Assessing willingness to pay for marine and coastal ecosystems: A Case Study in Greece

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Abstract
The achievement of good environmental status (GES) of marine and coastal ecosystem services is specified in the Marine Strategy Framework Directive (MSFD). This paper uses the choice experiment methodology (CE) to estimate the value of non-market benefits of marine and coastal ecosystem. Non-market benefits are rarely considered in marine planning and management. Assessing respondents' willingness to pay in order to contribute in the development of marine planning and management implies that changes in marine and ecosystem services in Greece should be considered. Using appropriate econometric methods the empirical results show government trust and willingness to pay is directly linked. The results demonstrate also that preferences are heterogeneous with changes in certain marine and coastal attributes.

Keywords: Marine Strategy Framework Directive; Marine and coastal ecosystems; Non-market valuation; Choice experiment.

JEL Classification: Q50; Q57; C25.

1. Introduction

Marine and coastal ecosystems play an important role in the balance of the environment as they interrelate and interact dynamically. The coverage of water amounts to more than 70% and the remainder consists of land area (Burke et al. 2001; UNEP 2006). The total length of the coastlines worldwide extends over 350,000-1,000,000 km and circa 84% of the countries that have a coastline within its extent display a variety of geomorphological types and ecosystems (Martinez et al. 2007). Moreover, it is indicative the fact that human population lives within 100 km of the coast (Cohen et al. 1997; Gommes et al. 1998; Burke et al. 2001).

Mankind is strongly dependent on marine and coastal ecosystems and it is attracted by the environmental goods and services that are plentiful in these types of ecosystems and that influence their choice to live permanently for leisure, recreation, and tourism or even for commercial reasons (Martinez et al. 2007).

On the other hand, biodiversity loss, poor water quality and sea level rise provoked by anthropogenic pressures are some of the challenges that marine and coastal ecosystems has to encounter without profoundly depicting the integrated envision of the disaster (Halpern, 2007, 2008). Salm et al. (2000) reported that the environmental degradation of marine and coastal ecosystems is multifaceted in term of the various human constructions which aim to contribute to increasing profits, but in essence replace the natural environment with harbors, industries, dams and settlements.

The European Union (EU) has developed a comprehensive Maritime Policy, which includes the Marine Strategy Framework Directive (MSFD) (Directive, 2008/56/EC) and the recently recommended Maritime Spatial Planning Directive (pMSPD) (European Commission, 2013), in addition to improving the quality of Europe's regional sea (Directive, 2000/60/EC of the European Parliament and of the Council, European Commission, 2006,

2007; Directive, 2008/56/EC of the European Parliament and of the Council). According to the MSFD, the marine strategies adopted by the EU member states in the future must enable the sustainable use of environmental services (Article 1). The MSFD emphasizes the importance of healthy ecosystems as a prerequisite for ESs to be provided (Directive, 2008/56/EC of the European Parliament and of the Council).

This paper contributes to the marine and coastal ecosystem valuation literature by applying a state-of-the-art valuation method to a case study in Greece, where the application of valuation studies is very limited. The aim of this study is to provide policy-makers with much needed information on the economic value of the benefits generated by the sustainable management of the marine and coastal ecosystems in Volos, Lesvos and Crete. The economic value of the changes in the ecological, social and economic conditions of the marine and coastal ecosystem has been estimated with a recently developed non-market valuation technique, namely the choice experiment (hereafter CE) method.

There are to date only a few CE applications to marine and coastal ecosystems and to our knowledge, the study presented here is the first application of a CE in Greece that includes the attribute of the state of *Posidonia oceanica*, an endemic seagrass in the Mediterranean, which has been significantly degraded by structural damage from anchors. The European species of seagrass include *Zostera marina* (eelgrass) grows from the Arctic to the Mediterranean Sea and is the only seagrass species found along the coast of Iceland. Following, *Zostera noltii* or *Zostera nana* in literature (dwarf eelgrass) is widely distributed along the Mediterranean and Atlantic coasts, but does not extend further north than the southern coasts of Norway. *Cymodocea nodosa* (seahorse grass) is found in the Mediterranean Sea and in the warmer regions of the Atlantic Sea from southern Portugal to the northwestern African coast. *Posidonia oceanica* is a strictly Mediterranean species (Borum et al. 2004). The existing valuation studies that use the CE method introducing the

attribute of Posidonia oceanica include only Diedrich's et al. (2013) study that used the classification tree method to estimate the willingness to pay (WTP) in a Marine Protected Area (MPA) located in a heavily used Bay on the island of Mallorca in Spain. This MPA was designated to protect *Posidonia oceanica*. The CE on marine and coastal ecosystems in Greece presented here provides a valuable addition to this scant literature.

The structure of the paper is the following. Section 2 reviews the existing relevant literature and section 3 describes the case study. The empirical results of the econometric analyses are reported in section 4 while the last section concludes the paper.

2. Literature Review

A number of empirical studies based on application of the CE reported in the assessment of environmental improvement of aquatic ecosystems. These studies therefore vary according to the purpose or in the selection of the sample. The research focus is on identifying the perceptions of the users of the aquatic ecosystem in general (Can & Alp, 2012), or those who live near a particular aquatic ecosystem (Kataria et al. 2012; Stithou et al. 2013). There are also research efforts in the assessment of the value of improving the environmental status of the aquatic ecosystem in the geographical context of a country (Kataria 2009; Metcalfe et al. 2012).

With respect to coastal waters, Hynes et al. (2013) applied the choice experiment on the west coast of Ireland to elicit swimmers' willingness to pay to improve the health of benthic water and management of the coastal erosion problem. In Turkey, Can & Alp (2012) conducted a research on the effective management of the marine ecosystem of the port Gkotsek Turkey, which is threatened due to increased tourism and the lack of effective policies. Metcalfe et al. (2012) conducted a large-scale empirical study for all water bodies, including the coastal waters in the United Kingdom. They used an ecological approach to value water and particular attributes used within a timeframe. With regard to investigations

related to the valuation of marine biodiversity, Norton and Hynes (2014) used attributes such as sustainable fisheries, marine pollution levels and endemic species to describe the conservation of marine biodiversity according to Marine Strategy Framework Directive.

The majority of studies are associated with the ecology of the aquatic ecosystem, incorporating variables related to attributes describing recreation and aesthetics of the environment, however, the way in which these attributes are included in the studies vary greatly throughout the literature. For example, may include attributes that pertain to endemic species whose levels describe quantitative characteristics (Morrison & Bennett 2004; Kragt et al., 2011; Eggert and Olsson, 2009). Alternatively, they may include quality characteristics generally associated with the biodiversity of the aquatic ecosystem (Hanley et al. 2005; Alvarez-Farizo et al. 2007; Birol et al. 2008).

The aesthetics of aquatic ecosystems often affected by the waste disposal and the clarity of the water (Alvarez-Farizo et al. 2007; Hanley et al. 2006; Stithou et al. 2013; MacDonald et al. 2015). Some studies describe and potential risks of environmental degradation of aquatic ecosystems to human health, thereby combining the attributes that describe the recreation and the risks to human health (Smyth et al., 2009). In the United Kingdom, Beaumont et al. (2008) estimated values related to the existence and preservation of marine biodiversity, including concepts such as ecosystem health and recreational opportunities.

Doherty et al. (2014) via a multidisciplinary research attempted to elicit the preferences of respondents regarding the recreational values and the state of health of ecosystems along rivers, coasts and lakes. In Spain, Remoundou et al. (2015) examined the willingness to pay for measures to combat the effects of climate change affecting the marine and coastal ecosystem and the residents' leisure opportunities.

Empirical studies involving the attributes of reefs are few (MacDonald et al. 2015; Taylor and Longo 2010; Marre et al. 2015). According to McArthur and Boland (2006) it is vital to understand the links between seagrass and fish production. If this relationship can be quantified, the value of the contribution of seagrass to fisheries production can be estimated and decision makers can take efficient measures regarding the long-term sustainability and health of marine ecosystems. Costanza et al. (1997) calculated the goods and services provided by the global natural environment to be worth US$16-54 trillion per year in 1997 and a value for seagrass of US$19,004. This value importantly, does not include many of the obvious values such as fisheries. Samonte-Tan et al. (2007) estimated the total net benefits of coral reefs seagrass, mangroves, beaches, intertidal areas, and marine waters of the Bohol Marine Triangle (BMT) in the Philippines.

In Greece, a limited number of studies have been carried out aiming at determining the role of environmental assessment methodologies. Kountouri et al. (2009) examined the value of constructing a wind farm using the contingent valuation method (CVM). Moreover, Birol et al. (2006) investigated the role of economic valuation for providing information to design effective and sustainable policies for water management. As part of this study an empirical study on the wetlands of Lake Cheimaditida was applied in order to estimate the total value including non-use values. Birol et al. (2007) investigated the farmers' willingness to pay for the adoption of an effective management of waste water treatment in the aquifer at Akrotiri in Cyprus. The results showed that the majority of participants, were willing to participate in a wastewater treatment program. On the southeast side of the Aegean, in Mytilene, Jones et al., (2008) conducted a survey in order to estimate the willingness to pay of respondents to improve the quality of coastal waters via a wastewater treatment program. Organtzi et al. (2009) conducted a survey on the coast of Toroneos Gulf on the east side of the Kassandra peninsula. The questionnaire included three groups of participants, including residents,

owners of holiday homes and campers. In Mytilini there have been also conducted another study involving the elicitation of willingness to pay to protect the coast from the coastal sedimentary formations affecting coastal tourism. The rock formations are usually created in the intertidal zone along the coastline (Kontogianni et al., 2014). As regards the investigation of the water quality of Greek marine and coastal ecosystems, the literature is also limited. Kontogianni et al. (2003) attempted to examine the impact of the deterioration of the water quality of Thermaikos Gulf in Thessaloniki. Respondents were asked to state their maximum willingness to contribute to Gulf restoration.

According to Jones et al. (2011) tourism has significant positive and negative impacts on the management of coastal ecosystems with high biodiversity value. In Crete, there have been investigated the visitors' preferences on two alternative policies to reinforce the protection of spawning areas for the sea turtle *Caretta Caretta*. According to the results visitors who trust the authorities tend to consider that the imposition of a tax would be an effective policy. One of the few empirical studies carried out to assess the value of endangered species, held in Mytilene by Langford et al. (1998). A methodological extension of this investigation was made by Kontogianni et al. (2012) the purpose of which was to provide participants with two methodological frameworks. Comparing the results of surveys conducted in 1995 and 2009 noted that in 2009 were more reliable results.

Halkos & Matsiori (2012) conducted a CVM research to assess the economic benefits resulting from improving the quality of coastal beaches along the Pagasitikos Gulf, in central Greece. The goal of the research was to extract the key factors influencing the willingness to pay for the protection of the coasts, the coastal development and coastal management. Recently, Halkos & Matsiori (2015) explored the attitudes and motivations of the residents of Thessaloniki and Volos to contribute to the protection of marine biodiversity. Using

appropriate statistical and econometric methods exported three factors explaining the environmental profile of the participants.

3. Case Study

We apply a CE survey to quantify consumer preferences for the six attributes (defined in Table 1) that represent the good environmental status of marine and coastal ecosystem in Greece. CE surveys are used to elicit public preferences for environmental goods and policies that are typically not related to existing markets (Boxall et al., 1996; Louviere et al., 2000; Halkos, 2013). Respondents choose their preferred option from hypothetical but realistic choices that include the attributes important to the product. Usually, these attributes have multiple levels, designed to create realistic variation among the options. The respondents' preferences for each attribute can be elicited from their choices using discrete choice statistical methods (Hanley et al. 2001; Alpizar et al. 2001; Carlsson et al. 2003; Hensher and Greene 2003; Hensher et al. 2005; Halkos 2006, 2011).

A large number of unique management scenarios can be constructed from this number of attributes and levels. Experimental design techniques and Ngene software were used to obtain an orthogonal design, which consisted of only the main effects, and resulted in 24 pairwise comparisons of alternative management scenarios. These were randomly blocked to 2 different versions, each with 12 choice sets. Each set contained one marine and coastal management scenario profiles and an option to select neither scenario. This is a status quo or baseline alternative, whose inclusion in the choice sets is instrumental to achieving welfare measures that are consistent with demand theory (Louviere et al., 2000; Bateman et al., 2003).

The respondents were explained that if they chose the baseline scenario option, they would not be expected to pay, however, there would not be any active marine and coastal ecosystem management, in which case the conditions in these ecosystems would deteriorate

to low levels for edible fishes, charismatic species status, beach development, *Posidonia oceanica* state and increasing non-indigenous species attributes (as defined in Table 1).

The sixth attribute included in the CE is a monetary one, which is required to estimate welfare changes. The levels of the monetary attribute used in the CE and the payment vehicle employed were determined through a pilot survey (Birol et al., 2006). The payment vehicle was an increase in the water bill for the next years till 2020 to be channeled to a Marine and coastal ecosystems Management Fund, which would be managed by a trustworthy and independent body. Water bill was preferred over voluntary donations since respondents may have the incentive to free-ride with the latter (Whitehead, 2006). The payment levels used are 2€/year, 5€/year, 10€/year, 25€/year, 75€/year, 150€/year. Furthermore, the use of targeted Likert-type questions and open-ended questions aided significantly in the interpretation of the attributes.

The primary research in Greece covered three regions and lasted six (6) months. The three regions are: (a) Volos-Pagasetic Gulf, (b) Rethymnon Crete and (c) Mytilene Lesvos. From the three regions, 468 completed and validated questionnaires were collected. Useful information we have received from the pilot study, which was preceded by the main survey, as far as finalizing the questionnaire, deciding on the way of eliciting the data, and specifying the sample size. To assure the representativeness of the sample, the proportionate stratified random sampling with reference to the population of each region have been used. Using the available data on the number of people living in the three regions from the 2011 census, the variable "region" has been decided as the stratification variable.

As a statistical unit we considered the household (living permanently or temporarily in each region) and its representative who would participate to the scheduled interview. The

main survey lasted from 10th of January till 11th of April 2014.[1] Data collection was conducted by means of a personal interview after a visit to the site. The survey instrument contained the choice experiment questions, as well as questions about attitudes towards marine and coastal management, individual opinions on the Mediterranean Sea, the comparative importance scoring questions, the demographic and the socioeconomic characteristics of the participant. In average terms, the respondents indicate strong agreement with the statements that human activities cause environmental damages to the part of the Mediterranean Sea around Greece, and a high quality marine environment is essential for tourism. On the other hand, they strongly disagree that building new hotels in public beaches is more important than protecting the marine environment.

4. Econometric Results

4.1. Multinomial Logit Model

The CE method has its theoretical foundation in Lancaster's model of consumer choice (Lancaster, 1966), and its econometric basis in random utility theory (McFadden, 1974). Lancaster proposed that consumers derive satisfaction not from the goods themselves, but from the attributes they provide. To illustrate the basic model behind the CE presented here, consider a respondent's choice for a marine and coastal ecosystem management scenario and assume that utility depends on choices made from a choice set, which includes all the possible management scenario alternatives. The respondent is assumed to have a utility function of the form:

$$U_i(Z_j, e_{ij}) = V_i(I_j, Z_j) + e_{ij} \quad (1)$$

Where for any respondent i, a given level of utility will be associated with any management scenario alternative j. Utility derived from any of the marine and coastal management

[1] The authors have benefited from their participation in the FP7 project entitled "Options for Delivering Ecosystem Based Marine Management" (ODEMM). This research relies on a different much simpler questionnaire that the one used in the primary research of the project and in the lines of the questionnaire presented (not adopted) in the 7th ODEMM meeting in Edinburgh 5-8 June 2012.

scenario alternatives depends on the attributes of the management scenario (Z_j), and the social, economic and attitudinal characteristics of the respondent (I_j).

Table 1: Attributes and levels in the choice experiment survey

	Attributes	**Description**	**Levels**	
1	Species Status	Edible fishes and charismatic species status	***Edible Fishes***	***Charismatic***
			Good Status	Good Status
			Pressured	Pressured
			Business as usual	Business as usual
2	Beach development	Increasing hotel units	4 hotels	
			3 hotels	
			2 hotels	
			Business as usual	
3	Marine Protected Area (MPA) Zoning	MPA Zoning: amateur fishing, anchoring, small-scale professional fishing, SCUBA diving	All activities are allowed	
			Anchoring, small-scale professional fishing, SCUBA diving is allowed	
			Small-scale professional fishing, SCUBA diving is allowed	
			SCUBA diving is allowed	
			Business as usual	
4	Posidonia Oceanica State	Percentage of Posidonia Oceanica state that is not impacted	85%	
			65%	
			35%	
			17%	
			Business as usual	
5	Non-indigenous species warnings	Warnings related to (a) the safety of seafood and (b) the safety in the water when they go for swimming	No warnings	
			Warnings about the safety in the water	
			Warnings about the seafood	
			Warnings about both	
			Business as usual	
6	Price		2€/year[2]	
			5€/year	
			10€/year	
			25€/year	
			75€/year	
			150€/year	
			0€/year -Business as usual	

[2] In 2012 prices.

The random utility theory (RUT) is the theoretical basis for integrating behavior with economic valuation in the CE method. According to RUT, the utility of a choice is comprised of a deterministic component (V) and an error component (e), which is independent of the deterministic part and follows a predetermined distribution. Assuming that the relationship between utility and attributes is linear in the parameters and variables function, and that the error terms are identically and independently distributed with a Weibull distribution, the probability of any particular alternative j being chosen can be expressed in terms of a logistic distribution. Equation (1) can be estimated with a Multinomial Logit Model (McFadden 1974; Greene 1997), which takes the form:

$$Pr_{ij} = \frac{exp(V_{ij})}{\sum_{k=1}^{K} exp(V_{ik})} \quad (2)$$

The CE was designed with the assumption that the observable utility function would follow a strictly additive form model (McFadden 1974; Greene 1997). The 468 participants in the CE answered a total of 5616 sets of options presented to them. Those who chose "to leave the situation as it is" without intending to pay for the management of environmental pressures described by the 6 different survey attributes, responded to an additional series of questions aiming to diversify their protest responses from the real zero offers. Specifically, those who answered "I cannot devote money for such actions" gave genuine zero bids. The purpose of this examination was to identify protest answers and in order to be removed from the sample (Hanley et al., 2007).

In Volos, 11 participants out of 227 (4.8% of the sample) have chosen the zero offer. Their choice was not a protest offer as it was verified with the respective questions in the questionnaire. In Crete, 20 participants out of 123 (16.2% of the sample) have chosen the zero offer and not the protest offer. In Lesvos from 118 participants, there were no zero bids.

The LIMDEP 10.0 NLOGIT 5.0 econometric package was used to produce the econometric models. The Multinomial Logit Model (McFadden 1974) has been estimated with aggregated data on three areas: Volos, Crete and Lesvos. Although the overall fit of the model, as measured by Pseudo R^2, is low by conventional standards used to describe probabilistic discrete choice models (Ben-Akiva and Lerman, 1985), the coefficients are highly significant at less than 1% level and all the signs are as expected a priori. The attributes are all statistically significant which indicates that they are fundamental determinants of the choice of the participants. The sign of the price coefficient indicates that the effect on utility of choosing a choice set with a higher payment level is negative.

Table 2, presents the basic model for the whole sample including the basic survey attributes, the effects on participants' perceptions according to the responsibility to ensure the health of marine ecosystems, the effects of demographic and socioeconomic characteristics and the overall effects. Overall the results indicate that positive and significant economic values exist for higher levels of ecological, economic and social attributes of the marine and coastal ecosystems. In the entire sample those who wish to maintain the small-scale commercial fishing and state that the government is responsible for ensuring the health of the marine environment, are reluctant to contribute to the implementation of management measures to improve environmental quality (cult). Also the unwillingness of stakeholders to contribute to an improvement in environmental quality is increasing, as participants believe that the government has the ultimate responsibility to ensure the health of the marine environment (resp1) and as doubts about the government's ability to contribute substantially to the protection of the marine environment are enhanced (trust). However, it seems that a sacrifice of the environmental quality, is sufficient to reduce unemployment and boost the tourism industry (econ1, econ 5). Additionally, it is impossible to achieve recovery of the Greek economy without making investments to protect the marine environment (econ 3).

Table 2: MNL models-pooled data

Variables	MNL-Basic	MNL-Perceptions	MNL-Demographic-Socioeconomic	MNL-Overall effects
Attributes	Coeff. (s.e)	Coeff. (s.e)	Coeff. (s.e)	Coeff. (s.e)
edible	.20011*** (.05856)	.41678*** (.06245)	.29279*** (.06058)	.42417*** (.06351)
charism	.11787** (.05891)	.35682*** (.06284)	.22917*** (.06116)	.36703*** (.06400)
beach	-.09184*** (.03515)	.07377* (.03789)	-.01939 (.03680)	.07325* (.03870)
users	-.18069*** (.02374)	-.01593 (.02765)	-.10929*** (.02615)	-.01850 (.02853)
posid	.06830*** (.02615)	.17752*** (.02787)	.11710*** (.02711)	.18104*** (.02840)
consq	.05646** (.02625)	.21313*** (.02931)	.11970*** (.02792)	.21485*** (.02995)
price	-.01531*** (.00069)	-.01510*** (.00071)	-.01521*** (.00070)	-.01547*** (.00072)
Effects				
Cult		-.01240*** (.00132)		-.01263*** (.00134)
resp1		-.00842*** (.00123)		-.00703*** (.00126)
resp2		.00290** (.00122)		.00361*** (.00124)
trust		-.00976*** (.00135)		-.00987*** (.00137)
legisl		-.00468*** (.00116)		-.00445*** (.00118)
econ1		-.00269** (.00119)		-.00405*** (.00123)
econ2		-.00663*** (.00170)		-.00656*** (.00178)
econ3		.00230* (.00124)		.00470*** (.00128)
econ4		-.00504*** (.00146)		-.00508*** (.00150)
econ5		.00746*** (.00141)		.00726*** (.00144)
age			-.02508*** (.00254)	-.01935*** (.00275)
gender			-.48524*** (.05676)	-.36938*** (.06201)
members			.05608** (.02354)	.11018*** (.02486)
employment			.06990*** (.01433)	.10140*** (.01529)
income			.07959*** (.01518)	.08119*** (.01606)
Sample size	5616			
LL	-3387.85214	-3161.65	-3297.901	-3102.3373
Pseudo R^2	0.09	0.15	0.12	0.16

***Indicates significance at 1%, **Indicates significance at 5%, *Indicates significance at 10%.

According to the demographic and socioeconomic characteristics, the younger participants (age), who have families with more than two members (members) are sensitized on environmental quality showing that they care about the future generations. This of course depends on the existence of an employment that ensures an income.

4.2. Mixed Logit Model

The MNL model assumes the independence of irrelevant alternatives (IIA) property, which states that the relative probabilities of the options being chosen are unaffected by the introduction or removal of other alternatives. The MNL model assumes homogeneous preferences across respondents. Preferences, however are heterogeneous and accounting for this heterogeneity enables estimation of unbiased estimates of individual preferences and enhances the accuracy and reliability of estimates of demand, participation, marginal and total welfare (Greene, 1997). There is a huge amount of variability in the reasoning underlying decisions made by a population of individuals. In order to observe the heterogeneity, MLogit (Mixed Logit) models have been estimated. The attributes enter into the utility function by examining linear, uniform, triangular, logarithmic and non-stochastic specifications. The monetary factor is considered constant in order to facilitate the process for estimating social welfare measures (Train, 2003). Formally, the random utility function in the MLogit model is given by:

$$U_{ij} = V\left(Z_j(\beta + n_i),\ I_i\right) + e_{ij} \qquad (3)$$

Similarly to the MNL model, utility is decomposed into a deterministic component (V) and an error component stochastic term (e). Indirect utility is assumed to be a function of the choice attributes (Z_j), with parameters β, which due to preference heterogeneity may vary across respondents by a random component η_i, and of the social, economic and attitudinal

characteristics (I_i). By specifying the distribution of the error terms e and η, the probability of choosing j in each of the choice sets can be derived (Train, 1998). Equation (2) now becomes:

$$Pr_{ij} = \frac{exp\left(V(Z_j(\beta+n_i).I_i)\right)}{\sum_{k=1}^{K} exp\left(V(Z_j(\beta+n_i).I_i)\right)} \quad (4)$$

Treating preference parameters as random variables requires estimation by simulated maximum likelihood. Procedurally, the maximum likelihood algorithm searches for a solution by simulating a number of draws from distributions with given mean and standard deviations. Halton sequences are used for simulations (Halton, 1960). Probabilities are calculated by integrating the joint simulated distribution.

The selection therefore of random parameters and the unknown distributions of the parameters is a difficult process (Train 2003; Hensher et al. 2005). However, after a number of trials, MLogit models for the pooled sample have been estimated and are presented in Table 3 and Table 4. All the parameters except the payment attribute was specified to be normally distributed (Train 1998; Morey and Rossmann 2003; Carlsson et al. 2003).

As shown in Table 3, the MLogit- Basic model is statistically significant (Chi-square =1025.57654 and a p-value equal to zero) with Pseudo- R^2 =0.13. All variables used in the model are statistically significant except for the variable of charismatic species as the participants seem to be influenced by the population of edible fishes to enhance environmental quality contributing to a management program. MLogit model estimates reveal significant and large derived standard deviations for two attributes (edible fishes and coastal development) indicating that the data support choice specific unconditional unobserved heterogeneity for these attributes and some respondents might prefer lower levels of these.

4.3 Mixed Logit Model with Interactions

Even if unobserved heterogeneity can be accounted for in the MLogit model, the model fails to explain the sources of heterogeneity (Boxall and Adamowicz, 2002). One solution for detecting the source heterogeneity while accounting for unobserved heterogeneity

is by including interactions of respondent-specific social and economic characteristics with choice specific attributes. This enables the MLogit model to pick up preference variation in terms of both unconditional taste heterogeneity and individual characteristics and hence improve model fit (e.g., Revelt and Train, 1998; Morey and Rossmann, 2003).

Table 3: MLogit models-pooled data

	MLogit-Basic		**MLogit-Perceptions**		**MLogit-Demographic-Socioeconomic**	
Attributes	**Coeff.**	**s.e.**	**Coeff.**	**s.e.**	**Coeff.**	**s.e.**
Random Parameters						
edible	.33507***	0.10527	.43271***	0.0652	.46201***	0.1133
beach	-.16530**	0.07116	-3.938***	1.2928	-.12410*	0.0688
age					-.03258***	0.0044
Non Random Parameters						
charism	0.09979	0.08354	.37176***	0.0720	.24710***	0.0821
users	-.23078***	0.03532	-0.0164	0.0285	-.13514***	0.0371
posid	.11637***	0.04284	.18322***	0.0295	.17934***	0.0453
consq	.05709*	0.034	.21628***	0.0306	.14708***	0.0382
price	-.02070***	0.00206	-.01577***	0.0009	-.02002***	0.0021
Effects						
cult			-.01293***	0.0014		
res1			-.00872***	0.0012		
res2			.00309**	0.0012		
trust			-.01002***	0.0014		
legisl			-.00488***	0.0012		
econ1			-.00277**	0.0012		
econ2			-.00684***	0.0017		
econ3			.00248*	0.0012		
econ4			-.00517***	0.0015		
econ5			.00771***	0.0014		
age						
gender					-.59726***	0.0889
members					.06983**	0.0311
emloyment					.09595***	0.0213
income					.10486***	0.0221
Sample size 5616						
LL	-3379.23315		-3158.98001		-3294.15851	
Pseudo R^2	0.13		0.19		0.15	

***Indicates significance at 1%, **Indicates significance at 5%, *Indicates significance at 10%.

After extensive testing of the various interactions of the attributes with the respondents' social and economic characteristics collected in the survey, the model that includes the age, the gender, the number of members in the household, the employment and the income was found to fit the data the best. The results are reported in the Table 4. This model has a higher overall fit compared to MNL models and MLogit-Basic, MLogit-Perceptions, MLogit-Demographic-Socioeconomic model, with a Pseudo R^2 of 0.21.

4.4 Elasticities

According to Louviere et al. (2000), the direct point elasticity given as in (5), is interpreted as the elasticity of the probability of alternative *i* for policy maker *p* with respect to a marginal change in the *k*th attribute of the *i*th alternative (i.e. X*ikp*), as observed by policy maker *p*.

$$E_{X_{ikp}}^{P_{ip}} = \frac{\partial P_{ip}}{\partial X_{ikp}} \cdot \frac{P_{ip}}{X_{ikp}} \tag{5}$$

If the percentage change in the probability for the direct elasticity is observed to be greater than 1, that elasticity is said to be *relatively elastic*. If the percentage change in the probability is observed to be less than 1, that elasticity is said to be *relatively inelastic*. If a 1 percent change in a choice probability is observed given a 1 percent change in *Xik* then the elasticity is described as being of *unit elasticity* (Hensher et al., 2005). Table 5 presents direct point elasticities estimated for the attributes. The demand for the attributes of the survey is relatively inelastic means that a unit change in attributes influences the probability of "Alternative 1" less than one percent. This implies that an increase in the pricing of a policy for the management of a healthy marine and coastal ecosystem would increase revenue for the decision maker. In particular, the attributes that most affect the probability of "Alternative 1" is the "edible fish" and the "MPA Zoning". The attributes that affect less the probability of choice is the "beach development and the "*Posidonia Oceanica* State".

Table 4: MLogit model with interactions estimates

	MLogit-Averall Effects-Interactions	
Attributes	**Coefficients**	**s.e.**
Random Parameters		
beach	-5.53771***	1.10087
Non Random Parameters		
edible	.43351***	0.06406
charism	.38580***	0.06548
users	0.01128	0.02991
posid	.18861***	0.02902
consq	.23067***	0.03054
price	-.01577***	0.00073
Effects		
cult	-.01246***	0.00134
res1	-.00681***	0.00128
res2	.00376***	0.00124
trust	-.00955***	0.00144
legisl	-.00416***	0.0012
econ1	-.00371***	0.00125
econ2	-.00571***	0.00179
econ3	.00541***	0.00131
econ4	-.00412***	0.00153
econ5	.00728***	0.00145
age	-.03223***	0.00407
gender	-.19780**	0.08494
members	.07761**	0.03178
emloyment	.08422***	0.01622
income	.05019**	0.02381
Interactions		
beach*age	.06191***	0.01259
beach*gender	-.59234**	0.24558
beach*members	.22332**	0.09532
beach*income	.10328**	0.04323
Sample size	5616	
LL	-3080.33471	
Pseudo R^2	0.21	

***Indicates significance at 1%, **Indicates significance at 5%, *Indicates significance at 10%.

4.5 Willingness To Pay

The choice experiment method is consistent with utility maximization and demand theory (Bateman et al. 2003), thus when the parameter estimates are obtained by the use of the appropriate model, welfare measures can be estimated using the following formula:

$$CV = \frac{ln \sum_i exp(V_{i1}) - ln \sum_i exp(V_{i0})}{\beta_{price}} \quad (6)$$

Where CV (compensating variation) is the welfare measure, β_{price} is the marginal utility of income represented by the coefficient of the monetary attribute in the CE, and V_{i1} and V_{i0} represent indirect utility functions before and after the change in management. For the linear utility index the marginal value of change in a single attribute can be represented as a ratio of coefficients, reducing the equation (6) to:

$$WTP = \frac{-\beta_{attribute}}{\beta_{price}} \quad (7)$$

Table 5: Elasticity estimates

	Alternative 1	**Alternative 2 Business as usual**
Edible Fish	.16110	-.10331
Charismatic species	.0948	-.0608
Beach development	-.0976	.0626
MPA Zoning	-.2614	.1676
Posidonia Oceanica State	.0925	-.0593
Non-indigenous species warnings	.0778	-.0499

Table 6 reports the marginal WTP values, for each of the attributes estimated. The ranking of attributes remains consistent for the MNL and MLogit models. The estimation of WTP through increased water bill for eight years until 2020 indicates that respondents are willing to pay 13.07 € (MNL estimation) in order to maintain the levels of the population of edible fishes, 11.8 € in order to introduce MPA zoning for marine ecosystems under threat, 7.7€ in order to maintain the level of populations of charismatic species (such as *caretta caretta*), 6€ to adverse the increased coastal development, 4.46 to maintain the good environmental status of *Posidonia oceanica* in marine ecosystems and 3.69 to adverse the negative consequences of increased population of non-indigenous species.

Table 6: Willingness to Pay Estimates per household

	MNL	**95% confidence interval**	**MLogit**	**95% confidence interval**
Edible Fish	13.07	(5.57-20.57)	16.19	(6.22-26.15)
Charismatic species	7.7	(0.16-15.24)	4.82	(3.09-12.73)
Beach development	6	(1.50-10.50)	7.99	(1.25-14.72)
MPA Zoning	11.8	(8.76-14.84)	11.15	(7.80-14.49)
Posidonia Oceanica State	4.46	(1.11-7.81)	5.62	(1.57-9.68)
Non-indigenous species warnings	3.69	(0.33-7.05)	2.76	(0.46-5.98)

5. Conclusion

This paper contributes to the limited literature on estimation of economic values of marine and coastal ecosystems using choice experiments, and is one of the few valuation studies that has been undertaken in Greece. The results indicate that there are positive and significant economic benefits associated with ecological, economic, and social attributes of the marine and coastal ecosystems in Volos, Lesvos and Crete. The impacts of social, economic and attitudinal attributes of respondents on their valuation of marine and coastal attributes are significant and conform to economic theory. Further, there is considerable preference heterogeneity within the Greek public, which should be taken into consideration when designing provision of public goods, such marine and coastal ecosystems.

The significant contribution of this study is providing policy makers with the type of management programs that the Greek public is willing to support. In particular, the attributes that most affect the probability of selecting a policy for the management of a healthy marine and coastal ecosystem “Alternative 1” is the “edible fish” and the “MPA Zoning”. The attributes that affect less the probability of choice is the "beach development", the “*Posidonia Oceanica* State” and the “Non-indigenous species warnings”. Furthermore, the results of the study also reveal that trust is a significant parameter explaining the respondents’ perceptions of the proposed policy instruments. Specifically, it is interesting to observe that institutional trust was a determinant factor of respondents’ willingness to contribute to a management program.

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