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Marine Recreational Ecosystem Service Value Meta-Analysis

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Abstract

Marine and coastal ecosystems provide a wide variety of recreational opportunities that are highly valued by society. For the purposes of conducting a meta-analysis we build an extensive global dataset of marine recreational ecosystem service values from the literature. Using this database we developed a number of meta-regression specifications with the objective of evaluating the study specific effects of location, ecosystem, valuation methodology and statistical estimation methods on the reported value estimates. Furthermore, the paper investigates if cultural differences between studies are an important determinant that should be considered in international (meta-analytical) value transfer. This was achieved by including a number of cultural parameters from previous societal studies and surveys into our meta-regression models. We found that accounting for differences in cultural dimensions across recreation valuation studies had a significant influence on value estimates. While a multi-level modelling approach that controls for study effects, proved to be a better fit than a standard one level specification, we found that the absolute in-sample transfer errors associated with the standard OLS model were slightly less on average based on the differences between the actual and predicted values in our meta-database.

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1. Introduction

The coastal and marine environments provide a wide variety of opportunities for recreational activities such as swimming, angling, diving, sailing, and kayaking and have been shown to generate substantial cultural ecosystem service benefits. Indeed, a review of studies that have attempted to evaluate the cultural ecosystem services provided within a country's jurisdiction more often than not highlight recreation as one of the most valuable cultural ecosystem services provided (Beaumont et al., 2008; UNEP, 2006 and Hansen and Malmaeus, 2016). Recreation is one of the services that are more directly linked to human well-being and thus may play an important role in motivating public support for restoration and protection efforts (Brancalion et al., 2014; Daniel et al., 2012). Recreation is also one of the most often valued of the different ecosystem service categories in the literature (de Groot et al., 2012). It could be argued however that recreation is the cultural service with easiest monetary translation due to the existence of market and non-market valuation methods. Other cultural services such as aesthetic, inspirational and cultural heritage are highly valued but are often not monetarized due to the lack of available data and/or methods.

In this paper we investigate the relationship between the valuation of marine and coastal recreation service benefits and the cultural context of the beneficiaries using a meta-analysis. Meta-analysis also allows us to investigate the influence that other study characteristics such as the choice of method, the model used and the type of ecosystem where the recreation takes place, have on recreational value estimate variation in previous studies. The meta-analysis facilitates the statistical analysis of the summary findings of prior empirical recreation valuation studies. As Bateman and Jones (2003) point out, the method "offers a transparent structure with which to understand underlying patterns of assumptions, relations and causalities, so permitting the derivation of useful generalizations".

Although cultural factors have been considered from a theoretical perspective as having an influence on an individual's preferences and on their valuation of environmental goods (Pouta, 2004; Ojea and Loureiro, 2007; Hynes et al., 2013; Kountouris and Remoundou, 2016) there is limited empirical evidence of the relationship between cultural identity and valuation. In a review of the literature related to how cultural factors may co-determine preferences and values, Hynes et al. (2013) demonstrate how numerous studies have shown that economic values reflect the culturally constructed realities, worldviews, mind sets and belief systems of particular societies and/or subsets of society. The authors also show how it has been argued that preferences are not exogenous. Rather, they are shaped by social interactions as well as political and power relations operating within a system of local, regional, and global interdependencies (Dietz et al., 2005; Hoyos et al., 2009; Wilk and Cligget, 2006; and Hornborg et al. 2007).

Cultural identity has been shown to influence recreational preferences and values. Cultural identities are comprised of shared language, symbols, customs, values, attitudes, and expectations (DeSensi, 1994). Early work by Allison (1979) suggested that ethnic groups choose to participate in certain activities due to cultural traditions, practices and group characteristics such as language or religion. Philips (2007) points out that one of the main reasons leading to differences in recreation and leisure participation results from differences between different racial or ethnic groups in their attitudes, values, systems and norms. In an early study, Shultz et al. (1998) suggested that cultural influences may affect respondents' stated preferences for environmental goods in developing countries.

Loomis et al. (2006) examined the influence of ethnicity and language on Willingness to Pay (WTP) and concluded that language rather than ethnicity may influence WTP responses. More recently, Hoyos et al. (2009) show that cultural identity may have considerable influence on the WTP to protect natural resources. They find that the WTP to protect the environmental attributes of a protected site in the Basque region of Spain is approximately 28–33% higher if the cultural identity of the respondent is Basque. Elsewhere, Pemberton et al. (2010) find significant differences in stated WTP between social groups in a contingent valuation study of a forest reserve threatened by copper mining which they attribute to some social group's historical aggressiveness towards strangers and their belief that they have rights over the natural resource.

In the only previous study to explicitly incorporate cultural identity factors into a value transfer (VT) exercise, Hynes et al. (2013) investigated if cultural differences influence the validity of value transfer estimates. Using information from a study that ranked 62 societies with respect to nine attributes of their cultures (House, 2004), the authors developed an index that was then used to re-weight multiple coastal ecosystem service value estimates. The study then examined whether these culturally-adjusted VT estimates were statistically different than simply transferring the income-adjusted mean transfer estimates for each coastal ecosystem service from international study sites to the policy site. The study concluded that using cultural indicators could lead to an improvement in the reliability of the ecosystem service valuation approach and ultimately in its use as a tool for the sustainable management of natural coastal ecosystems and the services they provide.

Away from a valuation setting but of relevance to this paper Kountouris and Remoundou (2016) investigate national culture's influence on preferences and attitudes for environmental quality. The cultural diversity of immigrants in European countries was used by the authors to isolate the effect of culture from the confounding effect of the economic and institutional environment. The results of the study suggest that culture is a significant determinant of migrants' individual environmental preferences and attitudes. Elsewhere, Berkes (2004) points out that conservation and environmental policy often operates within highly complex socio-ecological systems in which relationships between society and natural systems are dynamic and multi-scale.

While cultural factors can influence the value placed on recreation, Taylor (2001) also points out that recreation itself can "provide people the space for emancipation, opportunities to challenge stereotypes and pathways to resist social construction of marginalised ethnic identities". Floyd (2007) contends that many leisure studies fail to control for factors such as race relation, class mobility and accepted leisure behaviour in explaining leisure participation. Mbuthia and Maingi (2010) also highlight the fact that there are few attempts in the literature to isolate and measure the various dimensions of marginality, and ethnicity that may influence travel for tourism and participation in recreation and leisure. Hynes et al. (2013) also suggested that further research was needed to examine the best way of making adjustments for cultural differences in international VT.

Ghermandi and Nunes (2013) point out that from an economic perspective, sustainable management strategies for marine-based tourism and recreation need to be founded on a thorough assessment of their value in the relevant policy context. Such recreational values are generally obtained from primary revealed preference valuation studies (e.g. travel cost studies) that report the economic measure of direct-use access value for recreation sites and activities, or stated preference studies (e.g. contingent valuation or site choice experiments) that estimate both use and non-use values associated with a change in recreational opportunities.

In this paper we build an extensive global dataset of non-market marine recreational ecosystem service values from stated and revealed preference studies with over 350 distinct value observations. Using this database we develop a number of meta-regression specifications with the objective of examining how study-specific effects such as valuation methodology and statistical estimation approach used, influence reported recreation benefit value estimate variation. The second objective of this study is analytical as we detail alternate approaches to the construction of the meta-analysis models using both conventional Ordinary Least Squares (OLS) regression techniques and generalised multi-level linear modelling methods. The final key objective of the study is to examine whether cultural identity has a statistically significant impact on reported recreation benefit value estimate variation.

We therefore add to the literature by exploring how cultural factors and other study specific characteristics influence the variation in recreation value estimates observed in previous studies using a meta-regression. We test if accounting for measurable differences in cultural attitudes towards the environment in a meta-analysis of recreational values from the recreation valuation literature improves model fit and researchers' ability to predict values from VT models that incorporate information from international studies. The valuation method, model specifications and the data used in the meta-analysis are presented in the following section.

2. Materials and Methods

Meta-analyses have been conducted for recreation values in a number of different contexts; early applications being Smith and Kaoru (1990), Rosenberger and Loomis (2000), Shrestha and Loomis (2001) and more recently De Salvo and Signorello (2015). Previous meta-analyses of marine and coastal ecosystem values have also been carried out for coral reefs by Brander et al. (2007) and for multiple marine ecosystem types by Liu and Stern (2008) and Rao et al. (2015). There have also been a number of meta-analyses carried out on the recreational pursuit of angling where a large literature of primary valuation studies can be relied upon (Johnston et al. 2006 and Moeltner et al. 2007). In perhaps the most comprehensive meta-analysis of marine and coastal recreation to date (comprehensive in terms of number of value observations, valuation types included and global coverage), Ghermandi and Nunes (2013), developed a meta-analytical framework built upon a Geographic Information System (GIS). This allowed for the exploration of the spatial dimension of the valued ecosystems, including the role of spatial heterogeneity of the selected meta-regression variables as well as the spatial profile of the transferred values.

In the field of ecosystem service valuation, meta-analysis is generally applied using regression-based techniques to infer the impact of explanatory variables (such as valuation method, ecosystem type where the recreation in the study takes place, GDP per capita in the country where the study was conducted, etc.) on the formation of values in a set of study sites (Shrestha and Loomis, 2001; Florax et al. 2002; Brander et al. 2007). Using meta-analysis, information from the past studies published in the literature can form a meaningful basis for recreation ecosystem service valuation at a new policy site via VT. Therefore, the initial stage of any meta-analysis involves a survey of the relevant literature to identify potential studies to be included in the database.

Database Development

The meta-analysis presented here relies on an extensive dataset of international non-market valuation studies of the recreational services provided by marine and coastal ecosystems. In compiling the dataset we focused on studies that applied the single or zonal travel cost revealed preference methods, the contingent valuation or site choice stated preference methods or the mixed contingent behaviour method. The focus of the studies could be any recreation pursuit involving any marine or coastal ecosystem so recreation that took place on the shoreline such as angling or beach pursuits as well as recreation activity on and under the water were allowed. The study could also be from any part of the world as we were interested in testing the influence of cultural factors on the observed value estimates.

For the meta-analysis dataset, we updated the literature review by Ghermandi and Nunes (2013) with valuation studies available up to 2015. Additional studies were also added based on a thorough search of marine and coastal recreation valuation studies using electronic databases including the Ecosystem Services Valuation Database developed by the Foundation for Sustainable Development and the Environmental Systems Analysis group of Wageningen University, the Netherlands and the US National Ocean Economics Programme Non-Market Valuation Database. The first and second authors' extensive research experience in the area and their own collection of working papers, conference papers and reports also resulted in additional appropriate studies being added to the database.

The development of the database resulted in 311 distinct value observations from 96 primary valuation studies used in the final analysis. The full database actually contains the meta data relating to 108 studies (350 value observations) but due to missing information for 12 of these studies only 96 (311 value observations) were used in the final analysis. While 44 of the 96 studies have unique value estimates, the remaining 52 average 4.5 distinct value estimates each. This reflects the fact that many studies involve testing the effect of different methodological assumptions and alternative econometric specifications on welfare estimates resulting in multiple value estimates being presented. Both peer-reviewed scientific literature as well as unpublished working papers and reports were included in the database. The list of studies used in the meta-analysis is provided as supplementary material. Table 1 provides summary statistics of the valuation studies used. In particular the average values and standard deviations of the main characteristics from the valuation studies in the database are presented. Just over half (55%) of the studies were carried out (survey conducted) between 2002 and 2015. Five studies were from the 1980s and 25 from the 1990s.

- **Table 1 here**

For each observation in the dataset, the recreational benefit value estimates as well as study, sample and site-specific information were recorded. All the studies were estimated with stated or revealed preference non-market valuation techniques. In terms of the actual valuation method used, contingent valuation and choice experiments account for 106 and 60 observations, respectively. The alternative forms of the travel cost method (zonal, individual level and contingent behaviour) account for under half of the observations (145 observations) used in the analysis. This includes 21 values that were estimated with the zonal travel cost method, 98 estimated with the individual level travel cost method and 26 estimated with the contingent behaviour travel cost approach.

A range of marine and coastal ecosystem types are represented in the data. In total, 119 observations relate to beaches, 10 to lagoons, 8 to mangroves, 55 to reefs, 16 to estuarine environments and 103 to a mosaic of ecosystem types at the study site. While the dataset is global in terms of representativeness just under one third of the observations are from the US and Britain. More specifically, 31% of the sample observations are from North American studies, 33% from Europe, 13% from Asia, 10% from Australia, 8% from Latin America and just 6% from Africa. The majority of the observations examine the value of recreation at current status (45%) and in many studies a variety of recreational pursuits are involved. Having said that, 30% of the observations refer uniquely to the values associated with sea angling while a further 10% refer to diving. These activities are controlled for in the models. The WTP questions addressed in the stated preference studies cover a range of scenarios that relate to change in activities due to such issues as water quality, marine protection status or impacts from pollution and litter. The samples involved in each study can also be categorised by different population types. The majority of the estimates are derived from general recreational surveys but 14% are from household level surveys, 18% are tourist only and 17% are local residents only.

The economic values reported in the studies were calculated in different years and expressed in different currencies and metrics. In order to compare them, they were standardized to a common metric and currency: 2015 US dollar per person per year ($/person/year). Per-household estimates were converted to per-person estimates taking into account the average number of persons reported per household in the original studies. Per-trip estimates were multiplied by the average number of recreation trips per year reported in the primary studies in order to have all values expressed on an annual basis. In line with previous meta-analyses (Ghermandi and Nunes, 2013, Brouwer et al. 2008), implicit price deflators from the World Bank and differences in purchasing power among the countries provided by the Penn World Tables were incorporated into the value estimates to account for inflation or cost of living differences between the study sites. Values are distributed around an average of $239 per person/year with an associated standard deviation of $491 per person/year.

Cultural Parameter Selection

In terms of the cultural parameters used in the analysis we make use of cultural indicators developed under two previous studies; the GLOBE study and the World Values Survey (see table 2). The GLOBE (Global Leadership and Organizational Behaviour Effectiveness) study ranked 62 societies with respect to a number of attributes of their cultures (House et al., 2004). We use 2 of the 7-point Likert scale indicators developed under GLOBE in this analysis; *Performance Orientation* and *Humane Orientation*. As previously discussed by Hynes et al. (2013) a low score in *Performance Orientation* indicated a society that values harmony with the environment rather than control, while a high score indicated a society that values assertiveness, competitiveness and materialism. A low score in *Humane Orientation* indicated a society where power and material possession motivate people and where values of pleasure, comfort and self-enjoyment have high priority, while a high score indicates a society where values of altruism, benevolence, kindness, love and generosity have high priority.

- **Table 2 here**

We also use data from the 6th wave of the World Values Survey (WVS) completed in 2014 across 100 countries. The WVS surveys collects indicators on environmental preferences, beliefs and awareness along with other social, economic and demographic data. We measure the environmental preferences of different nationalities with the response to the following statements in the WVS:

1. I would give part of my income if I were certain that the money would be used to prevent environmental pollution;
2. The Government should reduce environmental pollution, but it should not cost me any money;
3. Economic growth and creating jobs should be the top priority, even if the environment suffers to some extent;
4. Environmental problems in the world: Pollution of rivers, lakes and oceans is a serious/very serious problem.

The percentage of respondents from each country that agreed with these statements was used as indicators of a cultures attitude to the environment in the meta-analysis. All studies in the database were linked to cultural parameter values based on the country the study was conducted in. Finally, GDP per capita is also included as a cultural indicator in table 2 as income levels are known to influence the value placed on leisure pursuits by a society (Hynes et al, 2013).

Statistical Analysis

The chosen meta-regression models allow the researcher to examine the statistical relationships between the value estimates provided in the compiled recreational valuation studies and specific characteristics of these studies, including methodological characteristics, sample characteristics, and the characteristics of the recreation activities themselves. In order to investigate the factors driving the variability in recreation ecosystem value we first estimate an OLS meta-regression model as follows:

$$Ln(Y_i) = \square X + u_i \quad (1)$$

where $\ln(Y_i)$ is the natural logarithm of the endogenous recreation benefit value in each study measured in 2015 \$/person/year; the subscript *i* is an index for the value observations; and $\square X$ is the matrix containing the explanatory variables **X**, including valuation study characteristics, site and recreation characteristics and cultural

characteristics for the study populations and their associated coefficients γ and u_i is an error term that is assumed to be well-behaved. The model
is semi-logarithmic with the exception of the GDP per capita variable, which is included in the logarithmic form.

Three specifications of the OLS model are presented. Specification 1 includes just the main valuation study characteristics as independent variables. The second specification adds additional variables related to site and recreational pursuit characteristics such as dummies for diving and angling, the type of sample in the study and the type of ecosystem covered in the study. Finally, the third specification includes the cultural variables for the study populations.

The structure of the data used in the analysis is complex, with values being generated by different studies, in different countries and using different valuation techniques. Since the values estimates are obtained from different models, different underlying samples and estimation methods, heteroscedasticity, or unequal variance, is likely within the estimated meta-models. In our model we therefore estimate White's heteroscedasticity-consistent standard errors.

While the OLS-based models are useful in examining the factors driving the variation in the study benefit values this estimation approach assumes independence between estimates. Given that we have multiple observations coming from the same studies in our date base this assumption is likely to be violated in our OLS regression. Also, as previously recognized by Bateman and Jones (2003), Brouwer et al. (2008), and Ghermandi et al. (2008), within the conventional OLS pooled meta-regression, some of the variables used to predict recreational value such as the author, study, or region to which a given estimate pertains may be constant across a range of such estimates. These authors suggest accounting for this data structure using a Generalized Least Squares regression technique called multi-level modelling. With this modelling approach in mind, the data structure described in the previous section could be seen as actually corresponding to a range of hierarchical levels; of value estimates, within studies, and perhaps within countries. In our final meta-regression we therefore explicitly incorporate two levels, within which our data is clustered, by estimating a two-level mixed-effects linear regression model. Following Brouwer et al. (2008) model (1) now can be written as:

$$Ln(Y_i) = \boldsymbol{\beta} \boldsymbol{X} + \boldsymbol{Z\theta} \quad (2)$$

where, unlike previously with the OLS regression where we had a single vector of error terms we can now model a more complex structure where the values of the error terms are dependent on explanatory variables in the matrix $\boldsymbol{Z}$ for the random part of the model. In our particular case the clustered-data representation of the mixed model given in (2) can be extended to a single nested level of clustering for study, creating a two-level model once the observations are considered. We also considered the possibility of country and author level effects, creating three-level hierarchical models. In these cases, however, we found that the variance within estimates did not differ significantly between countries or between authors and only present the two level model in what follows. Formally, following Rabe-Hesketh and Skrondal (2015), (2) now can be written as:

$$Ln(Y_{jk}) = \beta X_{jk} + Z_{jk}^{(2)} u_k^{(2)} + \epsilon_{jk} \quad (3)$$

for i = 1,….n_{jk} first-level recreational value observations nested within j = 1,…..M_k second-level groups representing individual studies. Group *j, k* consists of n_{jk} observations, so Y_{jk}, X_{jk}, and ϵ_{jk} each have row dimension n_{jk}. $Z_{jk}^{(2)}$ is the $n_{jk} \times q_2$ design matrix for the second-level random effects $u_k^{(2)}$. Furthermore, it can be assumed that:

$$u_{jk}^{(2)} \sim N(0, \sigma_{u2}^2); \; \epsilon_{jk} \sim N(0, \sigma_\epsilon^2 I) \quad (4)$$

and that $u_{jk}^{(2)}$ *and* ϵ_{jk} are independent. Therefore, as pointed out by Bateman and Jones (2003) while "traditionally the residual error term of a model is seen as an annoyance and the aim of the modelling process is to minimize its size. With multilevel models, the error term is of pivotal importance in model estimation. Rather than a single error term being estimated, it is stratified into a range of terms, each representing the residual variance present at each level of the hierarchy." In the multi-level model estimated in this paper the estimated explanatory variables remained fixed as in the OLS model. However, the random parameters are those where individual estimates are made for every unit at each level of the hierarchy. In our case, $u_{jk}^{(2)}$ *and* ϵ_{jk} are random, as a value of ϵ_{jk} is estimated for each recreational value estimate (at level 1 of the model) and a value of $u_{jk}^{(2)}$ is estimated for each study (at level 2 of the model). It is the use of a hierarchical structure within the error term to form random parameters that differentiates this multi-level modelling approach from the more traditional OLS modelling approach. While there are a number of methods that may be used in estimating the variance components, the model is this case is fitted using standard maximum likelihood estimation procedures.

One of the main reasons for carrying out a meta-analysis of valuation estimates is to use them in a VT exercise. Transfer errors provide us with an indication of the confidence that we can have in the final valuation of a policy site if we rely on a transfer methodology. We test the use of the meta-regressions as a transfer approach by examining how well the models do in predicting the values for the study observations from our meta-database. Following Hynes et al. (2013), the transfer error for a value observation from study *v* is calculated as:

$$TransferError_v = \frac{(TransferredEstimate_v - OriginalEstimate_v)}{OriginalEstimate_v} \times 100 \quad (5)$$

where *TransferredEstimate*$_v$ is the marine recreation value predicted by the meta-analysis model for the study and the *OriginalEstimate*$_v$ is the actual estimate from the study.

3. Results

The coefficient estimates and associated standard errors of the OLS models and the generalized linear multi-level regression model are presented in Tables 3 and 4, respectively.

OLS model results

The OLS model of table 3 presents 3 specifications that build on each other in terms of the number of parameters included. An F test indicates that, taken jointly, the coefficients in the three specifications are significant at the 1% level. The signs of the coefficients are generally stable across the specifications although the significance levels do change. White's general test of heteroscedasticity rejects the null hypothesis of homogeneous variance of the residuals across all models so White's heteroscedasticity consistent standard error models are employed.

- **Table 3 here**

The valuation method coefficients of specification 1 (second column of table 3) are statistically significant. Relative to the base case of individual travel cost models the results indicate that the lowest recreational benefit values come from the contingent valuation studies, followed by choice experiments and then by the contingent behaviour and zonal travel cost models. The choice experiment coefficient becomes insignificant in specifications 2 and 3. The results also indicate that studies from Europe and Africa have lower value estimates than from the base case of the US. Studies that are set up to investigate WTP to avoid degradation are found to be statistically more likely to produce larger value estimates than those that are valuing just the current recreation value. Interestingly, whether the study is peer-reviewed or from the grey literature does not appear to have a significant effect on value estimates across any of the specifications.

From the results of specification 2 (third column of table 3) it can be seen that studies that relate specifically to sea angling are statistically more likely (at 10% level only) to be associated with higher benefit value estimate. Even though all household-level survey estimates were converted to per-person estimates we find that the household-level surveys dummy still indicates that such surveys will still produce higher estimates.

All the ecosystem types included in specification 2 were highly significant, with the exception of estuaries. Interestingly, the base case of a mixed ecosystem type (a mosaic ecosystem landscape) is associated with the highest value estimates followed by the individual types of beach, lagoon, reef and finally mangrove. This suggest that a mosaic landscape in terms of ecosystems would appear to provide higher recreational values than single ecosystem sites. Having a higher percentage of territorial waters in the study's home country under protection status also leads to higher value estimates.

Finally, in specification 3 (fourth column of table 3) we also included the selected cultural parameters. All 7 cultural indicators were found to be significant at the 95% level or higher. The positive coefficient for *humane orientation* indicates that the recreational value estimates from cultures where society values of altruism, benevolence, kindness, love and generosity have high priority will be higher while the negative coefficient for the *performance orientation* parameter indicates the recreational value estimates from cultures where society value assertiveness, competitiveness and materialism will be lower. In terms of the World Value survey parameters, recreation value estimates are higher for those countries that had higher rates of agreement with the statements that economic growth and creating jobs should be the top priority, even if the environment suffers to some extent (*Economic Growth*) and that the pollution of rivers, lakes and oceans is a serious/very serious problem (*Waterway Pollution*).

The recreation value estimates are lower for those countries that had higher agreement with the statements that they would give part of their income if they were certain that the money would be used to prevent environmental pollution (*Income V Environment*) and that the government should reduce environmental pollution, but it should not cost them any money (*Govn reduce Pollution*). While the negative coefficient on the parameter for *Income V Environment* may at first seem counter intuitive it makes sense when one considers that studies with lower stated value estimates are likely to result from samples that truly consider their budgets in the first instance. They provide lower values in WTP studies even though many in the society will pay something from their incomes. If this holds true, then one would expect a negative sign on this parameter estimate.

The Shapiro-Wilk test for the full model (specification 3) indicated a deviation of the predicted residuals from normality. However, a visual inspection of the distribution of the residuals would appear to indicate that this deviation was not substantial. We also examined if multicollinearity was an issue in our full model by calculating variance inflation factors (VIF). Diagnostic testing with the variance inflation factor (VIF) did not provide indication of multicollinearity between predictor variables; the highest VIF being 4.8.

Mixed-effects regression model results

We also estimated a generalized linear two-level mixed-effects regression model explicitly incorporating study level effects. The results of this mixed model are presented in table 4. For this final model specification we also removed variables that proved to be highly insignificant in the OLS specifications. A Wald test statistic shows that, taken jointly, the coefficients in the mixed model are significant at the 1% level. A likelihood-ratio test comparing the model with a one-level ordinary linear regression, i.e. a standard model assuming no hierarchical structure in the data, is highly significant for these data indicating that the two-level mixed model is a better fit.

- **Table 4 here**

One of the main objectives of fitting the multi-level model was to determine if, after controlling for the variables in the fixed part of the model, there was still statistically significant variation in the recreational ecosystem service value estimates between studies. The estimated variance components of these random effects are shown in the lower part of Table 4. The estimated variance of the overall error term, σ_{ϵ}^2, is 0.35. The variance of the level-two errors, associated with the multiple estimates within studies (σ_{u2}^2), is 1.60. The parameter estimates for σ_{u2}^2 is greater than zero, suggesting that variability between estimates and between studies remains after controlling for the explanatory variables that were included in the fixed part of the multi-level model. The estimated variance of the estimates at level 1 and 2 are highly significant at the 99% level.

Transfer Errors

Using equation 5, the in-sample transfer errors for each value observation are calculated based on their difference from the predicted estimates generated from the alternative model specifications. As can be seen in table 5, the transfer errors vary across models and across valuation study types. The full OLS model (model 3 in table 3) appears to produce lower transfer errors for studies that employ contingent valuation method (CVM), individual level travel cost model (TCM) and contingent behaviour methods whereas the mixed model produces lower estimates for the choice experiment (CE) studies and zonal travel cost studies. With mean transfer errors of 50% or below for CVM, CE and TCM the OLS model would appear to perform better as a transfer function. The full OLS model also produces a much lower transfer error on average across all studies in the database (84%) compared to the mixed model (149%). The median absolute transfer error is lower than the mean for both models at 66.28% and 72.62% for the OLS and mixed models respectively.

- **Table 5 here**

As expected, the transfer errors are higher in the OLS specification (2) where the cultural parameters have been excluded compared to where they are included (model 3). As can be seen from the distribution of transfer errors across the studies presented in figure 1, approximately one third of the sample have absolute transfer errors of 50% or less. Just under 80% of absolute value errors fall below 100%, with the full OLS model performing slightly better than the mixed model.

- **Figure 1 here**

4. Discussion

Three OLS meta-regression model specifications were presented. Controlling for the valuation method, the region of study origin, the type of valuation question and the type of article in specification 1 only accounted for 23% of the variation in the recreational value estimate according to the adjusted R^2 coefficient. When we added in the site and sample specific variables in specification 2, the adjusted goodness of fit increased to 0.40. One of the most interesting findings from the OLS models is the extent to which the goodness of fit of the model improved with the inclusion of the cultural parameters in specification 3. The adjusted R^2 value increased to 0.62, a 22% increase on specification 2. The OLS models provide the analysist with an understanding of how differences in valuation methods, site characteristics, study question and design as well as cultural differences across respondents might influence the variation in the resulting recreational benefit value estimates, but basic OLS estimation assumes independence between estimates which is unlikely to hold where there is multiple observation per study.

We found that controlling for the study level effects using the multi-level model lead to a better statistical fit compared to a standard OLS model which assumes no hierarchical structure in the data. The fixed part of the multi-level mixed model reported in Table 6 shows some differences from the OLS results. While prior expectations regarding the impact of the alternative valuation methods held it is interesting to note the significance of the choice experiment parameter at the 10% level in the multi-level mixed model whereas it was insignificant in our full OLS specification. Also, the zonal travel cost parameter and the WTP to avoid degradation parameter was found to insignificant once study level effects are controlled for in the mixed model. The cultural parameters maintain the same signs as in the OLS model but the *Humane Orientation* variable was now insignificant.

The substantially larger variance associated with the study level residuals compared to the estimated variance for the overall error term in the multi-level mixed model indicate that factors associated with the studies themselves may be more important in explaining the residual variation in the recreation ecosystem service value estimates.

We found that the inclusion of the cultural indicators greatly improved the explanatory power of the meta-regression models and suggest that using such indicators should allow a wider range of studies to be employed in an international meta-analysis of valuation estimates. The cultural parameters from the World Value survey were also found to be particularly robust to the model specification employed. Finally, the relative magnitude of the valuation method coefficients across the models was found to be in line with the findings from previous recreational value meta-analyses (Ghermandi and Nunes, 2013 and Bateman and Jones, 2003) and with Carson et al. (1996) who found in a review of 83 studies that CV estimates were significantly lower than travel cost values.

Beyond the models presented here we also considered the inclusion of interaction terms between the cultural parameters and the valuation methods to test if cultural differences had more or less influence across the various valuation approaches but found no statistically significant effects and so did not include them in the final specification of the model. We also estimated an alternative form of the full OLS model where all observations were retained in the regression, but weighted so that each of the 96 studies receives a weight of 1. This model resulted in parameter estimates that were broadly similar in sign and significance but the R^2 was reduced by over 10 points. Using the number of value estimates in the primary studies as substitute weights is not uncommon in meta-analysis but still ignores other possible hierarchical structures in the dataset of value estimates[1].

While the transfer errors from the alternative model specifications were relatively large this is not unexpected given the broad range of valuation methods and recreational scenarios present in the underlying data. Interestingly, if we remove the 15 worst performing studies in terms of transfer errors (where transfer errors are greater than 500%) from the calculations of the mean transfer errors in table 5, then overall mean transfer errors for the remaining studies falls to 45% for the full OLS model and just 30% for the mixed model. These poorer fitting studies appear to have very low value estimates associated with them, thus a very large percentage error does not translate into a large absolute error. These poorer fitting studies do not appear to be associated with any one valuation type, region or recreational activity. The transfer errors reported in table 5 are not out of line with those found in the international VT

[1] The results of these alternative models are available from the authors upon request.

literature and in most instances are more favourable (Shrestha and Loomis 2001; Ready et al. 2004; Ready and Narvud, 2006; Brander et al., 2007 and Lindhjem and Navrud, 2009).

In a meta-analysis of coral reef recreation values, for instance, Brander et al. (2007) found an average transfer error equal to 186% while, in a review of transfer errors in the environmental economics literature, Rosenberger and Stanley (2006) found error rates ranging between 8 and 577%. Furthermore, Brander et al. (2007) point out that a source of error in meta-analysis based VT results from the difficulty in capturing differences in the quality and quantity of the services under consideration. In our particular case, the values that individuals and different user groups associate with recreation at beaches, estuaries, lagoons, and other coastal and marine ecosystems will vary widely and are difficult to control in a meta-analysis especially when many studies value visits for 'general' recreation at these ecosystem types. An area for future research is to examine if a meta-analysis that concentrates on just one valuation methodology or just one specific type of recreation pursuit with cultural parameters included preforms better than one excluding such cultural parameters.

5. Conclusions

This paper carried out a meta-analysis to explore the impact that alternative valuation methodologies, study characteristics and ecosystem types have on resulting recreation ecosystem service value estimates. An important objective of the paper was also to examine if cultural differences between study sites are an important determinant that should be considered in international VT. An extensive global dataset of non-market marine recreational ecosystem service values was employed to develop a number of meta-regression specifications. While standard OLS estimation was used to explain the variation in value estimates, a generalized linear multi-level model was also developed that explicitly incorporated study level effects due to the fact that we have multiple value estimates from some studies in the database.

As has been pointed out in almost all valuation meta-analysis studies previously, the lack of fundamental information, such as the characteristics of the site studied, the specifics of the methods used and the characteristics of the relevant population under study can greatly reduce the number of usable studies (or explanatory variables included) in a functional transfer exercise (Brouwer et al., 2008; Brander et al. 2007; Woodward and Wui, 2001, Rosenberger and Phipps, 2002, Ghermandi and Nunes, 2013). There have been numerous calls in the literature for additional explanatory data and better information relating to the relevant population under study to be made available in the original studies for use in follow-on VT exercises. Even in this study, we had over 350 marine recreation value observations in our meta-database but did not have sufficient information for 41 of these for inclusion in the meta-analysis.

We would go further even than the usual call for a standard protocol for the reporting of valuation results. Getting a valuation study published in an economic journal usually requires developing a new model specification or tweaking some aspect of the underlying valuation methodology. This often results in significantly different valuation results from what is achieved with the standard work horse models employed under each valuation approach and results in a wide variety of estimates for consideration in a meta-analysis. We would suggest that publishing authors should be encouraged to provide the valuation results from employing the standard models with their data as supplementary material in any valuation exercise. So for example, for single site travel cost models the authors would always supply the basic negative binomial count model results and associated per trip value estimates; for a choice experiment, the results of a basic conditional logit model and associated value estimates would be supplied and for a single bound dichotomous choice CVM study a basic Probit model and associated value estimate would be provided.

Using the estimates from these basic models should provide more statistical control over the variation in values in meta-analysis and would also be more comparable to findings in the grey literature where less ‘bells and whistles’ are likely to be found on the models employed. This would to a large degree eliminate the variation in point estimates that results from the different methodological tests being carried out in these studies and focus the analysis on the variation that is due to, for instance, valuation technique, site and context attributes. Indeed an interesting piece of future research would be to get the authors of the valuation studies used here to provide the estimates from the basic model possible in each case (where not already available) and rerun the meta-analysis to see the impact on model results and transfer errors.

From a policy perspective, the fact that sites associated with multiple ecosystems (mosaic landscape types) are associated with higher reported value estimates would suggest that priority should be given to the protection of such sites over single ecosystem sites if the goal is to maximise recreational value. Also, our results concerning the inclusion of cultural indicators may have important policy implications, especially insofar as value transfers are concerned. Policy-makers’ demand for rapid and inexpensive ecosystem service valuation techniques has given rise to an increasing number of value transfer exercises, but value transfer practices within policy analysis are often inadequate (Johnston and Rosenberger, 2010). Unadjusted unit value transfers from global databases (e.g., De Groot et al., 2012) are common in the literature and, where adjustments to the local contexts are pursued, these are often limited to basic economic variables (e.g., correcting for differences in income per capita between study and policy site). The present study suggests that, insofar as recreation benefits are concerned, accounting for cultural differences would contribute to improve current value transfer practices, potentially leading to more accurate estimates at the policy sites.

References

Allison, M., 1979. On the Ethnicity of Ethnic1 Minorities in Sport. Int. Rev. Sociol. Sport. 14(1), 89–96.

Bateman, I. and Jones, A., 2003. Contrasting conventional with multi-level modeling approaches to meta-analysis: expectation consistency in UK woodland recreation values. Land Econ. 79(2), 235–258.

Beaumont, N., Austen, M., Mangi, S., Townsend, M., 2008. Economic valuation for the conservation of marine biodiversity. Mar. Pollut. Bull. 56, 386–396

Berkes, F., 2004. Rethinking community-based conservation. Conserv. Biol. 18 (3), 621–630

Brancalion, P.H., Cardozo, I.V., Camatta, A., Aronson, J., Rodrigues, R.R., 2014. Cultural ecosystem services and popular perceptions of the benefits of an ecological restoration project in the Brazilian Atlantic forest. Restor. Ecol. 22(1), 65–71.

Brander, L., van Beukering, P., Cesar, H., 2007. The recreational value of coral reefs: a meta-analysis. Ecol. Econ. 63, 209–218.

Brouwer, R., Langford, I., Bateman, I., Turner, R.K., 2008. A meta-analysis of wetland contingent valuation studies. In: The Stated Preference Approach to Environmental Valuation III: Benefit-Cost Analysis and Natural Resource Damage Assessment. Ashgate Publishing Ltd, Aldershot

Carson, R., Flores, N., Martin, K., Wright, J., 1996. Contingent Valuation and Revealed Preference Methodologies: Comparing the Estimates for Quasi-Public Goods. Land Econ. 72, 80–99.

Daniel, T.C., Muhar, A., Arnberger, A., Aznar, O., Boyd, J.W., Chan, K.M., Costanza, R., Elmqvist, T., Flint, C.G., Gobster, P.H., Gret-Regamey, A., Lave, R., Muhar, S., Penker, M., Ribe, R.G., Schauppenlehner, T., Sikor, T., Soloviy, I., Spierenburg, M., Taczanowska, K., Tam, J., von der Dunk, A., 2012. Contributions of cultural services to the ecosystem services agenda. Proceedings of the National Academy of Sciences 109(23), 8812–8819.

Dietz, T., Fitzgerald, A., Shwom, R., 2005. Environmental values, Annu. Rev. Env. Resour. 30, 335–372.

De Groot, R., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L., ten Brinkm, P., van Beukering, P., 2012. Global estimates of the value of ecosystems and their services in monetary units. Ecosyst. Serv. 1, 50–61.

De Salvo, M., Signorello, G., 2015. Non-market valuation of recreational services in Italy: A meta-analysis. Ecosyst. Serv. 16, 47–62

DeSesensi, J., 1994. Multiculturalism as an issue in sport management. J. Sport Manag. 8, 63–74.

Florax, R., Nijkamp, P., Willis, K., 2002. Meta-analysis and value transfer: comparative assessment of scientific knowledge. In: Florax, R.., Nijkamp, P., Wilis, K. (Eds.), Comparative Environmental Economic Assessment. Elgar, Cheltenham, UK.

Floyd, M., 2007. Research on race and ethnicity in leisure: Anticipating the fourth wave.
Leisure 3, 245–254.

Ghermandi, A., van den Bergh, J., Brander, L.M., de Groot, H.L.F., Nunes, P., 2008. The economic value of wetland conservation and creation: a meta-analysis. Fondazione Eni Enrico Mattei, Working Paper Series 79/2008.

Ghermandi, A., Nunes, P., 2013. A global map of coastal recreation values: Results from a spatially explicit meta-analysis. Ecol. Econ. 86, 1–15.

Hansen, K. and Malmaeus, M. 2016. Ecosystem services in Swedish forests. Scand. J. For. Res. 31 (6), 626–640.

House, R., P. Hanges, M. Javidan, P. Dorfman, Gupta, V., 2004. Culture, Leadership, and Organizations: The GLOBE Study of 62 Societies, Sage Publications.

Hornborg, A., J. McNeill, Martinez-Alier, J., 2007. Rethinking Environmental History: World-System History and Global Environmental Change, Lanham: Altamira Press.

Hoyos, D., Mariel, P., Fernandez-Macho, J., 2009. The influence of cultural identity on the WTP to protect natural resources: some empirical evidence. Ecol. Econ. 68, 2372–2381.

Hynes, S., Norton, D., Hanley, N., 2013. Accounting for Cultural Dimensions in International Benefit Transfer. Environ. Resour. Econ. 56, 499–519.

Johnston, R., Ranson, M., Besedin, E., Helm, E., 2006. What Determines Willingness to Pay per Fish? A Meta-Analysis of Recreational Fishing Values. Mar. Resour. Econ. 21, 1–32.

Johnston, R., Rosenberger, R.S., 2010. Methods, trends and controversies in contemporary benefit transfer. J. Econ. Surv. 24 (3), 479–510.

Kountouris, Y., Remoundou, K., 2016. Cultural Influence on Preferences and Attitudes for Environmental Quality. Kyklos 69 (2), 369–397.

Lindhjem, H., Navrud, S., 2009. Asking for Individual or Household Willingness to Pay for Environmental Goods? Implications for aggregate welfare measures. Environ. Resour. Econ. 43, 11–29.

Liu, S., Stern, D., 2008. A Meta-analysis of Contingent Valuation Studies in Coastal and Near-Shore Marine Ecosystems. MPRA Paper No. 11720.

Loomis, J.B., Ellingson, L., Gonzalez-Caban, A., Seidl, A., 2006. The role of ethnicity and language in contingent valuation studies: a fire prevention policy application. Am. J. Econ. Sociol. 65, 559–586.

Ojea, E., M. Loureiro, 2007. Altruistic, egoistic and biospheric values in willingness to pay (WTP) for wildlife. Ecol. Econ. 63, 807–814.

Oinonen, S., Borger, T., Hynes, S., Buchs, A.K., Heiskanen, A.S., Luisetti, T. and van der Veeren, R., 2016. The role of economics in ecosystem based management: The case of the EU Marine Strategy Framework Directive, First lessons learnt and way forward. Journal of Ocean and Coastal Economics, 2(Articl).

Pemberton, C., Harris-Charles, E., Patterson-Andrews, H., 2010. Cultural bias in contingent valuation of copper mining in the commonwealth of Dominica. Ecol. Econ. 70 (1), 19–23.

Mbuthia, S., Maingi, S., 2010. The influence of ethnicity on leisure pursuits and tourism behaviour of Somali immigrants in Leeuwarden, Netherlands. J. Hosp. Manag. Tour. 1(1), 1–11.

Moeltner, K., Boyle, K., Paterson, R., 2007. Meta-analysis and benefit transfer for resource valuation-addressing classical challenges with Bayesian modeling. J. Environ. Econ. Manag. 53 (2), 250–269.

Philips, E., 2007. Contexts for Mobilization: Spatial Settings and Klan Presence in North Carolina, 1964–1966. Am. J. Sociol. 113(3): 781–814.

Pouta, E., 2004. Attitude and belief questions as a source of context effect in a contingent valuation survey, J. Econ. Psychol. 25, 229–242.

Rosenberger, R., Loomis, J., 2000. Panel Stratification in Meta-Analysis of Economic Studies: An Investigation of Its Effects in the Recreation Valuation Literature. J. Ag. Appl. Econ. 32 (3), 459–470.

Rosenberger, R., Stanley, T., 2006. Measurement, generalization, and publication: Sources of error in benefit transfers and their management. Ecol. Econ. 60, 372–378.

Rabe-Hesketh, S., Skrondal, A., 2015. Multilevel and Longitudinal Modeling Using Stata, Third Edition: Volumes I and II, A Stata Press Publication, College Station, Texas.

Rao, N., Ghermandi, A., Portela, R., Wang, X., 2015. Global values of coastal ecosystem services: A spatial economic analysis of shoreline protection. Ecosyst. Serv. 11, 95–105.

Ready, R., S. Navrud, B. Day, R. Dubourg, F. Machado, S. Mourato, F. Spanninks, Rodriquez, M., 2004. Benefit transfer in Europe: how reliable are transfers between countries? Environ. Resour. Econ. 29, 67–82.

Ready, R., Navrud, S., 2006. International benefit transfer: Methods and validity tests, Ecol. Econ. 60, 429–434.

Rosenberger, R.S., Phipps, T.T., 2002. Correspondence and convergence in benefit transfer accuracy: a meta-analytic review of the literature. Division of Resource Management, West Virginia University.

Shrestha, R., Loomis J., 2001. Testing a meta-analysis model for benefit transfer in international outdoor recreation, Ecol. Econ. 39, 67–83.

Shultz, S., Pinazzo, J., Cifuentes, M., 1998. Opportunities and limitations of contingent valuation surveys to determine national park entrance fees: evidence from Costa Rica. Environ. Dev. Econ. 3, 131–149.

Smith, V., Kaoru, Y., 1990. Signals or noise? Explaining the variation in recreation benefit estimates. Am. J. Agric. Econ. 72 (2), 419.

Taylor, T., 2001. Cultural diversity and leisure: Experiences of women in Australia. Society and Leisure 24 (2), 535–555.

UNEP, 2006. Marine and coastal ecosystems and human wellbeing: A synthesis report based on the findings of the Millennium Ecosystem Assessment. UNEP.

Wilk, R., Cliggett, L., 2006. Economies and Cultures: Foundations of Economic Anthropology, Westview Press.

Woodward, R., Wui, Y.S., 2001. The economic value of wetland services: a meta-analysis. Ecol. Econ. 37, 257–270.

Tables

Table 1. Summary statistics of valuation study observations in Meta database

Variable	Unit and Measurement	Mean	Std. Dev.	Number of Observations
Study Characteristics				
Study method				
Contingent Valuation Method	Binary	0.34	0.47	106
Choice Experiment	Binary	0.19	0.40	60
Zonal Travel Cost	Binary	0.07	0.25	21
Contingent Behaviour Model	Binary	0.08	0.28	26
Individual Travel Cost Model	Binary	0.32	0.47	98
Benefit Value				
Benefit Value (ln)	2015 $/year (PPP)	3.83	1.98	311
WTP to avoid degradation	Binary	0.23	0.42	74
WTP for improvement	Binary	0.32	0.47	101
Value at current status	Binary	0.45	0.5	135
Other study characteristics				
Study was pre 2002	Binary	0.45	0.50	140
Report or Non peer reviewed publication	Binary	0.27	0.44	23
Site and Ecosystem				
North America	Binary	0.30	0.46	92
Europe	Binary	0.34	0.47	106
Asia	Binary	0.13	0.34	40
Australia	Binary	0.10	0.30	31
Latin America	Binary	0.07	0.27	22
Africa	Binary	0.06	0.23	20
National marine waters under protection	Percentage	23.83	17.57	311
Ecosystem Service and Impacts				
Sea Angling	Binary	0.30	0.46	92
Diving	Binary	0.10	0.30	31
Water Quality impact	Binary	0.16	0.36	49
Pollution and Debris impact	Binary	0.05	0.23	17
Marine Protected Area	Binary	0.38	0.49	21
Sample				
Household level survey	Binary	0.14	0.35	43
Tourists only	Binary	0.18	0.38	55
Residents only	Binary	0.17	0.38	53
Ecosystem				
Estuarine	Binary	0.05	0.22	16
Beach	Binary	0.35	0.47	119
Mangrove	Binary	0.03	0.16	8
Reef	Binary	0.18	0.38	55
Lagoon	Binary	0.03	0.18	10
Other/mixed	Binary	0.36	0.48	103

Table 2. Summary Statistics of Cultural Indicators used in Meta-Analysis

Variable	Unit and Measurement	Mean	Std. Dev.
GDP per capita (ln)	2015 $/year (PPP, ln)	10.36	0.70
Globe Cultural Indicators			
Humane Orientation	Likert Scale (1-7)	4.17	0.47
Performance Orientation	Likert Scale (1-7)	4.26	0.25
World Value Survey Indicators			
Would give part of my income for the environment (Income v Environment)	Percentage in country sample who agree with statement	12.11	5.51
The Government should reduce environmental pollution, but it should not cost me any money (Govn. Reduce pollution).	Percentage in country sample who agree with statement	68.79	15.26
Economic growth and creating jobs should be the top priority, even if the environment suffers to some extent (Economic Growth)	Percentage in country sample who agree with statement	55.85	8.22
Environmental problems in the world: Pollution of rivers, lakes and oceans is a serious /very serious problem (Waterway Pollution)	Percentage in country sample who agree with statement	60.28	17.72

Table 3. Ordinary Least Squares Results

Variables	Model 1	Model 2	Model 3
Contingent Valuation	-1.27 (0.28)***	-0.91 (0.28)***	-1.02 (0.25)***
Choice Experiment	-1.12 (0.25)***	-0.42 (0.29)	-0.108 (0..33)
Zonal Travel Cost	0.85 (0.52)*	1.70 (0.53)***	1.22 (0.53)**
Contingent Behaviour	-1.02 (0.35)***	-1.01 (0.39)**	-1.27 (0.34)***
Europe	-0.98 (0.22)***	-1.09 (0.25)***	-1.69 (0.31)***
Australia	0.53 (0.37)	0.59 (0.42)	-1.76 (0.35)***
Latin America	0.19 (0.40)	1.56 (0.50)***	0.04 (0.46)
Africa	-1.51 (0.76)**	-0.92 (0.64)	0.31 (0.63)
Study was pre 2002	0.10 (0.22)	-0.04 (0.23)	0.08 (0.21)
Report or Non peer reviewed publication	-0.19 (0.24)	-0.01 (0.27)	-0.33 (0.26)
WTP to avoid degradation	1.12 (0.26)***	1.01 (0.29)***	0.46 (0.25)*
WTP for improvement	0.47 (0.26)*	0.47 (0.33)	0.44 (0.25)*
Sea Angling		0.56 (0.31)*	0.43 (0.23)*
Diving		0.65 (0.46)	0.12 (0.43)
Water Quality impact		-0.10 (0.32)	-1.05 (0.31)***
Pollution and Debris impact		0.69 (0.39)*	-0.21 (0.41)
Marine Protected Area		-0.21 (0.23)	-0.26 (0.20)
Household level survey		1.01 (0.31)***	0.99 (0.28)***
Tourists only		0.30 (0.37)	-0.30 (0.38)
Residents only		-0.27 (0.23)	-0.58 (0.21)***
Estuarine		0.65 (0.42)	0.17 (0.48)
Beach		-1.24 (0.28)***	-0.76 (0.25)***
Mangrove		-3.17 (0.72)***	-1.93 (0.83)**
Reef		-1.60 (0.41)***	-0.28 (0.46)
Lagoon		-1.58 (0.41)***	-1.67 (0.39)***
National marine waters under protection		0.05 (0.01)***	0.05 (0.01)***
GDP per capita (ln)			0.05 (0.27)
Humane Orientation			0.94 (0.42)***
Performance Orientation			-2.14 (1.04)***
Income v Environment			-0.07 (0.02)***
Govn reduce Pollution			-0.02 (0.01)**
Economic Growth			0.09 (0.02)***
Waterway Pollution			0.03 (0.01)***
Constant	4.44 (0.30)***	4.59 (0.38)***	3.99 (3.38)
Observations	311	311	311
Adjusted R-squared	0.23	0.39	0.62
R-squared	0.25	0.43	0.65

Note: Regression with robust standard errors. Significance is indicated with ***, **, and * for 1%, 5% and 10% statistical significance levels, respectively.

Table 4. Generalized Linear Multi-level Model Results

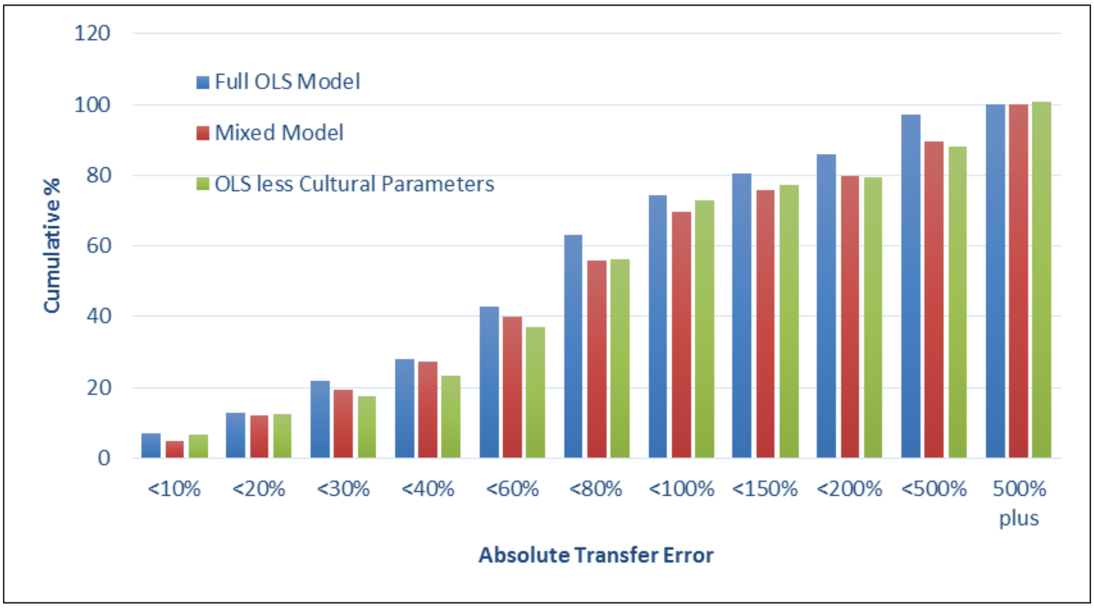
Variables	Coefficient.	Std. Err.
Contingent Valuation	-0.847***	(0.212)
Choice Experiment	-0.559	(0.347)
Zonal Travel Cost	0.075	(0.294)
Contingent Behaviour	-1.532***	(0.212)
WTP to avoid degradation	0.273	(0.245)
WTP for improvement	0.117	(0.293)
Europe	-1.276***	(0.466)
Latin America	-0.575	(0.584)
Report or Non peer reviewed publication	0.171	(0.319)
Sea Angling	0.212	(0.223)
Water Quality impact	-0.405	(0.283)
Marine Protected Area	-0.297	(0.306)
Household level survey	0.652*	(0.364)
Tourists only	0.376	(0.328)
Residents only	-0.245	(0.335)
Beach	-0.696**	(0.273)
Mangrove	-2.820*	(1.441)
Reef	-0.812*	(0.441)
Lagoon	-0.384	(0.453)
GDP per capita (ln)	-0.251	(0.315)
National marine waters under protection	0.041***	(0.015)
Humane Orientation	0.532	(0.567)
Performance Orientation	-1.430*	(0.862)
Income v Environment	-0.062*	(0.033)
Govn reduce Pollution	-0.020*	(0.011)
Economic Growth	0.038*	(0.021)
Waterway Pollution	0.028***	(0.01)
Constant	9.218**	(4.417)
Random (Hierarchical) Effects		
Level 1 (recreation ecosystem service value estimate)		
Variance (σ_{ϵ}^{2})	0.353***	0.035
Level 2 (Study)		
Variance (σ_{u2}^{2})	1.599***	0.279
Observations	309	309
Number of groups	95	95
Log likelihood	-396	

Significance is indicated with ***, **, and * for 1%, 5% and 10% statistical significance levels, respectively.

Table 5. Transfer Errors

Database Observations	OLS Model (Model 3) *With Cultural Parameters*		OLS Model (Model 2) *Without Cultural Parameters*		Mixed Model	
Valuation Study Type	Mean Transfer Error (%)	Std. Dev.	Mean Transfer Error (%)	Std. Dev.	Mean Transfer Error (%)	Std. Dev.
Contingent Valuation Method	51	157	151	478	108	296
Choice Experiment	24	102	84	277	18	93
Individual Travel Cost Model	42	321	205	543	183	551
Zonal Travel Cost	336	1100	412	769	65	351
Contingent Behaviour Model	191	615	240	758	244	771
All valuation studies	84	412	181	523	149	471

Figure 1. Cumulative Distribution of Absolute Transfer Errors



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