introduction-to-factor-analysis/a-practical-introduction-to-factor-analysis/

APPENDIX A: Statistical Test Results

Alternative Models

Table A.1. Nested logit model results.

chosen	Coef.	Std.	z	P>|z|	95% Confidence Interval	
Option						
Price	0.000	0.000	-0.430	0.668	-0.001	0.001
LargeBaleenWhales_H	0.042	0.084	0.500	0.617	-0.122	0.206
LargeBaleenWhales_MH	0.029	0.060	0.490	0.627	-0.089	0.148
LargeBaleenWhales_M	0.031	0.061	0.520	0.605	-0.088	0.151
OtherBaleenWhales_H	0.013	0.028	0.470	0.638	-0.042	0.068
OtherBaleenWhales_MH	-0.017	0.050	-0.350	0.730	-0.115	0.081
OtherBaleenWhales_M	-0.063	0.153	-0.410	0.679	-0.362	0.236
Toothed_whales_H	0.025	0.043	0.600	0.552	-0.058	0.109
Toothed_whales_MH	0.012	0.024	0.530	0.598	-0.034	0.059
Toothed_whales_M	-0.027	0.081	-0.340	0.736	-0.186	0.132
SealsSeaLions_H	0.017	0.027	0.610	0.542	-0.037	0.070
SealsSeaLions_MH	-0.027	0.083	-0.330	0.745	-0.189	0.135
SealsSeaLions_M	-0.027	0.076	-0.350	0.724	-0.175	0.121
SeabirdsShorebirds_H	-0.037	0.096	-0.390	0.700	-0.226	0.152
SeabirdsShorebirds_MH	0.008	0.022	0.380	0.700	-0.035	0.052
SeabirdsShorebirds_M	-0.061	0.147	-0.410	0.680	-0.350	0.228
type equations						
status_quo						
nep_index	-0.537***	0.125	-4.29	0.000	-0.782	-0.292
inc_with_preds	-0.183***	0.059	-3.10	0.002	-0.299	-0.067
summer_season	-0.154	0.192	-0.80	0.423	-0.531	0.223
Other						
nep_index	0	(base)				
inc_with_preds	0	(base)				
summer_season	0	(base)				
dissimilarity parameters						
/type						
status_quo_tau	1.000	1.880			-2.685	4.685
other_tau	0.184	0.401			-0.601	0.969

Number of observations: 4,173
Standard errors adjusted for 473 clusters in ID
*P<.10, **P<.05, ***P<.01

Table A.2. Mixed effects logistic model results.

chosen	Coef.	Std.	z	P>|z|	95% Confidence Interval	
Option						
Price	-0.001***	0.000	-3.11	0.002	-0.002	0.000
LargeBaleenWhales_H	0.317**	0.158	2.01	0.045	0.007	0.627
LargeBaleenWhales_MH	0.230	0.153	1.51	0.132	-0.069	0.530
LargeBaleenWhales_M	0.279*	0.164	1.70	0.089	-0.043	0.601
OtherBaleenWhales_H	0.085	0.161	0.53	0.598	-0.230	0.400
OtherBaleenWhales_MH	-0.077	0.149	-0.52	0.606	-0.368	0.215
OtherBaleenWhales_M	-0.326**	0.170	-1.92	0.055	-0.659	0.007
Toothed_whales_H	0.217	0.164	1.32	0.186	-0.105	0.539
Toothed_whales_MH	0.154	0.137	1.13	0.260	-0.114	0.422
Toothed_whales_M	-0.097	0.181	-0.54	0.591	-0.451	0.257
SealsSeaLions_H	0.048	0.175	0.28	0.783	-0.294	0.390
SealsSeaLions_MH	-0.181	0.188	-0.96	0.335	-0.549	0.187
SealsSeaLions_M	-0.088	0.144	-0.61	0.539	-0.370	0.193
SeabirdsShorebirds_H	-0.207	0.202	-1.03	0.305	-0.603	0.189
SeabirdsShorebirds_MH	0.051	0.164	0.31	0.754	-0.270	0.373
SeabirdsShorebirds_M	-0.310	0.212	-1.46	0.144	-0.726	0.106
/Normal						
sd(LargeBaleenWhales_H)	0.263	0.605			2.88E-03	23.948
sd(LargeBaleenWhales_MH)	0.436	1.158			2.39E-03	79.541
sd(LargeBaleenWhales_M)	0.091	0.824			0.000	4575046
sd(OtherBaleenWhales_H)	0.237	0.948			9.42E-05	597.669
sd(OtherBaleenWhales_MH)	0.000	.			.	.
sd(OtherBaleenWhales_M)	0.230	0.599			1.38E-03	38.230
sd(Toothed_whales_H)	0.221	0.521			2.16E-03	22.534
sd(Toothed_whales_MH)	0.157	0.761			1.16E-05	2110.503
sd(Toothed_whales_M)	0.460	1.893			0.000144	1468.957
sd(SealsSeaLions_H)	1.869	1.387			0.43675	8.002
sd(SealsSeaLions_MH)	0.319	0.681			4.82E-03	21.071
sd(SealsSeaLions_M)	0.188	0.450			1.75E-03	20.324
sd(SeabirdsShorebirds_H)	0.344	0.798			3.64E-03	32.529
sd(SeabirdsShorebirds_MH)	0.290	0.603			4.92E-03	1.71E+01
sd(SeabirdsShorebirds_M)	0.133	0.615			1.56E-05	1.14E+03
Option A						
nep_index	-0.850***	0.126	-6.74	0.000	-1.097	-0.603
inc_with_preds	-0.231***	0.070	-3.3	0.001	-0.369	-0.094
summer_season	-0.400*	0.242	-1.65	0.099	-0.875	0.075
_cons	1.100	0.610	1.8	0.071	-0.096	2.297
Option B						
nep_index	-0.423***	0.113	-3.75	0.000	-0.644	-0.202
inc_with_preds	-0.087	0.058	-1.50	0.135	-0.201	0.027

chosen	Coef.	Std.	z	P>|z|	95% Confidence Interval	
summer_season	0.259	0.165	1.57	0.117	-0.065	0.583
_cons	0.806	0.501	1.61	0.108	-0.177	1.788
Option C	(base alternative)					

Number of observations: 4,392
Integration sequence: Hammersley
Integration points: 906
Note: convergence not achieved
*P<.10, **P<.05, ***P<.01

Table A.3. Fixed effects conditional logit model results.

chosen	Coef.	Std.	z	P>|z|	95% Confidence Interval	
Option						
Price	-0.001***	0.000	-5.02	0.000	-0.002	-0.001
LargeBaleenWhalesOrd	0.087***	0.029	3.05	0.002	0.031	0.143
OtherBaleenWhalesOrd	0.063**	0.032	1.97	0.049	0.000	0.126
Toothed_whalesOrd	0.087**	0.035	2.50	0.012	0.019	0.155
SealsSeaLionsOrd	0.069**	0.031	2.25	0.024	0.009	0.130
SeabirdsShorebirdsOrd	0.021	0.029	0.72	0.469	-0.036	0.079
Option A	(base alternative)					
Option B						
nep_index	0.442***	0.112	3.93	0.000	0.222	0.663
inc_with_preds	0.153*	0.086	1.78	0.075	-0.015	0.321
summer_season	0.675*	0.311	2.17	0.030	0.066	1.284
_cons	-0.915	0.651	-1.40	0.160	-2.191	0.362
other						
nep_index	0.823***	0.136	6.04	0.000	0.556	1.090
inc_with_preds	0.226**	0.091	2.48	0.013	0.047	0.404
summer_season	0.417	0.331	1.26	0.207	-0.231	1.065
_cons	-1.429	0.687	-2.08	0.037	-2.775	-0.083

Number of observations: 4,392
Standard errors adjusted for 503 clusters in ID
Pseudo R^2 = 0.1948
*P<.10, **P<.05, ***P<.01

Hausman Tests

Table A.4. Results of Hausman test for IIA, nested logit model.

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	fullset	excluded	Difference	S.E.
Price	-0.00095	-0.00166	0.0007087	.
LargeBaleenWhales_H	0.263315	0.289505	-0.0261905	.
LargeBaleenWhales_MH	0.2241	0.231053	-0.0069527	.
LargeBaleenWhales_M	0.243548	0.30908	-0.0655319	.
OtherBaleenWhales_H	0.0362	0.10247	-0.0662703	.
OtherBaleenWhales_MH	-0.08937	-0.02517	-0.0642013	.
OtherBaleenWhales_M	-0.28334	-0.27222	-0.0111162	.
Toothed_whales_H	0.125492	0.244043	-0.118551	.
Toothed_whales_MH	0.1191	0.165386	-0.0462862	.
Toothed_whales_M	-0.05624	0.007308	-0.0635468	.
SealsSeaLions_H	0.068447	0.214725	-0.1462781	.
SealsSeaLions_MH	-0.13672	0.065682	-0.2023969	.
SealsSeaLions_M	-0.0716	-0.02917	-0.0424293	.
SeabirdsShorebirds_H	-0.11077	-0.02777	-0.083003	.
SeabirdsShorebirds_MH	0.114665	0.152191	-0.0375261	.
SeabirdsShorebirds_M	-0.19343	-0.13715	-0.0562816	.

H_o: difference in coefficients not systematic
Chi^2_{16} = (b-B)'[(V_b-V_B)^(-1)](b-B)
Chi^2_{16} = -19.20
$|Chi^2_{16}|$ = 19.20
p-value = 0.259

Table A.5 Results of Hausman test for random effects versus fixed effects.

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	random	**fixed**	**Difference**	**S.E.**
Price	-0.0012344	-0.0011799	-0.0000545	0.000202
LargeBaleenWhales_H	0.3172348	0.2601783	0.0570564	0.11441
LargeBaleenWhales_MH	0.2303144	0.2131325	0.0171819	0.10609
LargeBaleenWhales_M	0.2789844	0.2439984	0.034986	0.113556
OtherBaleenWhales_H	0.0846598	0.0478969	0.0367628	0.112504
OtherBaleenWhales_MH	-0.0766678	-0.0777305	0.0010627	0.094261
OtherBaleenWhales_M	-0.3259953	-0.2976511	-0.0283442	0.112301
Toothed_whales_H	0.2169948	0.1723866	0.0446082	0.117753
Toothed_whales_MH	0.1541658	0.1367908	0.017375	0.086443
Toothed_whales_M	-0.0969851	-0.0668231	-0.0301619	0.130794
SealsSeaLions_H	0.0481659	0.0989109	-0.050745	0.132942
SealsSeaLions_MH	-0.1811339	-0.1160491	-0.0650848	0.131074
SealsSeaLions_M	-0.0881588	-0.0786482	-0.0095107	0.088881
SeabirdsShorebirds_H	-0.2071035	-0.1229224	-0.0841811	0.163123
SeabirdsShorebirds_MH	0.051384	0.087842	-0.0364581	0.115752
SeabirdsShorebirds_M	-0.3098686	-0.2149975	-0.0948711	0.174419

H_o: difference in coefficients not systematic
Chi^2_{16} = (b-B)'[(V_b-V_B)^(-1)](b-B)
Chi^2_{16} = 0.45
p-value = 1.000

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