



Tourist Preferences for Seamount Conservation in the Galapagos Marine Reserve

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Seamounts provide oases of hard substrate in the deep sea that are frequently associated with locally enhanced biological productivity and diversity. There is now increasing recognition of their ecological and socio-economic importance. However, management strategies for these habitats are constrained not only by limited ecological understanding but by the general public's understanding of the pressures facing these ecosystems. This study adds to the growing literature on willingness to pay for conservation of deep-sea ecosystems and species by undertaking a stated preference survey to assess tourist's awareness of seamounts and their preferences for protection within the Galapagos Marine Reserve. Visitors' perceptions of seamount biodiversity must be studied because tourists are key drivers of the Galapagos economy and account for 41% of the Marine Reserve budget. Our survey captured the attitudes, perceptions and willingness to pay of tourists for an increase in the entrance fee to the Galapagos Marine Reserve. Results showed tourists were willing to pay on average US\$48.93 in addition to existing entrance fees. The results of this study support the willingness to develop a multiuse management plan for the Galapagos Marine Reserve, balancing conservation, local communities livelihoods and sustainable tourism. Our results evidence a willingness to support and fund conservation, which is of critical importance to both the Galapagos National Park and local non-governmental organizations heavily reliant for their work on entrance fees and donations respectively. Overall, the conclusion from this study is that, despite limited knowledge, visitors of the Galapagos Islands attach positive and significant values to the conservation of seamount biodiversity.

Keywords: seamounts, deep-sea, marine conservation, contingent valuation, ecosystem services, Galapagos Marine Reserve, MPAs

HIGHLIGHTS

- Respondents were willing to pay on average US\$48.93 in increased entrance fees to the Galapagos Marine Reserve.
- Tourists placed equal emphasis on management plans which aimed to benefit local people's livelihoods, science and tourism.

INTRODUCTION

Offshore seamounts are prevalent and pervasive underwater ecosystems and make up one of the largest biomes of the deep-sea (Staudigel et al., 2010; Wessel et al., 2010). Seamounts are extinct underwater volcanoes that may rise hundreds or even thousands of meters above the surrounding seafloor. While estimates vary, it is believed that there may be over 100,000 seamounts greater than 1 km high that remain uncharted globally (Wessel et al., 2010). Seamount habitats and biodiversity have gained increased academic interest because of their unique ecological and socioeconomic value (Ramirez-Llodra, 2020). They provide many ecosystem services that present use and non-use values to human populations such as fisheries, biodiversity and habitat conservation (for current and future generations), mining, pharmaceuticals and cultural and recreational values (Ressurreição and Giacomello, 2013). Yet, in recent decades, human pressures on seamounts, notably the physical damage caused by bottom trawling, has threatened their biodiversity and resilience (Rogers, 2019). Several of the cold-water corals that can dominate seamount benthic communities are also highly vulnerable to ocean acidification and projected increased temperatures (Roberts and Cairns, 2014; Roberts et al., 2016). Damage to seamounts and their overexploitation can also have widespread consequences on human's food security and medicinal use (Pitcher et al., 2007). Any additional or new activity, or the intensification of an ongoing activity, could become the tipping point for the collapse of a seamount ecosystem. Therefore, growing awareness of human pressures on seamounts, coupled with their important ecological roles in maintaining biodiversity and food webs (Morato et al., 2010) has made seamounts management and conservation a growing policy priority. It is important to recognize that significant gaps remain in our current knowledge of global seamount ecology and biodiversity largely due to their depth and remoteness limiting research (Danovaro et al., 2020). The limited seamount communities surveyed to date and the lack of understanding of their ecological connectivity greatly impedes our assessment of the impacts of human activities on seamounts, as well as the effectiveness of management strategies (Morato et al., 2010; Clark et al., 2012).

Beyond the lack of fundamental scientific knowledge, there are significant additional barriers to seamount ecosystem management. There is a need for comprehensive and effective governance frameworks for marine biodiversity in the high seas (Marsac et al., 2019). The limited frameworks to support these complex ecosystems is also challenged with the difficulty of managing human activities in the high seas, including monitoring, control and surveillance (De Santo, 2018). The magnitude of threats posed to seamounts, and other ecosystems characteristic of areas beyond national jurisdiction, have made their sustainable management a major international policy priority. At the time of writing the United Nations was negotiating an international legally binding instrument under the UN Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond

national jurisdiction (General Assembly resolution 72/249, the 'Biodiversity Beyond National Jurisdiction or BBNJ process).

One option to assist decision-makers in managing the conflicts that arise between the management of human activities and the conservation in the high seas is recognizing and quantifying the economic value of biodiversity (TEEB, 2010). Economic valuations can be used to assess ecosystem services and the value of their benefits to humans (Tinch et al., 2019), which are critical inputs to conduct a cost-benefit analysis in support conservation or restoration interventions (O'Connor et al., 2020a). By incorporating ecosystem service measurements on a quantitative interdisciplinary scale (including monetary, biophysical, and social) it is now feasible to produce practical information to inform well-informed decisions guiding sustainable use of seamount ecosystems (Ainscough et al., 2019). However, in comparison to terrestrial and coastal habitats, there are comparatively few studies which undertake a socio-economic valuation of marine ecosystems, especially in relation seamounts (Jobstvogt et al., 2014). This poses serious challenges for decision-makers responsible for identifying seamount management options, specifically for policies that are centered on maximizing human welfare, or specifically, use values stemming from ecosystem services (Potts et al., 2014). Without including socio-economic knowledge of these ecosystems, management considerations risk failure (Saarikoski et al., 2018). A lack of understanding of the nature of public support for seamount conservation might further hamper the adoption and effectivity of such measures. This is particularly the case given that the known benefits of deep-sea ecosystems lack widespread public awareness (O'Connor et al., 2020b).

Our research contributes to a better understanding of the benefits and values supported by seamount ecosystems. Although the use-values (i.e., economic value) of seamount ecosystem services are important components to take into consideration for management, this study considers primarily the non-use values (i.e., social value) provided by Galapagos seamounts using a stated preference survey to understand visitors preferences for conservation of seamounts in the Galapagos (Gillespie and Bennett, 2011). Little is known about the value of seamount ecosystem benefits, posing serious challenges to the Directorate of the Galapagos National Park when considering options for their future management (DPNG, 2014). Individuals assign Non-use values to economic goods, even if they never have and never will make use of these goods. This type of value is commonly applied to the value of natural habitats, biodiversity or cultural heritage sites (Arrow and Fisher, 1974; Costanza et al., 2014). Different types of Non-use values usually refer to an individual's willingness to pay for preserving goods for future use even if the individual has no use for it (option value), preserving a good for future generations (bequest value), or just for purely altruistic motivations (altruistic value) (Walsh et al., 1984).

To date, there is one known valuation study in the Galapagos focusing on ecosystem services provided by mangroves and our research adds further evidence to the policy and conservation-oriented valuations in the management of the Galapagos archipelago (Tanner et al., 2019).

Specifically, our research:

- (1) Adds to the evidence base on the relative importance of non-use values for Marine Protected Areas.
- (2) Explores the potential influence of tourists' willingness to pay for seamount conservation in the Galapagos Marine Reserve.
- (3) Identifies knowledge gaps and recommendations for future research into management measures applicable to seamounts in the Galapagos which we can build on in future research.

Our study is now possible as a result of new information on the ecology of deep seamount communities collected through deep-sea surveys in 2015 and 2016 (Salinas-de-León et al., 2020) and its findings help inform the practical policies that will be essential to ensure sustainable management of ecosystems in the deep and open ocean, e.g., via any new UN 'BBNJ' treaty. The recent findings of new species can be understood given the isolated and volcanic nature of the Galapagos archipelago, standing approximately 1000 km into the Pacific ocean, representing an oasis of life in the vastness of the ETP abyssal (ocean zone > 3000 m deep) plain. Beneath the surface, hundreds of seamounts provide ecosystem services of biodiversity provisioning, due to a confluence of warm and cold oceanic currents, which gives rise to a unique mixture of marine biodiversity (Banks, 2002). Seamounts are recognized to enhance productivity, providing fisheries provisioning services to the local fishing fleet and recreational ecosystems services to the thriving tourism sector at the heart of the archipelago's economy (Engie and Quiroga, 2014; Marin Jarrin et al., 2018).

CONTEXT OF STUDY: GALAPAGOS ISLAND AND SEAMOUNT CONSERVATION

The Galapagos Islands are celebrated for their ecologic and historical importance by declaring the Galapagos National Park as a UNESCO World Heritage Site in 1979. The Galapagos Marine Reserve (GMR) represents one of the largest and most biodiverse marine protected areas in the world and spans more than 138,000 square kilometers around the archipelago (Figure 1). To regulate the different uses of the marine reserve and ensure biodiversity conservation, the first zoning plan was created in 2000. The plan organized the coastline in sectors according to management/use subzones (fishing, tourism and conservation). The zoning plan divided the GMR into three zones: Zone 1—the multiple-use zone, which includes the deep waters of the GMR, Zone 2—the limited use zone, which consists of coastal waters (<300 m), islets and rocks, and seamounts and Zone 3—port zones. Zone 2 has four management subzones: 2.1 Conservation subzone, 2.2 Tourism subzone, 2.3 Fishing subzone, and 2.4 Areas of Special Temporal Management. At the time of preparation of this manuscript, the Galapagos national park Directorate is debating the new zonification for the GMR, which should become enforced by 2020. This new

system aims to divide the archipelago into multi-use protected area: sustainable use (sustainable fishing), conservation (non-extractive activities such as tourism), intangible (only research) and transition areas (Figure 1).

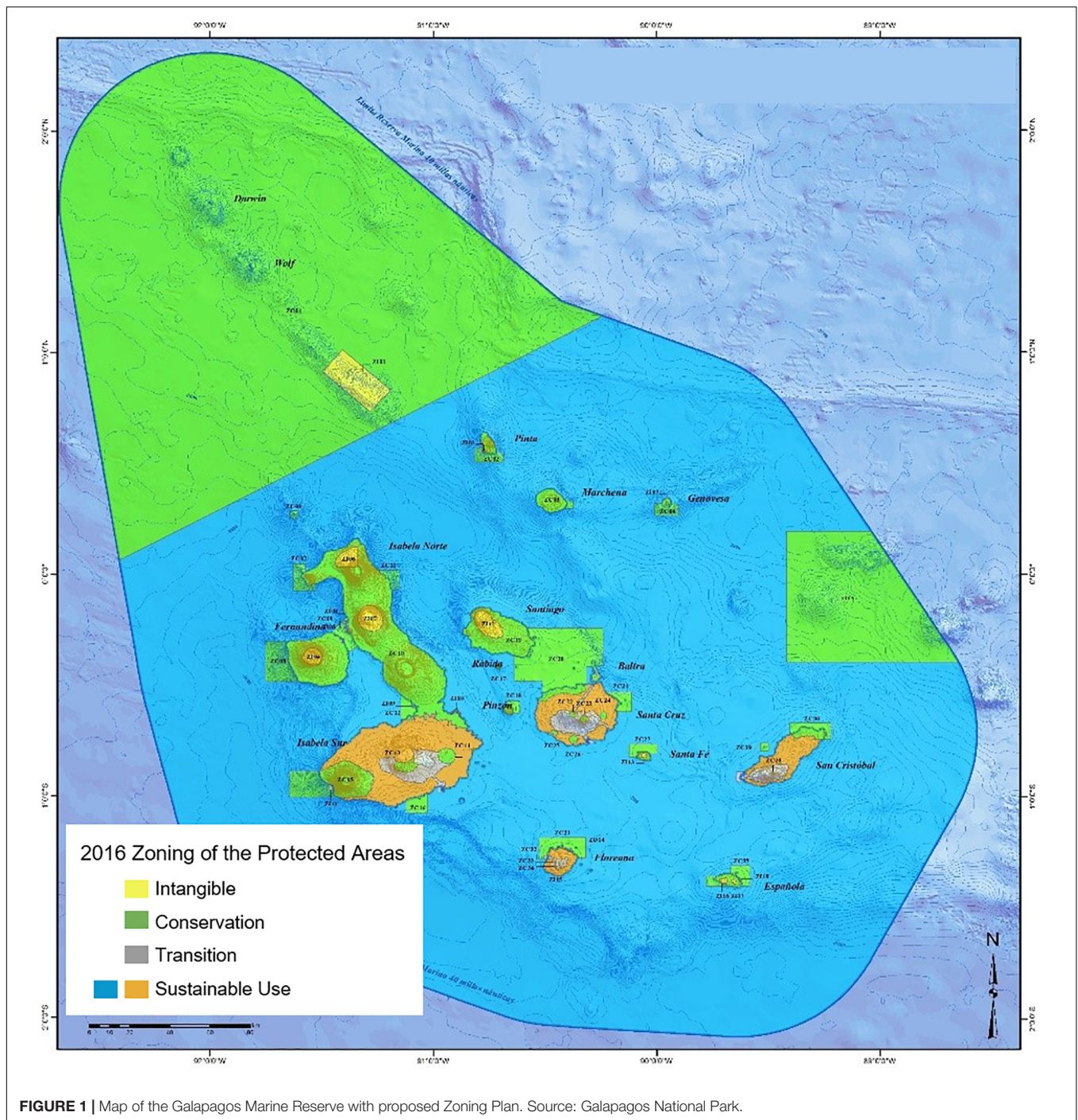
In the last decade, numerous deep-sea exploration cruises took place in the GMR, providing comprehensive datasets, based on physical sampling and video surveys, enabling scientists to characterize these unknown remote ecosystems. These efforts are being led by CDF in collaboration with GNP and numerous international research institutes (Darwin Foundation, 2020). The recent discovery of both new marine species and endemics show that seamount ecosystems should be specially considered for conservation (Salinas-de-León et al., 2020).

TOURISTS PERCEPTIONS AND MANAGEMENT PREFERENCES

The Galapagos Islands are internationally known for their unique ecosystems. This has created a thriving tourist industry, which is a key source of income for the local economy (Epler, 2007; Walsh and Mena, 2013). In 2019 the Galapagos hosted a total of 271,238 tourists a sharp increase from 42,000 received in 1989 (Galapagos National Park [GNP], 2020). However, according to Pizzitutti et al. (2014) tourism is also the main driver of change on Galapagos, affecting the social and ecological systems and is considered one of the principal drivers of invasive species introduced into the archipelago (Toral-Granda et al., 2017). If the number of international visitors and the supporting facilities continues to grow rapidly, there will be a need to question how this will affect the pristine biodiversity, natural environment and the social setting of the Galapagos Islands (Jones, 2013; Pizzitutti et al., 2014).

Entrance fees are amongst the most widespread revenue sources from national park visits and are associated with the management and protection of MPAs (Lindberg and Halpenny, 2001). Visitor entrance fees are the main source of income for the GMR and thus directly support conservation of the island, contributing an average of 41% of the budget for the conservation of protected areas (Galapagos National Park [GNP], 2014). Thus, the growth of marine tourism represents a favorable avenue to explore marine conservation funding mechanisms for deep-sea seamounts in the Galapagos, especially the case with the rise of local tourism champions whose self-interest is aligned with ecosystem services protection (Tanner et al., 2019). For this to happen, however, a better understanding of tourists' perception and attitudes toward the support for deep-sea seamounts is needed to design effective funding and conservation initiatives.

Consequently, we explore whether people are willing to pay an increased entrance fee to the Galapagos National Park which would provide additional conservation revenues for seamount conservation and associated biodiversity. We are specifically interested in how preferences are affected by respondent's knowledge of seamounts, their attitudes and perceptions toward seamount and marine conservation and how these measures can provide recommendations for ecosystem-based management scenarios employed by the National Park. The visitor fees are



therefore not expected to resemble the true value that tourists attach to deep-sea seamounts in the Galapagos Archipelago but rather provide recommendations for potential conservation mechanisms that might capture and monetize the surplus “welfare” experienced by tourists. Due to lack of economic and social research on deep-sea seamounts in the Galapagos, we aim to test hypotheses which provide insight into both key survey design issues (e.g., geographical and financial scoping) and policy questions (e.g., where and how to protect seamount

ecosystems?). Given the rapidly growing number of stated preference environmental valuation studies and their use in policymaking, it is important to arrive at a better understanding of the environment before implementing management efforts. This study identifies the interests and information needs of potential management measure for seamounts in the future.

There are various stated preference studies which have shown that visitors to protected areas are generally willing to pay much higher fees than are currently charged to support marine

conservation due to increasing tourism demand and increased desired to support conservation of species and ecosystems (Rivera-Planter and Muñoz-Piña, 2005; Moyle et al., 2017; Banerjee et al., 2018). More recently, valuation work has focused on how we can value biodiversity and ecosystem services in the deep sea (Ressurreição et al., 2011; Jobstvogt et al., 2014). One of the major challenges of estimating the value of deep-sea biodiversity stems from the public's unfamiliarity with the deep-sea environment (Jobstvogt et al., 2014). Poor understanding of complex ecological concepts such as biodiversity among members of the public also underpins many valuation challenges (Laurila-Pant et al., 2015). Evidence from this research is encouraging, limited knowledge does not equate to limited interest.

We recognize that seamounts and their associated biodiversity are an unfamiliar good for many respondents, and critics of stated preference methods argue that familiarity with the good is essential for providing meaningful responses to valuation questions (Carson et al., 2001). For seamounts, it is unlikely that respondents will have well-defined preferences before elicitation and instead preferences are constructed during the survey process (Gregory et al., 1995; Gregory and Slovic, 1997). Providing information to respondents who have little prior knowledge of the good is a crucial aspect of the survey and Mitchell and Carson (1989) identified information provision as “amongst the most important and most problematic sources of error” in contingent valuation. In our survey, we were interested whether the respondent's prior knowledge of seamounts leads to a higher or lower willingness to pay estimate than those who are not aware of seamounts. We were careful to ensure no cue was provided that their knowledge of seamounts was correct or incorrect. Also, we tested whether respondent's self-judged prior knowledge of the information presented to them during the survey affected their willingness to pay to avoid and control for scenario rejection or adjustment (Cameron et al., 2011).

MATERIALS AND METHODS

Survey Overview

To better understand tourist's perceptions and attitudes toward conservation of seamounts and their associated biodiversity a contingent valuation survey was designed and implemented to respondents in the Galapagos Archipelago. The survey aimed to understand initial willingness to pay values which would guide further research at the Galapagos National Park regarding the tourist's management preferences. Contingent valuation is a stated preference technique, which uses questionnaires to create a realistic, but hypothetical market, for respondents to indicate their willingness to pay for a change in an environmental good (Mitchell and Carson, 1989). Scenarios are constructed which offer different policy alternatives to the current *status quo*. The respondent is asked to state whether they would support an alternative policy option depending on what the new policy will provide, how this will be delivered and how much it will cost (Carson, 2000). If the study is well designed and carefully tested in advance the answers to the survey should reveal the respondent's

true willingness to pay for a given change. Our respondents are asked whether they would support an increase in the entrance fee to the GMR with the additional revenues used to fund research programs into seamount conservation and diversity.

Survey Design

The contingent valuation survey was designed following the recommendations of Johnston et al. (2017). A single questionnaire was produced to capture the attitudes, perceptions and willingness to pay of foreign and national tourists. Respondents were first provided with an introduction to the survey, followed by two questions to assess their prior knowledge and awareness of seamounts. Respondents were asked if they recognized a seamount and then were asked to define the term “seamount.” Following this, respondents received specific information the importance of the GMR as one of the largest and most diverse marine protected areas in the world, an introduction to seamounts, their associated biodiversity and their contribution to marine ecosystem services. In this manner, we present a clear baseline or *status quo* scenario, which is a central requirement in stated preference questionnaires (Johnston et al., 2017). This was followed by self-evaluation of participant's knowledge of seamounts and whether they already knew the information provided to them (using a 5-point Likert rating scale from “I knew everything” through to “I knew nothing”). This allowed us to test the respondent's perceived knowledge of seamounts and whether this influenced their willingness to pay, to evaluate whether respondents are adjusting or reinterpreting the presented information according to their subjective perceptions (Johnston et al., 2017).

The next stage of the survey aimed to identify social values that could be used in the resource allocation decision-making process. Respondents were presented with a photographic catalog of seamount species and asked to express which species they preferred for the allocation of conservation funds to deep-sea species. The images were screenshots from video transects during the Nautilus Cruise Galapagos Platform Expedition between 25 June and 26 July 2015. To ensure a representative sample, 10 species of invertebrates (annelids, xenophyophores, molluscs, arthropods, cnidarians, ctenophores, echinoderms, hemichordates, sponges, and tunicates) and five species of vertebrates (chordates) were used. Below each image, key information was presented, including the phylum, the scientific and known name and depth range. Each species was presented with a fact on their biological characteristics, ecological importance or human uses. Finally, four species were identified as “new species” because these species were discoveries from the Nautilus expedition (Salinas-de-León et al., 2020). A copy of the Figure is provided in the **Supplementary Material**.

This was followed by the willingness to pay question. Respondents were then presented with the elicitation scenario:

The Galapagos National Park is under the management of the Galapagos National Park Directorate. In the near future, they are proposing to increase the tourist entry fee in order to allocate more funds for deep-sea seamount conservation. The generated funds will be used for seamounts conservation projects, education and outreach [...] Please select the maximum amount you would

definitely be willing to pay (USD) in additional entrance fees to fund seamount biodiversity conservation programs, education and outreach.

Willingness to pay was elicited using a payment card format. Respondents were presented with values ranging from US\$0 to US\$100 and asked to select the maximum value they were willing to pay in additional entrance fees to enter the Galapagos National Park (or to specify another amount if above US\$100). The payment vehicle was the increase in tourist fee to the Galapagos National Park. The payment card format was justified as at the time of the survey the exact increase in the entrance fee was unknown. The bid vector is shown in **Table 1**.

To foster a level of incentive compatibility, our payment card was presented as a series of yes/no votes following Carson and Groves (2007) and Vossler et al. (2012). We highlighted that the cost was uncertain which is why a range of payments options was offered and respondents were told that their responses would be shared with policymakers, who are in the process of evaluating an increment in entrance fees to the Galapagos National Park. A reminder cue specifying that the results would be shared with policymakers was included:

“The price you choose will be used to inform the Galapagos National Park Directorate when deciding the allocation of future funding – so it is very important you answer the question truthfully.”

This further strengthens incentive compatibility by demonstrating that the relevant authority can enforce payments by the tourist who are under the jurisdiction of the Galapagos National Park Directorate (Vossler et al., 2012). Likewise, this feature in our design allows respondents to infer that the probability that the proposed project is implemented is weakly monotonically increasing with the proportion of yes votes, which is a requirement for incentive compatibility (Vossler and Holladay, 2018). As an aside, practical issues such as budget and timing constraints, the payment card format was the

most statistically efficient design for this survey although we acknowledge there is also the risk of being afflicted by both range and anchoring effects (Rowe et al., 1996; Covey et al., 2007).

A follow-up question asked respondents to state their primary motivation behind their willingness to pay bid. Respondents were asked to state their reason for a positive willingness to pay. Out of the five possible response options available, three reflected the intrinsic value of the good: (i) I want to preserve the seamount biodiversity for future generations; (ii) because the biodiversity on seamounts is unique and (iii) because the biodiversity on seamounts has a positive impact on the marine economy. The remaining two statements were understood to express personal motivations for valuing the good: (i) I want to personally contribute to projects that protect the environment and (ii) because I can afford it. To determine protest bids, those who stated a zero willingness to pay were asked their reason for doing so. Respondents with valid-zero willingness to pay would select statements regarding significance: (i) Seamount conservation is not important to me; (ii) I don't regard the environmental threats to seamounts as high and therefore conservation measures are not needed, and affordability (iii) I cannot afford it. Alternatively, statements that reflect protest-zero willingness to pay bids included: (i) conservation efforts should be funded by other sources; (ii) I don't agree with paying an entrance fee, and (iii) I don't agree with how the Galapagos National Park Directorate allocates tax funds. This approach is generally taken to maximize the validity of our valuation exercise, by minimizing different possible biases present in stated preference approaches (Bishop and Boyle, 2017).

Follow up questions focused on the individual's attitudes and perceptions regarding different aspects of marine conservation. Respondents were asked to rate how urgent they think seamount biodiversity conservation is, and their preferred management objective for the Galapagos National Park. Finally, respondents were asked about their socio-demographic characteristics. These questions aimed to collect information necessary to develop a set of tourist profiles which could be compared against previous visitor surveys undertaken in the Galapagos Islands and to control for possible covariates which are explanatory of observed willingness to pay changes. A full copy of the survey is available in the **Supplementary Material**.

The survey was designed by the research team and initially pre-tested with staff and students at the University of Edinburgh. This pre-test aimed to ensure readability and understanding of the payment vehicle and a credible and understandable scenario to respondents, whilst minimizing respondent fatigue (Champ et al., 2003). A pilot survey with tourists was then undertaken with 45 individuals on the National Geographic Islander cruise ship on May 25, 2017. Following this pilot exercise, minor changes were made to the final survey, including adding three more questions that capture participant's attitudes toward marine conservation. The final survey of 125 individuals was conducted between 29 May and 16 June 2017. Three main locations were used to administer surveys: (1) Charles Darwin Research Station, (2) Gus Angermeyer Pier and Ferry Terminal and (3) Tortuga Bay Beach. For sampling locations (1) and (2) the interviewer approached each individual/group who arrived and asked them

TABLE 1 | Payment card and bid vectors shown to the respondents.

Please select the maximum amount you would realistically be willing to pay (USD) in additional entrance fees to fund seamount biodiversity conservation programs.

\$0
\$5
\$10
\$15
\$20
\$25
\$30
\$35
\$40
\$45
\$50
\$60–70
\$80–100
I am prepared to pay more than \$100

to take part in the survey. For location (3), the interviewer randomly selected individuals and groups on the beach. This mixed-approach was taken to maximize the potential number of respondents in the sampling period. Unfortunately, our interviewer did not record how many individuals she approached to complete the survey but who refused. We recognize this would be a useful measure for future survey work. Respondents were approached by a trained interviewer and guided through the survey. The interviewer could respond to any questions asked by the respondent. Each interview took 12–15 min to complete. The target populations included foreign tourists (non-resident and Andean Community or Mercosur residents) and tourists who are citizens or residents of Ecuador. Sampling took place exclusively on Santa Cruz Island because it is the tourist hub of the archipelago (Epler, 2007). Tourists were required to be 18 years of age or older to complete the questionnaire and both English and Spanish translations of the survey were used. Most foreign tourists come from the United States, United Kingdom, and Europe, and therefore were approached using the English questionnaire, while national tourists were approached using the Spanish version.

Empirical Approach

Responses were analyzed using Stata (Version 16). Based on the recommendations of Bateman et al. (2002), datasets were analyzed to differentiate between genuine zero bids and protest zero bids. Mean and median willingness to pay were compared, before and after the exclusion of protest responses. The determinants of WTP were analyzed using both the Tobit and Interval regression model. The Tobit model, or censored regression model, is designed to estimate linear relationships between variables when there is either left or right censoring in the dependent variable (UCLA: Long and Freese, 2014). For WTP surveys left-hand censoring is appropriate as it takes into account respondents who are not prepared to pay toward the scheme. However, our survey used a payment ladder to elicit WTP and it is recognized that estimates from the Tobit model can result in a biased average valuation, as the expected values between the upper and lower bounds of the payment cards are unknown (Cameron and Huppert, 1989). Interval regression can overcome this issue by using the lower and upper bounds of the value chosen on the payment card (Haab and McConnell, 2002). For this survey, respondents were asked to tick the highest value they were prepared to pay. However, their true value may lie between the highest bid they chose and the next highest amount, for example, the respondent ticked \$5 and the next highest was \$10. In this case, their true value may lie between \$5 and \$10 and these bounds can be used in the interval regression estimation. Interval regression uses the lower-bound and upper-bound responses on the payment card as the dependent variables, minimizing the potential of over or underestimating WTP.

The final modeling approach considered whether multiple explanatory variables influenced WTP (Equation 1). The stated preference literature suggests that the valuation of an environmental good is impacted by a variety of socio-demographic factors and the relationship between the respondent and the good in question. Consequently, we included income,

age, gender, and nationality within our modeling framework. Also, there is an expectation that the respondent's experiences with the good in question and their personal motivations, will affect WTP (Cameron and Englin, 1997; LaRiviere et al., 2014; Needham et al., 2018). As such, we include the time that the respondent has spent on the Galapagos (measured in days), whether they are a member of an environmental group and their motivation for being willing to pay. Furthermore, we were interested in two variables related to the respondent's knowledge of the seamount. Firstly, if the respondent was aware of the term 'seamount' at the start of this survey. This was judged by the interviewer based on the respondent's answers to a series of opening questions about seamounts. Secondly, we included a variable which examined respondents own self judged awareness of seamounts. A list of the variables used in the modeling approach can be found in **Table 2**.

Four regressions were estimated:

- (1) Tobit model with only socio-demographic characteristics.
- (2) Tobit model with socio-demographic characteristics and other explanatory variables.
- (3) Interval model with only socio-demographic characteristics.
- (4) Interval model with socio-demographic characteristics and other explanatory variables.

Equation 1: Interval regression equation to explore which factors influence a respondent's willingness to pay for increased seamount conservation in the Galapagos.

$$WTP = b_0 + b_1income + b_2age + b_3gender + b_4nationality + b_5days + b_6env + b_7priorknowledge + b_8familiarity + b_9motivation + b_{10}urgency + b_{11}management + \epsilon_i$$

RESULTS

Sample Characteristics

In total 125 surveys were completed. Of the 125 respondents sampled, 81 were foreign tourists, eight were from the Mercosur and Andean Community of Nations, and 36 were Ecuadorian nationals. We removed the eight respondents from the Mercosur and Andean Community of Nations from our subsequent analysis as we felt the number of respondents from this region was too low to include in our analysis. The three tourism categories (Foreign, Mercosur and Andean Community of Nations and Ecuadorian nationals) each pay a different amount to enter the GNP. We felt this difference in entry fee would influence the respondent's willingness to pay, hence we wanted to include nationality as a control variable within our analysis. Despite removing eight of the respondents, we can conclude that our sample, despite its small size, is representative of the general characteristics of the Galapagos tourist's population (**Table 3**). We compared our sample descriptive statistics with annual visitation data reported by the Galapagos National Park for 2019 (Galapagos National Park [GNP], 2020). In 2019, 67% of all visitors were foreign with the remaining 33% being Ecuadorian. The gender breakdown of visitors is in favor of females at 55 to 45. In our sample, Ecuadorian tourists represent 31% of all

TABLE 2 | Variables used in the estimation process.

Socio-Demographic Variables	
Income	Household income:
Age	Age of respondents: 18 – 25, 26 – 35, 36 – 45, 46 – 55, 56 – 65, and over 66
Gender	0 = Male, 1 = Female
Nationality	0 = Ecuadorian National 1 = Foreign tourist
Additional variables	
ENV	Member of an environmental group 0 = No, 1 = Yes
Days	Days spent on the Island
Prior	Whether the respondent was familiar with the term seamount prior to the survey (as judged by the interviewer): 0 = No 1 = Yes
Familiarity	The respondent's perception of how much they already knew about the information presented to them: 0 = I knew less than half of the information presented to me 1 = I knew more than half of the information presented to me
Motivation	Respondents reason for being willing to pay: 1 = Biodiversity is beneficial for the marine economy 2 = Biodiversity is unique 3 = I want to preserve for future generations 4 = I can afford to 5 = other reason 6 = I want to personally contribute to projects that benefit the marine environment (warm glow effect)
Urgency	Response to whether seamount conservation is urgent or not: 1 = Unsure 2 = Not urgent at all 3 = Urgent or very urgent
Management	Respondents preference for the management of the Galapagos Marine Reserve: 1 = Equally important 2 = Promotes science 3 = Supports livelihoods 4 = Tourism focus

respondents, with the remaining 69% being of a foreign origin. The corresponding gender breakdown of our sample is 53 to 47 in favor of females. On average on 2019 the age of visitors to Galapagos is 35 years, which is also the biggest age bracket in our sample (34.2% are between 26 and 35). Likewise, the United States of America is the biggest nationality amongst foreign tourists, for both official data and our sample. Hundred and one of the respondents were visiting the area for the first time, with nine respondents on their second or third visit, four on their third or fourth visit and three having visited five times or more to ensure sufficient involvement of the local community in the management planning process.

Knowledge of Seamounts, Attitudes and Perceptions Toward Seamount and Marine Conservation

The analysis revealed the majority of respondents (76%) were unfamiliar with the term seamount as judged by the survey interviewer (Table 4). The self-evaluation of seamount ecosystems revealed that 85% of the respondents felt that they

TABLE 3 | Descriptive statistics for socio-demographic variables.

Variables	Number of respondents
Income	
Up to \$20,000	10
\$20,001–40,000	20
\$40,001–60,000	15
More than \$60,000	70
Gender	
Male	55
Female	62
Age	
18–25	27
26–35	40
36–45	15
46–55	13
56–65	14
66–75	8
Nationality	
Ecuadorian	36
Foreign	81
Education	
High school	16
Undergraduate Degree	58
Postgraduate Degree	37
Further education	6
Economic activity	
Working	70
Studying	14
Unemployed	18
Retired	15
Employment sector: mining, oil and gas, fisheries or tourism?	
No	102
Yes	15
Member of environmental group	
No	99
Yes	18
Number of visits	
First visit	101
Two and three visits	9
Four and five visits	4
More than five visits	3

knew only half or less of the information discussed in the survey introduction. Across the sample, only 3% stated they did not think seamount conservation was urgent, although 15% of the sample were unsure. Across the sample, 53% of respondents favored the development of an integrative management plan that equally addresses the social objectives of marine management in the Galapagos.

When respondents were asked to list the two most important marine environmental problems that came to mind, the main responses identified pollution (45%), overfishing (23%), climate change (15%) and wildlife conservation (8%) as the most important problems. The terms pollution combines mentions of “pollution,” “water quality,” “chemical and oil pollution,” and

TABLE 4 | A comparison of seamount knowledge and conservation priorities between foreign and local tourists.

Variables	Number of respondents
Perceived prior knowledge of seamounts	
Detailed knowledge of seamounts	28
No knowledge of seamounts	89
Self-evaluation of seamount information	
Knew more than half the information	18
Knew less than half the information	99
Conservation Urgency	
Not urgent	3
Moderately urgent	30
Urgent or very urgent	66
I don't know	18
Management Plan Preference	
Promote science	26
Tourism	23
Livelihoods	6
Equal importance	62
Allocation of funds	
Charismatic or uncharismatic	
Charismatic	55
Uncharismatic	62
Common or new	
Common	27
New	90
Human or eco	
Human	43
Ecological	74
Medical research or fisheries	
Medical	103
Fisheries	14
Species: Scientific name (Common name)	
<i>Yoda</i> sp. (Acorn Worm)	5
<i>Ophiocten</i> spp. (Brittle Star)	9
<i>Pontinus clemensi</i> (Brujo, Scorpionfish)	4
<i>Victogorgia</i> sp. (Octocoral)	14
<i>Aulacoctena</i> (Comb Jelly)	2
<i>Paromola cf. rathbunae</i> (Crab)	12
<i>Teuthidodrilus</i> sp. (Marine Worm)	13
<i>Graneledone</i> sp. (Octopus)	7
<i>Trachichthyidae</i> spp. (Orange Roughy)	1
<i>Lophiidae</i> spp. (Paco, Goosefish)	1
<i>Phellodermidae</i> family (Sea Sponge)	8
Unknown (Sea Squirt)	4
<i>Bathyraja</i> spp. (Stingray)	7
<i>Chaunacidae</i> spp. (Toadfish)	16
Unknown – xenophyophore (Foraminifera)	14

“sewage.” The term climate change covers responses of “climate change,” “sea-level rise,” and “ocean acidification”; and the term wildlife conservation includes responses within the category of biodiversity loss. This open-ended question provides insight into the ways that the tourists frame their main concerns in terms of marine impacts.

When respondents were asked their preference for the allocation of conservation funds to deep-sea species our results show that tourists were equally divided when it came to charismatic versus uncharismatic species protection. A much greater proportion of respondents favored the new species (77%) over the more known species (23%). When respondents were asked to choose a single deep-sea species to allocate conservation funds to, the most popular species was the toadfish (14%) followed by the octocoral and the xenophyophore (12% each), the squid worm (11%) and the crab (10%).

Willingness to Pay

Of the 117 respondents, 94% were willing to pay toward increased seamount conservation through an increase in visitor fee. Responses to the bid vectors presented on the payment card are shown in **Figure 2**. Hundred and ten of the 117 respondents accepted the first level on the payment card “\$5”. The number of respondents accepting the bid level gradually declines between \$5 and \$50 with a marked decline in respondents accepting a bid level above \$60 or more. Nine respondents were willing to pay over \$100. 7 respondents were not willing to pay, and based on the debriefing questions, three respondents were considered protest bidders because they thought conservation efforts should be funded by other sources. Beyond that, four were considered genuine zero bidders (**Table 5**). Enhancing seamount biodiversity conservation for the benefit of future generations was the most frequently expressed motive for wanting to pay for increased entrance fees followed by existence values and use-values (**Table 5**). Across all datasets, mean and median values were calculated before and after the removal of protest responses. The exclusion of the protest zero bids had a US\$1.29 impact on mean willingness to pay and it was decided to include these in the final regression analysis. The total sample mean willingness to pay was estimated at US\$48.93 (CI = US\$40.08–US\$57.78) (calculated using the lower bound willingness to pay from the payment card).

Table 5 shows the results of the regression analysis and **Table 6** shows the predicted mean willingness to pay based on the four different modeling approaches. The predicted mean willingness to pay varies between \$48.83 (Model 1) and \$54.56 (Model 4). The use of the Interval Regression Model increases the predicted willingness to pay and reduces the standard error of the estimate. The inclusion of additional explanatory variables has no significant effect on the predicted willingness to pay.

Several key results emerge from this analysis. Firstly, the results show that respondents prefer a management scenario which places equal emphasis on all three management plan aspects: promoting tourism, securing livelihoods and promoting science. Respondents are WTP \$22 less for a program which focuses on science only and \$24 less for a program focusing on tourism.

Secondly, in terms of urgency of conservation, there is a significant difference in WTP between respondents who are “unsure” compared to those who believe conservation is urgent at some level. There is no significant difference in WTP between those who think it is moderately urgent or very urgent.

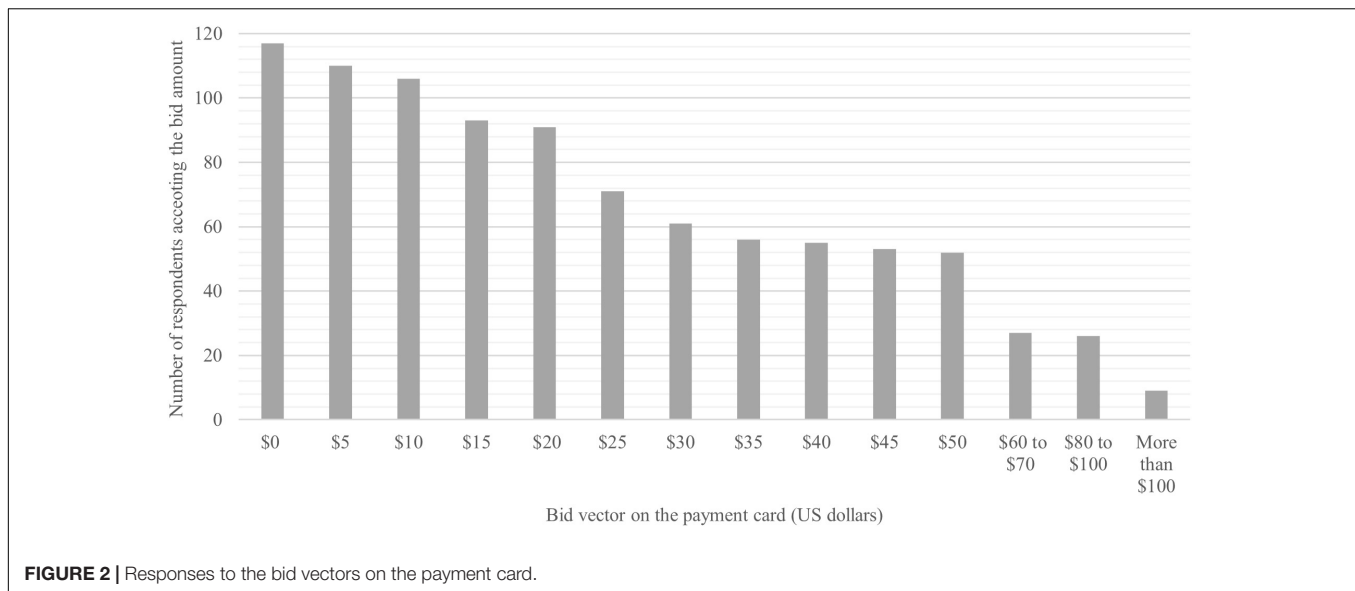


FIGURE 2 | Responses to the bid vectors on the payment card.

TABLE 5 | Overview of willingness to pay responses including protest bidders.

	Number of respondents
Whether a respondent is willing to pay?	
Yes	110
No	7
Protest responses	
Protest bidders (total) ^(a)	3
Genuine zero bidders (total) ^(a)	4
Positive willingness to pay (total) ^(b)	110
Reason for expressing a positive willingness to pay	
I want to preserve the seamount biodiversity for future generations (bequest value)	49
Because the biodiversity on seamounts is unique (existence value)	21
Because the biodiversity on seamounts has a positive impact on the marine economy (direct-use value)	9
I want to personally contribute to projects that protect the environment (warm glow)	24
Because I can afford it (warm glow)	5
Other (specify)	2
No response	7

^(a) Respondents could only tick one motive for their negative willingness to pay for seamount biodiversity conservation. ^(b) Respondents could only tick one motive for their positive willingness to pay for seamount biodiversity conservation.

A third finding is a difference in willingness to pay when we considered self-assessed awareness and actual knowledge of seamounts (as assessed by the interviewer). Respondents

who had higher knowledge of seamounts, as judged by the interviewer, were prepared to pay significantly more toward their conservation than those who were not familiar with seamounts (\$32.35, Model 4). In contrast, respondents who stated they were familiar with the information presented to them during the survey were willing to pay less than those who stated they were not familiar (\$-30.81, Model 4).

Finally, socio-demographic statistics have a limited effect on WTP. We find no significant effect of gender and a weak signal of age with those in the oldest age group willing to pay more than those in the youngest age group. There is a mixed effect for income. We find that those in the highest income band (more than \$60,000) are prepared to pay significantly more than those in the lowest category. However, respondents in the \$20,000–\$40,000 band are willing to pay less than those in the lowest income band (–\$23.26, Model 4). We find that foreign tourists are willing to pay \$49 more than Ecuadorian tourists.

DISCUSSION AND CONCLUSION

This study aimed to explore tourist perceptions and attitudes toward conservation of seamounts at the Galapagos Marine Reserve (GMR). The survey aimed to understand tourist's preferences and willingness to pay values which would inform local policymaking and conservation agendas. To do this we designed and implemented a contingent valuation survey to assess whether tourists would be willing to pay an increased entrance fee to the reserve and which management options tourists would prefer. Our study tested respondent's prior awareness of seamounts, provided them with information on seamounts and asked them to assess their own familiarity with this information before eliciting their willingness to pay for entrance fees for the GMR. We also assessed their motivations for contributing to conservation efforts and their preferences for the allocation of conservation funds to deep-sea species.

TABLE 6 | A comparison of results from Tobit and Interval regression estimation for exploring public willingness to pay for seamount conservation.

Variables	Tobit (1)	Tobit (2)	Interval (3)	Interval (4)
Income: baseline less than \$20,000				
\$20,001–40,000	−40.14*** (12.05)	−23.00* (11.82)	−34.63*** (11.09)	−23.26** (11.60)
\$40,001–60,000	−5.35 (12.55)	−11.87 (12.62)	−6.03 (11.82)	−12.06 (12.38)
More than \$60,000	26.91*** (10.03)	21.11** (10.01)	24.79*** (9.41)	20.32** (9.81)
Gender: baseline: female				
Male	7.08 (7.87)	7.48 (7.71)	6.15 (7.34)	7.40 (7.57)
Age: baseline 18 – 25				
26–35	6.90 (10.32)	10.80 (9.68)	8.17 (9.64)	10.38 (9.50)
36–45	2.05 (13.32)	−5.30 (13.08)	2.91 (12.45)	−5.51 (12.82)
46–55	7.33 (14.01)	0.60 (13.15)	7.25 (13.09)	0.82 (12.90)
56–65	16.19 (13.75)	6.52 (12.94)	16.04 (12.94)	6.47 (12.70)
66–75	52.64*** (16.69)	34.87** (15.69)	51.31*** (15.70)	34.25** (15.38)
Nationality: baseline Ecuadorian				
Foreign	58.51*** (9.52)	50.02*** (9.26)	57.29*** (8.93)	49.93*** (9.08)
Member of environmental group		4.93 (11.35)		4.27 (11.13)
Number of days spent at the GMR		0.00 (0.32)		0.02 (0.31)
Respondent has prior knowledge of seamounts (assessed by the survey interviewer)		33.33*** (11.84)		32.35*** (11.62)
Respondent knew most of the information presented to them in the survey (self-assessed)		−32.60** (12.53)		−30.81** (12.30)
Reason for positive willingness to pay: baseline biodiversity benefits marine sectors				
Biodiversity is unique		−3.34 (15.79)		−4.29 (15.50)
I want to preserve for future generations		−2.10 (13.62)		−3.70 (13.37)
I can afford to		23.67 (22.11)		22.87 (21.69)
Other reason		−9.46 (29.62)		−11.67 (29.04)
Personally, contribute to projects that protect the environment		−7.61 (14.95)		−8.48 (14.68)
Conservation urgency: Baseline unsure				
Moderately urgent		26.74** (12.31)		26.67** (12.07)
Very urgent or urgent		21.61* (11.39)		21.38* (11.17)
Preferred management option baseline: balance of all three				
Promote science		−22.09** (9.55)		−21.74** (9.37)
Support livelihoods		−5.42 (18.44)		−5.49 (18.09)
Tourism focus		−24.76** (10.35)		−23.93** (10.16)
Constant	−4.75 (12.08)	−4.56 (20.48)	−0.32 (11.28)	−0.51 (20.10)
Observations	117	110	117	110

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Our results show respondents were willing to pay an increase in their entrance fee to the benefit of seamount conservation, ranging from US\$40 to US\$57. This result is comparable with that obtained by Jobstvoigt et al. (2014) on the attitudes of the Scottish public toward deep-sea biodiversity, who found that 90% of respondents wished to protect deep-sea biodiversity for the benefit of future generations. However, the value is significantly lower than Ressurreição et al. (2011) who reported a willingness to pay €405–605 per person to prevent 10–25% reductions in deep-sea species richness. From a marine management perspective, we find that an integrative management plan was

viewed as most favorable with 53% of respondents favoring this approach and respondents were willing to pay \$25 more to fund a program with this focus, compared to either a tourism or research science-focused plan. From this perspective, tourists recognize the need to balance multiple activities including fishing, tourism and conservation, to achieve sustainability. Our results place equal emphasis on all three management plans. The new management plan and zoning of the Galapagos Marine Reserve from 2016 support zones for the sustainable use of the marine resources (“sustainable use”) maintain other zones with non-extraction activities (“conservation use”) and other pristine

zones of exclusive research use (“intangible”), although this plan is yet to be implemented.

The effect of socio-demographic characteristics on willingness to pay did not conform to the usual expectations in stated preference surveys. The relationship between income and willingness to pay was inconsistent which raises some questions about the validity of our results and whether people considered their budget constraints. A previous study on shark conservation in the Galapagos by Cárdenas and Lew (2016) also found a negative income effect. One explanation for this insignificant result is when we consider that the majority of tourists, irrespective of their wealth, are drawn to the Galapagos for its pristine nature (Mathis and Rose, 2016) and have already committed a significant amount of their household budget on the trip. As such, they are less concerned about what they spend when they reach the island and are more motivated by keeping the islands in their pristine state, at whatever cost. A second explanation for the insignificant results for the coefficients is the relatively small sample size (125 responses) and this may have led to insignificant coefficients for our socio-demographic variables. Indeed, we recognize one of the main limitations of our study is the small sample size (125 responses, of which 117 were used for the analysis) and will have reduced the statistical power in our chosen modeling approaches. Our study was undertaken as face-to-face interviews and to reduce interview bias we chose to use only one interviewer; however, this reduced the number of responses which could be collected within the 2-week sampling timeframe. We also recognize that this is one of the first studies of its kind in the Galapagos, with the first discrete-choice experiment held in 2011 yielding 252 responses (Mejía and Brandt, 2015). This survey suggests that with more sampling time available, a larger number of responses could be collected for future research. We encourage caution in the broader implementation of our results to policymaking in the Galapagos and instead see this study as a pilot in which a more in-depth study of local and tourist values for the GNP could be captured. The main stakeholders for the GMR are the tourism and local fishing sectors (all fishing in the GMR is restricted only to Galápagos residents and locally registered vessels), the conservation and science sector (both local and international), the Ecuadorian Navy and the Galápagos National Park Service (GNPS), who have the official responsibilities for managing the reserve. As tourism is one of the main stakeholders this study provides relevant information for future management and policy recommendations, particularly with the new entrance fees in Galapagos. As the GMR management plan stipulates the need to take into account the precautionary principle and to provide for adaptive management based on a solid scientific basis, stakeholder participation and sustainable use the information from this study can be useful for the updating of the management planning process.

We also found a significant difference in willingness to pay between foreign visitors and Ecuadorian nationals with foreign tourists willing to pay significantly more, although given the small sample size of local tourists surveyed any inference made of this group should be made with caution. A higher

allocation of funds by foreign tourists for marine conservation is reported in some studies (Arin and Kramer, 2002; Yeo, 2004). Foreign tourists expressed that snorkeling and diving and viewing land-based wildlife as their primary reason to visit the Galapagos. These tourists were interested in visiting the islands to interact with and appreciate the natural environment and thus were prepared to pay more to protect it. A limitation of our study is that it focused only on Galapagos tourists, and the sample under-represents national tourism. As such, to the extent visitors to other islands differ from Galapagos tourists in terms of their support for species conservation, the results may not be easily generalized beyond our study site. We also recognize that many of the foreign tourists only visit the island once in their lifetime which could undermine the validity of our elicitation format, however, we did ensure that the sample was representative of tourists which do visit the island. Our calculated willingness to pay (between US\$40 to US\$57 per person), is lower than the increased planned entrance fee agreed by the Galapagos National Park for 2020. Entrance fees for international tourists are set to increase to US\$200 from US\$100. This increase is greater than the willingness to pay calculated within our dataset and suggests the values we elicited were on the lower bound of individuals true valuations.

The majority of those who participated in our survey stated they had very little knowledge of seamounts as assessed by the interviewer. We find that respondents who did have prior knowledge of seamounts, as assessed by the survey interviewer, were willing to pay \$33 more than those who did not have prior knowledge. This result is in line with what is expected of *ex ante* knowledge and its relationship with WTP (Cameron and Englin, 1997). In contrast, respondents who stated they were familiar with the information presented to them were willing to pay less than those who were unfamiliar. These results at first appear to be contrasting. What we find is that respondents are less confident in their knowledge (stating their awareness of the information) but are knowledgeable (as assessed by the researcher) are prepared to pay the most. It could be argued that the unfamiliar nature of seamount biodiversity undermines the use of stated preferences methods to assess the non-use values of biodiversity. However, here we follow the argument of Ready et al. (1995), who state that participants gain information during the process of a contingent valuation survey and can develop preferences for the good in question. This is also in line with literature in the psychology field, which suggests that preferences are first constructed by the respondent for unfamiliar goods during the interview process itself (Schkade and Payne, 1994). Also, Meinard and Grill (2011) state that there is no literature which supports the claim that people without pre-existing preferences for a good are incapable of expressing their true willingness to pay.

It can be argued then that our results also provide support for existing hypothetical bias, which can arise when respondents report a WTP that exceeds what they actually pay using their own money in laboratory or field experiments (Loomis, 2011). Hypothetical bias has been linked to the familiarity of the good being valued (Vossler and Kerkvliet, 2003;

Vossler et al., 2003), with it being minimized when the good and the context can be made familiar and meaningful to respondents (Schläpfer and Fischhoff, 2010). As the WTP of respondents who self-assessed as more familiar with the good is lower than those who didn't, this finding supports the thesis that familiarity plays an important role in both reducing hypothetical bias and ensuring more robust results. Our approach of controlling for *ex ante* knowledge, with both subjective and objective (third-party) measures is thus an advisable methodological addition when conducting stated preference surveys on intrinsically unfamiliar goods such as remote deep-sea ecosystems. This result also suggests that more investment in education to create awareness of deep-sea conservation could be undertaken as part of future management efforts. For example, tourist cruises which include Remotely Operated Underwater Vehicles (ROVs) could showcase deep-sea biodiversity as part of the cruise. Through citizen science approaches, these activities can enhance scientific knowledge, as well as increasing awareness and providing additional funding streams for the conservation of deep-sea and seamount ecosystems.

Despite controlling for prior knowledge and familiarity, there is concern that some respondents are expressing a “warm glow” effect (Becker, 1974). The warm glow effect involves respondents stating their WTP for environmental goods as a way of ‘purchasing moral satisfaction’ (Czajkowski and Hanley, 2009). Within the survey, we asked respondents their main reason for expressing a positive willingness to pay and characterized these statements as either “warm glow” or not. Of these, we perceived 29 respondents as expressing “warm glow” motivations. Other empirical studies have recognized this phenomenon of impure altruism (Nunes and Schokkaert, 2003; Kirkbride-Smith et al., 2016), which is suggested to be more common among tourists on vacation (Polak and Shashar, 2013). This result is comparable with that obtained by Ressurreição et al. (2012) on public preferences for marine species in the Azores islands (Portugal), Gulf of Gdańsk (Poland), and Isles of Scilly (United Kingdom), who found that respondents saw the conservation of biodiversity as a moral obligation to take action on behalf of future generations. Thus, individuals with a taste for this warm glow derive utility from “doing the right thing” rather than from the good in question, though most (60%) tourists in this present study expressed the motivation of bequest and existence value as the main driver of willingness to pay. We found that these measures of warm glow had no significant impact on respondents stated willingness to pay. However, respondents who deem seamount conservation as “urgent” do express a significantly higher willingness to pay than those who are unsure or do not consider it urgent. This alone does not fully confirm warm glow effect, although when we consider that prior to the survey many respondents had very little knowledge of seamounts and therefore would not be concerned about their decline it suggests some degree of hypothetical bias. This highlights the challenge within the valuation of unfamiliar goods between providing sufficient information needed to establish “baseline conditions” and over-loading respondents with superfluous detail (Needham et al., 2018). Given the challenges of valuing unfamiliar goods such as seamount biodiversity, it is no surprise that most

TABLE 7 | A comparison of predicted willingness to pay across the four estimated regression models.

Model	Mean	Standard Error	95% Conf. Interval
Tobit 1 (sociodemographic variables only)	48.83	2.82	43.25 – 54.42
Tobit 2 (all explanatory variables)	52.05	3.13	45.84 – 58.25
Interval regression 3 (sociodemographic variables only)	52.47	2.69	47.15 – 57.80
Interval regression 4 (all explanatory variables)	54.56	3.08	48.46 – 60.66

empirical studies have focused on measuring non-use values of more familiar habitats such as shallow-water coral reefs and charismatic species such as sharks and mammals (see Casey et al., 2010; Ressurreição et al., 2012; Matsiori et al., 2013; Cazabon-Mannette et al., 2017). Comparing the mean willingness to pay estimates presented in **Table 7** to our estimate (US\$52) (**Table 8**) reveals the public's interest in protecting seamount ecosystems – even though they do not see or “directly” experience seamount biodiversity as they do with coral reefs, marine mammals and turtles. This conclusion is strengthened when we consider respondent's response rates concerning their preferences for the allocation of conservation funds to seamount species. Moreover, our results show that tourists were equally divided when it came to charismatic versus uncharismatic species protection – therefore challenging the commonly held view that charismatic species have a stronger influence on human preferences for biodiversity conservation than less charismatic species (Ressurreição et al., 2011). However, small differences in the valuations of marine mammals compared to invertebrates were also found by Ressurreição et al. (2011).

The key issues that threaten the sustainability of seamount biodiversity stem from our limited ecological understanding of seamount communities (Morato et al., 2010). This lack of knowledge is further compounded by limited information on the social and economic benefits of protecting deep-sea species. In the Galapagos, this has led to a clear bias toward the conservation of certain biomes that deliver direct-use values including rocky nearshore environments and sandy beaches (Edgar et al., 2004). Furthermore, there is a disproportionate allocation of funds for the conservation of charismatic species, such as sharks and penguins, that generate high economic returns to society (Vinueza et al., 2014). Moreover, there are no current studies that evaluate the use values provided by seamounts by small-scale deep-sea fisheries and “Pesca Vivencial” or sport fishing. Hence, a major challenge to implement seamount biodiversity conservation has been to demonstrate that direct links exist between seamount species and direct benefits to society. Due to the fact, the very few individuals have “direct” experiences of the seamounts, the economic valuation of seamount biodiversity using only direct-use ecosystem services and ignoring cultural services, would undervalue the good rather than support its conservation. From this perspective, the Directorate of the Galapagos National Park could recognize the need to include non-use benefits in the valuation of

TABLE 8 | Selected papers and key findings of marine species valuation studies using the contingent valuation method.

Author(s) (year)	Location	Users	Good Valued	Mean Willingness to Pay Range (a)	Frequency of Payment	Units	Survey
Aanesen et al., 2015	Norway	Public	Cold-Water Coral	\$364–381	Annual	H	2014
Casey et al., 2010	Riviera Maya, Mexico	Tourists	Coral Reef	\$42–58	Per visit	I	2005
Kirkbride-Smith et al., 2016	Barbados, West Indies	Tourists	Coral Reef	\$16–21	Per visit	I	2013
Jobstvogt et al., 2014	Scotland	Public	Deep-Sea Biodiversity	\$111–122	Annual	H	2012
Ressurreição et al., 2011	The Azores	Residents and Tourists	Invertebrates	\$63–108	One-time	I	2007
Ressurreição et al., 2011	The Azores	Residents and Tourists	Mammals	\$79–136	One-time	I	2007
Cazabon-Mannette et al., 2017	Tobago	Tourists	Sea Turtles	\$31	Per visit	I	2007–2010
Schuhmann et al., 2019	Barbados	Tourists	Coastal and Marine resources	\$36–52	Per Visit	I	2015
Susilo et al., 2017	Indonesia	Residents	Mangrove ecosystems	\$2.57 – 2.58	One-time	I	2016
Armstrong et al., 2019	Ireland, Norway	Public	Cold Water Coral	\$36.83 – 45.80	One-time	I	N/A
Grafeld et al., 2016	Guam	Divers	Coral Reef	\$10	One-time	I	2013

^aWillingness to pay is reported in U.S. dollars (all values converted using average annual currency conversion rates). Units refer to the value's unit measurement in terms of household (H) or individual (I).

seamount ecosystems, especially when our study leads to the conclusion that people experience a significant increase in their willingness to pay for seamount conservation through an increase in entrance fees.

The findings of our study provide a basis for understanding trade-offs between benefits from conservation and commercial uses of seamount biodiversity. The high non-use value that we identified justifies the need to ensure that cultural services are consistent with provisioning services in the rezoning of the archipelago's marine reserve. This is explicitly being discussed in a current re-zoning plan that addresses areas within the GMR as exclusive conservation zones or rather zones for sustainable use. Possible income through increased entrance fees stemming from non-use values for diverse ecosystems supports the case for enhancing conservation. Furthermore, as the major economic sector in the Galapagos, tourism has a vested interest in the conservation of ecosystems, since their economic incentives are aligned with conservation. The rise of a locally owned ecotourism sector is a positive development both for the local economy and ecosystem conservation and we argue that seamount biodiversity conservation can be managed as part of the wider objective of promoting sustainable tourism. The symbiotic relationship that exists between tourism and conservation in the Galapagos, places a high economic value on the existence of seamount biodiversity (Mathis and Rose, 2016) and we should protect these systems for the sake of conserving biological diversity in the Galapagos Marine Reserve, as well as for their economic importance.

On a broader scope, the findings of this study are timely for the debate over raising the entrance fee into the Galapagos National Park. The majority of tourists expressed the willingness to pay increased entrance fees to improve conservation efforts. Based on the predicted mean willingness to pay of foreign and national tourists and the total number of tourists who entered the Galapagos in 2016, over USD\$11.2 million in additional revenue

could be generated. Potential revenue from increasing tourist entry fees can, therefore, be a feasible avenue through which funding for conservation-oriented research, outreach campaigns and marketing can occur. Critically, funds stemming from entrance fees are assigned to various governmental agencies, not exclusively the Galapagos National Park, that are conservation and management oriented. Furthermore, research is almost exclusively carried out by non-governmental and academic institutions, such as the Charles Darwin Foundation, which don't receive access to these funds. It is thus important for visitors to know what conservation projects they are financing and which they are not. Upon entry into the Galapagos National Park, we suggest that tourists are presented with a pamphlet that outlines current research projects and specifies how funds from entrance fees are distributed amongst conservation priorities. Not only will this help to justify the fee payment, but it will also serve to educate tourists on important areas of conservation before their trip starts. Moreover, it will also avoid a possible "crowding out effect" on donations to the local NGOs which they depend upon since entrance fees do not fund the research they conduct. This is important because increasing tourists' knowledge of the host-area will help to increase their support for nature conservation, and also highlight key areas not covered by their entrance fees.

Conclusion

Overall, our findings suggest that tourists would support the development of a multiuse management plan for the Galapagos Marine Reserve. This plan balances conservation, local communities and sustainable tourism. Visitors to the Galapagos Islands attach positive and significant values to the conservation of seamount biodiversity. From a policy perspective, our results show that the non-use values people associated with species protection need to be incorporated alongside the direct-use values for better management of marine protected areas.

Additionally, the results show that overlooking the non-use values provided will lead to undervaluation of marine ecosystems and their services. As the new multiuse zoning plan for the Galapagos Marine Reserve is soon to be implemented, it is very timely to consider user preferences that combine conservation, sustainable fishing and sustainable tourism into the management plan. Tourism is also the main driver of the Galapagos economy, accounting for 78% of all employment, compared to less than 5% in fishing. The tourism sector is a main stakeholder to the Galapagos islands, but successful management plan should take into account other relevant stakeholders such as the local communities. The Galapagos Special Law (1998) established the GMR's overarching objective – the protection of the archipelago's marine biodiversity, both in terms of its intrinsic (preservation) and utilitarian (fisheries and tourism) values (Galapagos National Park Service [GNPS], 1998). The Management Plan states that the main aim of the GMR is to “protect and conserve the coastal-marine ecosystems of the archipelago and their biological diversity for the benefit of humanity, the local population, science and education.” (Galapagos National Park Service [GNPS], 1998). As this study was focused on tourism preferences, we, therefore, recommend performing additional studies to local communities such as fisheries to include their view into policy recommendations. One of the main purposes of the tourist visiting Galapagos is nature-tourism. Lack of awareness on the importance to support local communities is probably one of the main reasons that tourist did not include livelihoods in the management plan. Conclusions on this part should be taken with precaution, and additional efforts should be made to increase the awareness of tourist with the local community and livelihoods.

Although WTP studies are normally hypothetical in nature, i.e., depend on people's opinions (Carson et al., 2001) they can be useful for management and have been extensively used globally. Therefore, our study can be used to inform policymakers of one avenue toward sustainably managing seamounts while being mindful of the need to consider livelihoods, conservation and tourism into the equation. Knowing what we know about environmental funds of GMR, tourism funds dedicated to the conservation of seamounts would seem an important and practical step to ensure the protection of the diverse pelagic ecosystems, offshore seamounts, and ocean trenches globally. Thus our findings have relevance beyond the Galapagos as they give insights into the motivations people have to see the sustainable management of poorly known deep-sea ecosystems. Recent work shows members of the public in Norway and Scotland are supportive of deep-sea marine conservation, despite overall low levels of prior understanding (Ankamah-Yeboah et al., 2020). It is important that this public goodwill translates through national and international policy processes and those decisions are informed by the best available scientific information. In the context of the BBNJ treaty negotiations, while stakeholders show varying opinions on the role science plays, there is evidence of consensus regarding the benefits of integrative management, the application of precautionary approaches when data are insufficient, and the perceived trustworthiness and credibility of science (Gaebel et al., 2020). Our study reiterates and amplifies these positive messages. People

prioritize sustainable management and we need to support and nurture the human and technical capacities beyond developed economies so all have access to the information to make informed policy choices.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SI was the main manuscript author and wrote the abstract, discussion, and conclusion. TI designed the survey and collected the data as part of her Masters Dissertation at the University of Edinburgh under the supervision of JR, KN, and PM-P. PM-P supervised the collection of the data and design of the survey, reviewed the manuscript, and provided the input into the abstract, discussion, and conclusion. KN assisted in the survey design, undertook the data analysis, and wrote the methods and results. MT assisted in the data analysis and the writing of the methods and results, as well as providing comment on the manuscript. JR was the primary supervisor of SI's project, re-drafted the manuscript, and provided direction on the project. All the authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fmars.2020.602767/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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