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RESEARCH ARTICLE

VALUING MARINE BIODIVERSITY CONSERVATION IN SAL ISLAND (CAPE VERDE) USING THE CONTINGENT VALUATION METHOD

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ABSTRACT

In the present study, we estimated the value of marine biodiversity off Sal island (Cape Verde) through a contingent valuation methodology, where tourist divers, who had recently dove off Sal island, were asked about their willingness to pay (WTP) for the protection of local marine biodiversity through donations, fees, or other forms for the creation of a trust fund. Of 347 respondents,32% stated they were unwilling to contribute (protest bidders). Of those respondents who said they would be willing to contribute, 50% chose "fee" as the option where they were willing to pay less, whereas the "combined" option (i.e. including "donation", "fee" and "souvenir") was the one where respondents were willing to pay more, with around €1-7 and €0-800, respectively. We discuss the potential of trust funds as potential revenue sources to support marine biodiversity conservation and improve resilience of both local diver operator businesses, other tourist enterprises, and the local community as a whole.

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INTRODUCTION

Marine biodiversity is often put at risk when there is misuse of resources without the simultaneous action to conserve and replace those resources (Roberts *et al.,* 2002; Carpenter *et al.,* 2008). Different sources of funding for the protection of marine biodiversity are available and their effectiveness depends upon several circumstances - e.g. public policies, private or public organization commitments (Williams *et al.,* 2010). One such funding source is the establishment of trust funds, which are already established in several places worldwide (e.g. Subade, 2007; Peters and Hawkins, 2009). The economic value associated with marine biodiversity conservation has been studied in different places around the world, with particular emphasis in tropical waters. There are several studies in this area of research, most of them dealing with diving in MPAs, coral reefs or both. For example, the consumer surplus for the diver is often related to the increased chance of finding more corals, turtles or fish (e.g. Parsons and Thur, 2008) and eventually facing less pressure from divers (e.g. Schuhmann *et al.,* 2013). Divers usually tend to maximize utility, which is obtained if their expectations at a dive site are fulfilled (Semeniuk *et al.,* 2009). Diving tourist enthusiasts (eco-tourists) are keen to preserve marine habitats that offer a different experience (Uyarra *et al.,* 2010). Indeed, "uniqueness" is often a keyword used to describe a diver's favourite site (Parsons and Thur, 2008). Eco-tourists are typically interested in visiting dive spots that house rare or endangered species (Ramos *et al.,* 2006), as well as those that protect or mitigate a negative agent (Stamieszkin *et al.,* 2009). Malpractices, habitat loss and other phenomena expose marine biodiversity to risks (Wielgus *et al.,* 2009), and to counteract these effects, conservation measures are needed (Airoldi *et al.,* 2008). In that sense, divers can be involved in the process of evaluating marine biodiversity and demonstrate their willingness to pay (WTP) for underwater biodiversity (Sorice *et al.,* 2007). Stakeholders in general and eco-tourists in particular find that they need to contribute to the protection of coastal and marine spots (Pomeroy *et al.,* 2007). Several national marine parks have developed different financing mechanisms in order to achieve self-sustainability (e.g. Gallegos *et al.,* 2005), such as entrance fees to marine reserves (Arin and Kramer, 2002).

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Forsome sites, particularly marine protected areas (MPAs), funding from fees, grants, and donations are usually not enough to cover operational costs, and the involvement of local communities in the activities of the marine parks brings additional revenues from tourists to the local tourist industries (Dygico, 2013). The local economy, e.g. souvenir shops, also benefit from biodiversity conservation namely by selling protected area-related clothing and daily use objects (Ross and Wall, 1999). The objective of this paper was to determineeco-tourists' WTP for the creation or maintenance of certain divesites off Sal island. To achieve this goal, we developed an online survey to ascertain the factors that influence WTP.

Literature Review

The need to attribute values to environment preservation has been in existence since the middle of the last century (Smith, 2009). Typically, studies on the valuation of non-market resources use indirect methods (e.g. travel cost) and direct methods (e.g. contingent valuation) (Adamowicz *et al.,* 1994; Kopp and Smith, 2013). The contingent valuation method (CVM) was first proposed by Ciriacy-Wantrup as a survey-based economic technique (Ciriacy-Wantrup, 1947).

Within economics the standard CVM makes use of different formats to elicit a response based upon a hypothesised contingency, with the dichotomous choice and/or the payment card amongst the most commonly used. The stated preference methods used to measure WTP are usually based on the combination of several economic values associated for the use, option, and existence of natural and environmental resources (Freeman, 2003). Thus, in CVM surveys, it is common to find protest bidders and the ways to deal with them may vary (Meyerhoff & Liebe, 2006; Jacobsen & Thorsen, 2010). According to Halstead *et al*. (1992), protest bidders are not only those that give a value of zero to the commodity being offered (protest zero bids), but also disagree with or do not like the format of payment being used in the survey instrument. Diving surplus value is commonly expressed in monetary terms (Table 1). For instance Brander *et al*. (2007) collected information from 166 worldwide studies on the recreational value of coral reefs and standardized it in US$/visit.

Sal Island (Cape Verde)

Cape Verde is an island country spanning an archipelago of ten volcanic islands in the central Atlantic Ocean (Figure 1).

Table 1. Selected studies valuing access and quality change for diving

Author(s)	Location	Resource	Methodology	Year of study (YoS)	Value per diver in 'YoS US$'
Arin and Kramer (2002)	Phillipines	Marine park	CVM	1997	$3.40–5.50/day (WTP)
Tongson and Dygico (2004)	Tubbataha (Phillipines)	Marine park	CVM	1999	$41.11/trip (WTP)
Oh *et al*. (2008)	Texas (USA)	Marine sanctuary	CVM	2007	$101–171/yr (WTP)
Parsons and Thur (2008)	Bonaire	Marine park	CVM	2001	$45–192/yr (WTA welfare losses)
Asafu-Adjaye and Tapsuwan (2008)	Similan islands (Thailand)	Marine park	CVM	2004	$27.07–62.64/yr (WTP)
Nuva *et al*. (2009)	West Java (Indonesia)	Marine park	CVM	2004	$0.82/day (WTP)
Yacob *et al*. (2009)	Malaysia	Marine parks	CVM	2007	$1.92–2.79/yr (WTP)
Casey *et al*. (2010)	Yucatan (Mexico)	Coral protection	CVM	2005	$42–58/yr (WTP fees)
Thur (2010)	Bonaire	Marine park	CVM	2002	$61–134/yr (WTP fees)
Ransom and Mangi (2010)	Mombasa (Kenya)	Marine park	CVM	2007	$2.2–8/yr (WTP)
Schuhmann *et al*. (2013)	Barbados	Marine biodiversity	CVM	2007-09	$41–62/two-tank dive (WTP)

People take advantage of the availability of natural resources (utility), but the majority of the time, those resources are not sold in markets. Consequently, their value is uncertain, because there is no market price for them (Zhang & Li, 2005). Contingent valuation focuses on social choice (McFadden, 1994), and single or multiple instruments can be used to measure the above mentioned problem, i.e., to preserve certain public goods (Green *et al.,* 1998; McComb, 2006) or to accept natural or environmental losses (Andersson, 2007). The instruments used to collect elicitations from people vary (Welsh and Poe, 1998). Surveys, whether face-to-face, mail, telephone (Holbrook et at., 2003; Mitchell and Carson, 2013) or more recently web-based (Thurston, 2006; Heiervang and Goodman, 2011) are commonly used to gather information for the CVM. Comparisons of both instruments have also been tested (Berrens *et al.,* 2003; Canavari *et al.,* 2005; Lindhjem & Navrud, 2011). Basically, whatever the instrument used, people are asked to choose their preference, ideally in a single and straightforward way, by stating how much money they are willing to pay to preserve a given natural feature such as marine biodiversity (Kahneman & Sugden, 2005).

Located 570 kilometres (350 miles) off the coast of Western Africa, the islands cover a combined area of 4,033 square kilometres (1,557 sq mi) (Anonymous 2005). Cape Verde has few significant natural resources beyond fisheries, suffers frequent drought (Anonymous, 2007) and was recognised as one of the marine biodiversity hot-spots most threatened by species extinction (Roberts *et al.,* 2002). Nevertheless, Cape Verde hosts more than 300 fish species, with 6.3 % endemism (Wirtz *et al.,* 2013), five marine turtle species (Santos *et al.,* 2009) and a large number of macrofaunal endemic species (Cunha *et al.,* 2005; Duda Jr. and Rolán, 2005) in clean, pristine waters attracting more than half a million tourists annually (INE, 2013).

Diving is one of the main tourist attractions, with Sal Island and Boavista being the two most visited of the archipelago (INE, 2013). Despite the recent competition from the new airport built in 2007 on Boa Vista island, Sal island still attracts an increasing number of tourists (Duarte and Romeiras, 2009). The main tourism attraction in Sal is diving due to the pristine waters and as a tropical destination it offers a high diversity of warm-water marine species.

Job opportunities in Sal have risen in recent years. As a consequence many deprived people from other islands moved to Sal seeking a tourism-related job, which resulted in a rapid population growth (Simão and Môsso, 2013). The tourism sector has been one of the main reasons that poverty has attenuated on Sal (Rocha and Ferreira da Silva, 2014). Job opportunities are both directly and indirectly linked to the expanding tourism industry, where small-scale fisheries play an important role in the chain by supplying fresh fish and shellfish to the food and beverage businesses (Fidalga *et al.,* 2014). Fishermen have seen their catches achieving a higher price, because of the rising demand of high quality fish for restaurants and hotels (Barros, 2007) and a few studies on diving have already been carried out, such as the first attempt to characterize the Sal diver profile y (Ramos *et al.,* 2011).

A hypothetical conservation scenario was posed where respondents were invited to state their preferences in terms of willingness to pay for the status of marine biodiversity. Respondents were asked if they were in favor, against or indifferent to the contingent valuation question. Some follow-up questions were included to differentiate protest bids and other bidders. Those who were favorable or indifferent were asked to state their preferential options to contribute for the potential creation of a trust fund, namely a donation, buying a souvenir, a diving fee, or a combination of the above. Respondents were asked to choose one of eight donation amounts (< €1, €1-5, €6-10, €11-20, €21-50, €51-100, €101-200 and > €200). Following Brander *et al.* (2007), the valuation results were standardized in a single unit of monetized values in the currency (euros €),

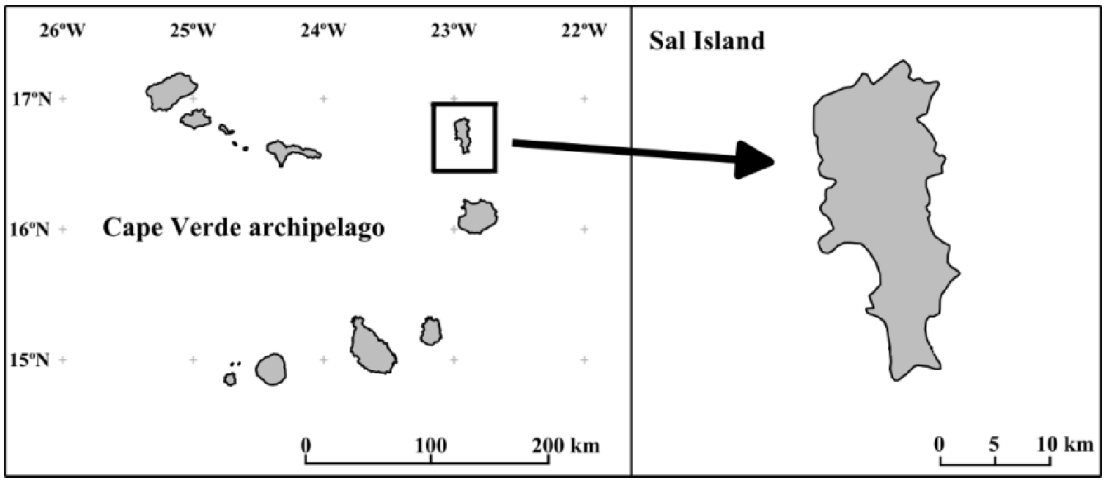

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Figure 1. Cape Verde archipelago: Sal Island location

MATERIALS AND METHODS

Questionnaire and data collection

The survey instrument was pre-tested on a sub-sample of five divers in October 2012. After some adjustments a questionnaire survey was placed online. A covering letter introducing the purpose of a CVM survey about the value of marine biodiversity conservation off Sal island and a link to a survey, was emailed to 7,434 addresses drawn from a list of divers who had visited Sal island and went out with a local dive operator. The questionnaire was active between February 18th and March 18th, 2013. Because it was aimed to reach a wide audience, both the cover letter and the questionnaire were presented in English. The expected average time to complete the questionnaire was 15-20 minutes and it consisted of29 questions: 26 multiple choice and 3 open-ended. The survey included questions about the geographic origin of respondents and some of their personal characteristics (e.g. age group, gender, marital status, job occupation group), holiday and tourism choices (e.g. season of the year to go on holidays, number of visits to Cape Verde, staying time, accommodation type), diving characteristics (e.g. dive expertise, dive avidity, preferences), and specific questions related to marine biodiversity (perceived status of marine biodiversity, perceived diving impact).

for the year 2013, for the entire island (Sal), per visitor (diver), during a certain time period (usually one week). Variables were used in statistical analysis (Table 2). There are different ways of dealing with protest bids (Freeman, 2003). Halstead *et al*. (1992) refer that there are three commonly used approaches: (1) simply dropping them from the data set, (2) including protest bids in the data set, (3) assigning protest bids a mean WTP according to some characteristics of other respondents. In this study protest bids are included in the data set.

Econometric model approach

According to Train (2009) the utility (u) derived by an individual (i) from a particular alternative (j) comprises a deterministic value component (v_{ij}) and a random component, where the latter is unobservable to researchers (ε_{ij}). Utility can be expressed as:

$$u_{ij} = v_{ij} + \varepsilon_{ij} \quad \text{..... (1)}$$

when it is accepted that when the individual chooses an alternative (k) over another alternative (j), it is implied that the utility received from the former outweighs that from the latter as follows:

$$u_{ik} > u_{ij} \quad \text{..... (2)}$$

Table 2. Selected variables used in the contingent valuation method and their description

Variable	Description
Individual characteristics	
Origin	Country where respondent lives most of the time (= 1 if Portugal, = 0 otherwise)
Gender	Gender (= 1 if male, = 0 if female)
Age	Age group (coded 1 to 4: 1 = under 26 yr old, 2 = 26 to 40 yr old, 3 = 41 to 60 yr old, 4 = over 60 yr old)
Educ	Last years at school / university completed (coded 1 to 3: 1 = under 9 yr, 2 = 9 to 12 yr, 3 = over 12 yr)
Ma_STATUS	Marital status (= 1 if married or living together, = 0 if single, widowed or divorced)
Trip characteristics	
Sal_Visit	Number of Sal Island visits (coded 1 to 4: 1 = once, 2 = twice, 3 = three to five times, 4 = more than five times)
MO_Visit	Month of last visit to Sal Island (=1 if summer: June, July and August, = 0 otherwise)
TOT_Cost	Proxy for income: total costs estimated (i.e. travel and lodgement costs)
Diving characteristics	
Dive_Exp	Diving experience (= 1 if less than fifty dives, = 0 otherwise)
Dive_YR	Number of dives per year (= 1 if less than ten dives, = 0 otherwise)
Fund	Willingness to contribute for a fund (coded 0 to 2: 0 = 'no' to WTP, 1 = 'maybe' WTP, 2 = 'yes' to WTP)
Help	Availability to participate and help in Sal conservation project (coded 0 to 2: 0 = 'no', 1 = 'maybe', 2 = 'yes')

Table 3. Dive tourists sample characteristics. NR stands for Natural Reefs, AR stands for Artificial Reefs, Indiff stands for divers with no preference for dive site, ALL stands for aggregated divers

	ALL (n = 292)		NR only (n = 16)		AR (n = 225)		Indiff. (n = 51)	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Individual characteristics								
ORIGIN	0.705	0.456	0.709	0.455	0.704	0.457	0.704	0.457
GENDER	0.692	0.462	0.688	0.464	0.691	0.463	0.690	0.463
AGE	2.421	0.655	2.440	0.647	2.423	0.657	2.422	0.658
EDUC	2.822	0.433	2.830	0.421	2.821	0.434	2.819	0.437
MA_STATUS	0.651	0.477	0.656	0.476	0.649	0.478	0.652	0.477
Trip characteristics								
SAL_VISIT	1.534	0.938	1.553	0.950	1.536	0.940	1.544	0.945
MO_VISIT	0.336	0.473	0.337	0.473	0.333	0.472	0.338	0.474
TOT_COST	2,505	1,041	2,515	1,048	2,509	1,040	2,510	1,049
Diving characteristics								
DIVE_EXP	0.606	0.489	0.603	0.490	0.605	0.490	0.610	0.489
DIVE_YR	0.651	0.481	0.635	0.482	0.636	0.482	0.641	0.481
FUND	0.795	0.629	0.805	0.638	0.801	0.634	0.801	0.636
HELP	0.966	0.682	0.965	0.684	0.966	0.684	0.965	0.684

Table 4. Summary of results for the WTP applied to Sal island divers using the multinomial logistic regression model

Fund type	Combined		Donation		Fee		Souvenir	
Variable	Coefficient[1]	SE	Coefficient[1]	SE	Coefficient[1]	SE	Coefficient[1]	SE
(Intercept)	-2.4255***	0.414	1.1150***	0.0396	-1.0692***	0.0319	-5.5413***	0.0461
ORIGIN	0.2714*	0.1562	0.7127***	0.0643	0.1727	0.2619	1.8967***	0.0478
GENDER	0.2489*	0.1430	0.5617***	0.0348	0.2003	0.2246	-0.2934***	0.0382
AGE	-0.3898*	0.2073	-0.8772***	0.1644	0.1403	0.1706	0.4182**	0.1292
EDUC	0.1684	0.1854	-1.3954***	0.1518	-0.4624**	0.1689	0.3514*	0.1393
SAL_VISIT	0.3144	0.1612	0.3932*	0.2068	-0.0607	0.1537	0.4140*	0.1809
TOT_COST	0.0000	0.0002	0.0005*	0.0002	0.0004	0.0002	-0.002	0.0004
D_EXP	0.0002	0.0009	0.0027*	0.0013	0.0011*	0.0008	0.0028*	0.0017
DIVE_YR	0.0107	0.0085	-0.0117	0.0147	-0.0048	0.0081	-0.0292	0.0214
HELP	1.1448***	0.2381	0.1020	0.0969	1.0600***	0.2063	0.2316**	0.0800

[1]Significance levels of 0.1, 0.05, and 0.01 are represented by *, **, and *** respectively. Residual deviance: 719. AIC:819.

Following Oh *et al*. (2008), Asafu-Adjayea and Tapsuwan (2008) and Casey *et al*. (2010), we used a random utility econometric model to verify if the responses to the hypothetical change to promote biodiversity conservation through the potential establishment of a trust fund. Respondents (*i*) were asked to compare their personal utility based on the current state or status quo (u_{ii}) with the establishment of a fund used to create artificial reefs and other mitigation measures to protect marine biodiversity at a given cost represented as (u_{ik}). We assume that utility is a function of a proxy of income (M_i) (i.e., based on diver's accomodation costs estimation and staying time plus the approximate standard flight cost according to the distance from the country of origin), individual socioeconomic characteristics of the respondent (S_i) and the WTP to contribute for a biodiversity fund (F_{ik}) which has two possible states (1 if the respondent is willing to contribute and 0 if is not), and unobservable elements that contribute to respondent's decision (ε). A diver (*i*) is willing to pay from a payment card a given amount (A_{ik}) (i.e., answer type ‘‘Yes’’ or “Maybe”) only if:

$$u_{ik}\,(F_{ik}\,,\, M_i - A_{ik}\,,\, S_i) + \varepsilon_{ik} > u_{ij}\,(0,\, M_i\,,\, S_i) + \varepsilon_{ij} \quad \ldots.(3)$$

WTP is calculated based either on supportive (“Yes” and “Maybe”) or protest (“No”) bids to the statement. It is assumed that the error terms are independently and identically

distributed with mean zero and variance $\pi^2/3$ (the multinomial logistic distribution function or multinomial logit), and the probability that the respondent gives a supportive answer is represented by:

$$Pr(\text{“maybe” or “yes”} = 1) = 1 / (1 + e^{-z}) \quad \ldots\ldots\ldots (4)$$

where z can be expressed by:

$$z = \alpha + \beta F_{ik} + \gamma S_i + \delta M_i \quad \ldots\ldots\ldots (5)$$

where α, β, γ and δ are coefficients to be determined.

RESULTS

Of 7,434 e-mails sent out, we received 347 replies (4.67%). Of those, only 292 surveys were filled out completely; these were used for subsequent analyses.

Descriptive statistics

Respondents' characteristics were allocated in three sections (Table 3). One related to individual characteristics, a second one connected to the diving trip to Cape Verde, and a third one linked to diving. Regarding man-made structural reefs, most respondents like this type of reef (76.5%) or are indifferent (19.3%), while few divers do not prefer man-made structures (5.2%).

fund over another do not depend on the presence or absence of the alternative “other” which was chosen by only few respondents. So, based on IIA it is assumed that the relative probabilities of choosing “fee” or “souvenir” do not change if the alternative “other” is added as an additional possibility.

Protest bids

Protest bids were included in the multinomial logit models (Figure 2). There were 94 respondents (i.e. about 32%) that were not willing to pay for a marine biodiversity conservation fund, even though more than half of those said they would be willing to participate in a conservation project in Sal Island. This suggests that 52 (out of 292 bids) appeared to be protest zero bids.

DISCUSSION/POLICY IMPLICATIONS

Preferences for marine biodiversity may vary according to different cultural backgrounds (Ressurreição *et al.,* 2012). However, a higher value is attributed for visiting a place where there is a strong conservation culture. The origin of the diving tourists may vary according to the destination, but certain patterns can be found, namely with regard tropical destinations (Hu and Wall, 2005; Dicken and Hosking, 2009; Vianna *et al.,* 2012), perhaps due to the pristine waters and higher biodiversity of marine species (Asafu-Adjaye and Tapsuwan, 2008).

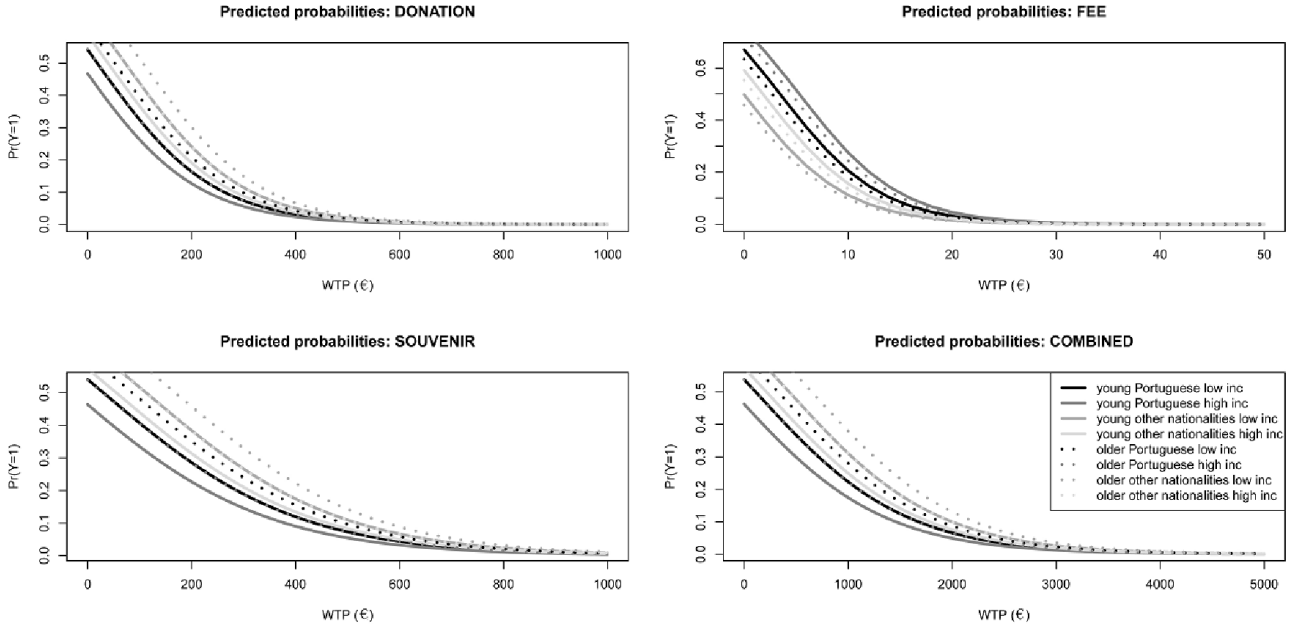

Figure 2. Multinomial logit distributions for each of the alternative choices of WTP (in euros)

Estimates of WTP

The multinomial logistic regression model for WTP was fitted (Table 4). The *p* values were calculated using Wald tests. For better consistency in results, we dropped two predictor variables (i.e., MA_STATUS and MO_VISIT). The outcome variable was fund type (FUND). The aim was to use the multinomial logit to model fund type choices (Figure 2). Based on the assumption of independence of irrelevant alternatives (IIA), it can be stated that the odds of preferring one type of

The question of biodiversity conservation seems to be highly relevant to divers when considering value attribution (Cruz-Trinidad *et al.,* 2011). If tourist divers are concerned that certain species are at risk, the value given to marine biodiversity conservation is lower; but in contrast, actions to stimulate the preservation of certain species can be very valuable for local economies (Barker *et al.,* 2011; Clua *et al.,* 2011). People seem to give their answers according to their feelings and beliefs and as such they put a value on the marine biodiversity that can be found (Bess and Rallapudi, 2007;

Pascual *et al.,* 2011). Here, we found that tourist divers tend to have higher WTP if a combined range of mechanisms to finance biodiversity exists, as was described by Terk and Knowlton (2010), Halkos and Jones (2011). It seems that establishing fees garnered support from those willing to pay a small amount. This finding is in accordance with what has been described in both the Philippines (Arin and Kramer, 2002) and in MPAs worldwide (Peters and Hawkins, 2009).

Previous CVM studies have expressed WTP by dive/trip or annually (Depondt and Green, 2006). Sometimes the WTP is related to the establishment of an access fee or a similar financial measure (Dharmaratne *et al*., 2000). In the present study, we developed a CVM in order to obtain divers' WTP according to different scenarios. In terms of fees, it seems that our results are in accordance with other studies presented in Table 1, but may diverge in terms of donation amount (Rivera-Planter and Muñoz-Piña, 2005; Parsons and Thur, 2008). When it comes the question on funding some caution is needed. For example, divers' WTP for such a fee is a matter of analysis because it assumes several premises from both the demand and the supply side (Subade, 2007). From the demand side, eco-tourists seek clean waters, special features, or certain species or individuals of a certain size or behaving in a certain way (Ramos *et al.,* 2006) and are WTP a certain amount to maintain or improve a preferred dive site (Grafton *et al.,* 2011). From the supply side, dive-operators and biodiversity project promoters have to guarantee what is aimed to achieve by the Rebuilding Nature Project. When considering the promotion of biodiversity through buying a souvenir, we feel the simplest way is by promoting natural and biological iconic ex-libris that are painted or embossed directly in daily clothing, toys and other objects that people want to use and consequently promote their attention and eventually their preservation. People seem to be WTP through this process (Seenprachawong, 2002).Donation seems to be sometimes used as an equivalent to fee (Rivera-Planter and Muñoz-Piña, 2005; Thur, 2010).

Funding biodiversity will need to be assessed on a case-by-case basis, and the surveys such as the one presented here will be important to determine the factors affecting WTP at different sites. The implementation of trust funds can be used to promote and manage biodiversity conservation, because they stimulate both directly and indirectly other tourism activities such as accommodation and transportation (Mustika *et al.,* 2012).

Finally, protest bids may have diverse reasons: the fee is too high, the belief that money to preserve biodiversity should come from taxes instead of donations, biodiversity is not worth anything to that person, or biodiversity is important for that person, but the person refuses to place a value on it (Halstead *et al.,* 1992; Meyerhoff and Liebe, 2006). A caveat of this study is that our survey did not include how a biodiversity conservation trust fund would be used, as already carried out elsewhere (e.g. Peters & Hawkins, 2009). The specification of such entities seems of fundamental importance to provide additional information to tourist divers who were willing to respond to this inquiry.

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