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Meta-analysis of nature conservation values in Asia & Oceania: Data heterogeneity and benefit transfer issues

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Abstract

We conduct a meta-analysis (MA) of around 100 studies valuing nature conservation in Asia and Oceania. Dividing our dataset into two levels of heterogeneity in terms of good characteristics (endangered species vs. nature conservation more generally) and valuation methods, we show that the degree of regularity and conformity with theory and empirical expectations is higher for the more homogenous dataset of contingent valuation of endangered species. For example, we find that willingness to pay (WTP) for preservation of mammals tends to be higher than other species and that WTP for species preservation increases with income. Increasing the degree of heterogeneity in the valuation data, however, preserves much of the regularity, and the explanatory power of some of our models is in the range of other MA studies of goods typically assumed to be more homogenous (such as water quality). Subjecting our best MA models to a simple test forecasting values for out-of-sample observations, shows median (mean) forecasting errors of 24 (46) percent for endangered species and 46 (89) percent for nature conservation more generally, approaching levels that may be acceptable in benefit transfer for policy use. We recommend that the most prudent MA practice is to control for heterogeneity in regressions and sensitivity analysis, rather than to limit datasets by non-transparent criteria to a level of heterogeneity deemed acceptable to the individual analyst. However, the trade-off will always be present and the issue of acceptable level of heterogeneity in MA is far from settled.

Keywords: Valuation; biodiversity; Asia; meta-analysis; meta-regression; benefit transfer. **JEL Classification**: Q26; Q51; Q57; H41

Introduction

According to the Millennium Ecosystem Assessment, more than 60 per cent of the world's ecosystems are being degraded or used unsustainably (Millennium Ecosystem Assessment 2005). The pressure on nature is among the highest in the many rapidly growing economies of Asia and Oceania, home to four of the world's 12 megadiversity countries (Australia, China, India, Indonesia). The (neoclassical) economist's prescription to stemming this deteriorating trend is to value changes in the provision of environmental goods in economic terms, and create markets or other mechanisms to internalise their values in the billions of everyday decisions of consumers, producers and government officials. Faced with this challenge, environmental economists have produced an enormous amount of primary valuation research using stated and revealed preference methods. However, paraphrasing Glass et al. (1981: p11)[1], results of much of this work "are strewn among the scree of a hundred journals and lies in the unsightly rubble of a million dissertations." This large body of valuation research could be much better utilised to demonstrate to decision-makers the social return to nature conservation, a key area where environmental economists need to do more in the future, as pointed out by David Pearce (2005). For a range of environmental goods meta-analysis (MA) techniques has been used to synthesize valuation research, test hypotheses, and facilitate the transfer of existing welfare estimates to new, unstudied policy sites ("benefit transfer" – BT) where such information can be useful, e.g. in cost-benefit analysis (Smith and Pattanayak 2002; Navrud and Ready 2007). Responding to Pearce's challenge, we use MA to review and take stock of the literature to date on

[1] Originally quoted in Stanley and Jarrel (2005).

environmental valuation of a complex and somewhat heterogeneous good – (changes in) conservation of habitat, biodiversity and endangered species – in a specific geographical region; Asia and Oceania. We attempt to answer the following two research questions; (1) To what extent do welfare estimates for this complex good conform with theoretically and empirically derived expectations regarding the good characteristics, valuation methods, study quality, socio-economics and other variables?; (2) How sensitive are the meta-regression results and the value forecasts for unstudied sites to; (a) the "scope of the MA", i.e. the level of heterogeneity of the good valued and the valuation methods used; and (b) the choice of meta-regression models?

The first question investigates whether the welfare estimates display the degree of validity and regularity more typically found for less complex environmental goods with higher share of use-values, and offers a first check of the potential for using such data for BT applications (Johnston et al. 2005; Lindhjem 2007). The second question contributes to our understanding and refinement of MA methodology in environmental economics, where the meta-analyst typically is left to make a number of choices, potentially introducing various subjective biases (Hoehn 2006; Rosenberger and Johnston 2007). An important analyst choice both for the robustness of MA models and their suitability for use in BT applications, relates to the scope of the MA, i.e. the trade-off between the number of observations and the acceptable level of heterogeneity in the data, as pointed out by e.g. Engel (2002) (Question 2a above). Another, related choice is which model to choose for BT, for example how to treat insignificant variables (Question 2b)[2]. There are different practices and little is known of the empirical effects

[2] An alternative approach to dealing with classical MA challenges, not pursued here, is to use Bayesian techniques (e.g. Moeltner et al (2007) and Moeltner and Rosenberger (2008)).

of these choices, though Lindhjem and Navrud (2008c) have shown that the precision of meta-analytical BT (MA-BT) depends on the model specifications, sometimes in unexpected ways.

Previous MA studies have primarily analysed the values of more homogenous types of environmental goods (e.g. water and air quality, recreation days) often within the same country (Desvousges et al. 1998; Rosenberger and Loomis 2000a; Van Houtven et al. 2007), though there is a trend towards studying more complex goods in international settings (e.g. wetlands, coral reefs, forests) (Brander et al. 2006; Brander et al. 2007; Lindhjem 2007). Only two studies have attempted an MA for a similar good to ours; Loomis and White (1996) (endangered species in the USA), and Jacobsen and Hanley (2007) (relationship between income and willingness to pay (WTP) for biodiversity worldwide). Neither of these studies focus specifically on MA methodology or implications for BT. Compared to previous work, we add several new and interesting dimensions; (1) To investigate the effect of the MA scope, we divide our dataset into two levels of heterogeneity; endangered species (more similar good and methods used) and nature conservation more generally (more heterogeneity in good and methods used); (2) We then estimate a number of meta-regression models for these two main datasets using different cleaning procedures investigating conformity with expectations and the robustness of results, and finally; (3) We report the level of forecast (or transfer) errors for unstudied sites broken down by type of models, nature conservation habitat, geographic region and valuation method used, based on a jackknife resampling technique introduced in MA by Brander et al (2006). Using a random effects meta-regression model we find that welfare estimates show some degree of regularity, though this decreases with the increased heterogeneity of the meta-data, as expected. However, even the heterogeneous models show explanatory and predictive power at the same

level or better compared with other MA studies of goods assumed to be more homogenous.

Conceptual framework and data

Conceptual framework

We start by defining "nature conservation" broadly as the protection or active management of any natural terrestrial or aquatic ecosystem, resource or amenity, Q. The economic value measure for an increase in the level of nature conservation (Q) is the change in the quantity and/or quality (QUAL) of Q, or some set of services provided by Q, and is referred to as consumers' surplus (CS) or Willingness to pay (WTP). From the standard indirect utility function, the bid function for a representative individual j for this change can be given by (Bergstrom and Taylor 2006)[3]:

$$(1)\ \ WTP = f(P_j, M_j, Q_j^T - Q_j^R, QUAL_j^T - QUAL_j^R, SUB_j^T - SUB_j^R, H_j)$$

Where P = a price index of market goods (assumed constant), M = (individual or household) income (assumed constant), Q^T-Q^R and $QUAL^T$-$QUAL^R$ are the changes in quantity and quality from a reference situation ("status quo") (R) to a target state-of-the-world (T), SUB = substitutes for Q available to individual j, H = non-income household or individual characteristics. Further to make (1) elastic enough for use in MA, we assume, following Bergstrom and Taylor (2006), a "weak structural utility theoretic approach" in which the underlying variables in the bid function are assumed to be derivable from some unknown utility function, but that flexibility is maintained to

[3] For simplicity and brevity we do not elaborate the details of how nature conservation may increase utility e.g. related to market goods and household production, e.g. as done by Van Houtven et al. (2007) for water quality.

introduce explanatory variables into the WTP model, such as study design and different valuation methods, that do not necessarily follow from (1). This is the most common approach in MA, where the meta-analyst records estimates of mean WTP from different studies and corresponding explanatory variables both informed by theory and empirical expectations. In this process, the empirical specification chosen for (1) needs to trade off the availability of variable information reported in valuation studies with the range of potentially relevant variables that can explain variation in welfare estimates. For example, information about substitute sites to a national park will most often not be reported, even if important for WTP. In addition, if information *is* reported, for example about the exact change in nature conservation valued, this change may not easily be comparable across sites and studies. No MA studies are free of this problem. Some try to map changes to a common unit of measurement in terms of hectares or to a water quality ladder or similar, though such simplified common units may mask differences in other dimensions of the good important to individuals (see e.g. discussion in Lindhjem (2007)). There are no easy solutions to this problem, and in our rather general case we interpret mean WTP from different studies as welfare estimates for a (small, though not marginal) change in Q and/or in one or more elements in an attribute vector of QUAL describing the quality of the nature site[4]. We then use dummy variables to detect differences in WTP depending on the type of habitat or change valued. Before discussing the empirical specification of (1), we first describe the data used for the MA.

Meta-data from nature conservation studies

[4] The ecosystem services and functions and total economic value from nature and biodiversity conservation are discussed in depth elsewhere, and for sake of brevity not elaborated in detail here (see e.g. Fromm (2000)).

Given this conceptual framework, we conducted a broad search for studies (published papers, reports, book chapters etc[5]) internationally available in English valuing nature conservation in the region drawn from various databases, including EVRI (Environmental Valuation Reference Inventory), ECONLIT, ISI Web of Science, EEPSEA's (Environment and Economy Programme for Southeast Asia), etc[6]. The first valuation studies related to nature conservation were conducted in Australia in the 1980s. In the rest of Asia, valuation started much later, but has grown in number substantially during the 1990's and 2000's. Based on the literature search we compiled a gross meta-dataset of 577 mean WTP estimates (i.e. observations) from 99 studies. A first crude screening of the studies was conducted by excluding the ones reporting negative mean WTP or very high or low estimates (2 standard deviations of the mean), leaving 550 estimates from 95 studies for detailed analysis. This reduces the influence of outlier estimates in our regression analysis. The resulting distribution of studies by region, by type of habitat or service valued, and valuation method used are given in Tables 1-3 below[7].

Most of the studies are from Southeast Asia, East Asia or Oceania (mostly Australia), with a smaller number of studies from South and Southwest Asia (Table 1). Australia

[5] We did not include Master degree theses for practical reasons (hard to find and/or to get hold of) and because many are written in the native language.

[6] Since the Australian database ENVALUE is no longer updated, has been (partly) integrated with EVRI, and include limited study information, our main search used the EVRI database.

[7] We do not claim to have achieved to collect an exhaustive database of all studies in Asia and Oceania, but the extent of our search makes us confident that we cover the majority of such studies. Further, it is unlikely that our search has been biased in any way (except for the focus on studies in English), which means that our data will give a objective picture of the valuation literature in the region. Finally, to answer our research questions, completeness is also not strictly necessary.

has the largest number of studies (with 22 studies), followed by the Philippines with 10 studies. Raw mean annual WTP is highest for Oceania at US$ 254, as expected, though also high for South Asia (US$ 206). The lowest WTP, all at around the same level, is found in Southeast Asia (US$ 83), East Asia (US$ 76) and Southwest Asia (US$ 66).

Table 1 Regional distribution of valuation studies

Region	Mean WTP (SD)	No. of obs.	No. of studies
Southeast Asia (SEA)	83 (212)	244	32
Oceania (O)	254 (914)	116	23
East Asia (EA)	76 (108)	99	23
South Asia (SA)	206 (286)	70	11
Southwest Asia (SWA)	66 (78)	21	6
Total		**550**	**95**

Notes: Oceania= Australia, Micronesia, Papua New Guinea, Vanuatu; SEA= Cambodia, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand, Vietnam; EA= China, Japan, Korea, Taiwan; SA= India, Sri Lanka; SWA= Iran, Israel, Pakistan.

Table 2 Distribution of valuation studies by habitat types

Types of habitats/services	Mean WTP (SD)	No. of obs.	No. of studies
Terrestrial habitats (reserves, national parks, forests)	116 (252)	176	33
Marine habitats (reefs, beaches, sea, watercourses)	80 (97)	162	27
Endangered species (single or multiple)	105 (220)	129	16
Wetlands (wetlands, mangroves)	514 (1503)	41	8
Other habitats/services (landscapes, eco.-services)	121 (182)	37	13
Total		**550**	**97***

Note: * Some studies have more split samples asking different types of good, and thus the number of studies is more than reported in Table 1.

Table 3 Valuation studies by methods

Method	Mean WTP (SD)	No. of obs	No. of studies
Contingent valuation method (CV)	124 (505)	417	77
Choice modelling/experiments (CM)	67 (41)	50	8
Travel cost method (TCM)	161 (162)	37	14
Others (market price, hedonic pricing)	269 (435)	46	5
Total		**550**	**104***

Note: * In some studies, there are more than one method used, and thus the number of studies (as understood by the software) is more than those reported in Table 1.

The most frequently valued habitat is terrestrial habitats (including forests, nature reserves and national parks), grouped together here for ease of exposition (Table 2). Marine and freshwater habitats (i.e. coral reefs, beaches, sea, rivers, watercourses) for simplicity termed "marine habitats", follow second. Wetlands have the highest value at US$ 514, mostly due to the market price methods often used to value such habitats (see next paragraph). Studies that value named and endangered (often iconic or charismatic) species or groups of species are categorised as "endangered species". Marine habitats provide the lowest value (US$ 80) compared to other types of habitats, while terrestrial habitats (US$ 116), endangered species (US$ 105), and other habitats (US$ 121) have values that are around 40-50 percent higher.

The by far most frequently used method of valuation is CV, with 77 studies, while the TCM comes second with only 14 studies (Table 3). Some studies find that CV yields lower WTP than TCM (e.g. Carson et al (1996)). A small number of studies (5) use other methods, such as the hedonic pricing method or calculating the value of wetlands and forests using the market price approach. These methods frequently calculate a different welfare measure than CV, CM and TCM studies, and also yield twice as high estimates as the other methods. Details of the individual studies (including reference) are given in the Appendix.

Information from the studies was then coded in a spreadsheet originally containing 30 variables, with between 1 and 36 observations drawn from each study (average 5.8). The same study typically has several sub-samples varying the methods used, scope and other aspects of the good being valued. The two first columns in Table 4 below give the variable names and definitions. Since there is no standardised way of reporting welfare estimates in the literature, a wide variety of units are typically used, e.g. WTP per

individual or household, per unit of area[8], per visitor, for different time periods (e.g. per month, per visit, per year, one-time amount etc.), and in different currencies and reporting years. To deal with this, we standardized the values to a common metric, i.e. WTP (US$ in 2006 prices) per household per year as a default, and coded WTP per individual, WTP per month etc., using dummies. For WTP per visit from CV or TCM studies, we calculated per visit WTP per year (if the study had information about how many trips a person would make per year, we converted to WTP per year). Values from different years were converted to 2006 prices using GDP deflators from the World Bank World Development Indicators. Purchase Power Parity (PPP) corrected exchange rates were used to correct for differences in price levels between countries, which is the common procedure in international BT and MA (Ready and Navrud 2006). Some theoretical models predict that WTP given per household is higher than individual WTP (e.g. Strand 2007), though empirical evidence is mixed (Lindhjem 2007; Lindhjem and Navrud 2008a). It can also be expected that WTP given per month multiplied by 12 to convert to an annual amount is higher than WTP originally stated on an annual basis (a well-known bias).

We also included other methodological variables that are often used in MA studies: whether the study used personal interviews, if the CV method applied a dichotomous choice (DC) WTP question format (i.e. the respondent says yes or no to a given bid, rather than stating max WTP), and whether the CV data were analysed using non-parametric statistical methods. DC formats are often found to give higher mean WTP (a main reason is so-called yea-saying), while non-parametric methods typically give a lower bound on WTP. There is no clear prior for use of interviews vs. other modes,

[8] Studies that reported results with per unit of area were excluded, as there total size typically was not given.

though type of survey mode is known to influence results (Boyle 2003; Lindhjem and Navrud 2008b). Further, we include a set of geographic and good characteristics variables to control for differences in welfare estimates between types of species (mammals, turtles) and habitat types, between regions and countries, and between primarily non-use vs. use value. Larger and more charismatic or iconized species (for example elephants or pandas) are likely to yield higher welfare estimates than non-charismatic species or biodiversity/nature conservation in general (e.g. as found in Jacobsen et al (2008)), though it is uncertain a priori if our MA will be able to detect such a pattern across several studies. Studies that primarily estimate non-use values are likely to give lower value estimates. There are no strong priors regarding other habitat types or regional/country dummies, though it is expected that these dimensions may influence WTP[9]. We considered including a dummy for the season of the study (e.g. rainy-dry season) similar to Lindhjem (2007), however in most cases such information was not reported.

The only socio-economic variable generally reported is income of the sample, which we include in our analysis. Around 78 percent of the studies report this. For those which don't, we follow common practice from other MA studies to use a proxy for income from other sources instead (we use GDP/capita for the country). It is expected that income will positively influence WTP, an often-found result in the literature for single studies. However, in MA studies WTP is often relatively insensitive to income levels (see e.g. Johnston et al. 2005; Jacobsen and Hanley 2007). One reason for this is the low variation in income levels in MA studies conducted within the same country or in

[9] We also considered using population density of the country of study as a variable, for example as done by Brander et al (2006) for wetlands. However, we think link between nature conservation and population density may be overly speculative, and excluded this variable in our analysis.

Western countries with similar income levels. In our case we have a fairly large variation in income levels, so should expect that WTP may increase with income.

Finally, we include a proxy variable for study quality; whether a study is a published or unpublished paper (i.e. a journal article or research report/working paper). Though published studies may be expected to apply more stringent and perhaps conservative methods, it is not clear if this would result in lower WTP. There may also be publication bias with unknown influence on WTP (Rosenberger and Stanley 2007). To capture trends in WTP values over time not captured by income (or other coded variables), we include a trend variable for the year of the study (rather than publication year). MA studies generally find WTP to increase over time, reflecting, perhaps, both increased nature scarcity and "greener" preferences. Since a portion of our studies is funded by the same institution and may share similarities we have not otherwise coded, we include a dummy (EEPSEA) to control for that. This procedure is similar to Bateman and Jones (2003), which find indications of similarities in WTP estimates from the same authors.

Table 4 Definition of meta-analysis variables and descriptive statistics

Variables	Description	Mean (SD) Level 1 data	Mean (SD) Level 2 data
Dependent variable			
WTP 2006	WTP in 2006 prices (US$)	73 (105)	133 (461)
Methodological variables			
SP	1 if stated preference, 0 otherwise	-	.84 (.35)
DC	1 if dichotomous choice, 0 otherwise	.95 (.22)	.51 (.50)
Hhldpay	1 if household's WTP, 0 if individual	.87 (.33)	.67 (.46)
Month	1 if payment is a monthly payment, 0 if otherwise	.79 (.40)	.35 (.47)
Nonpara	1 if estimate is non-parametric (Turnbull), 0 otherwise	.20 (.40)	.07 (.25)
Interview	1 if it is an in-person interview, 0 otherwise	.16 (.31)	.60 (.48)
Good characteristics variables			
Mammal	1 if it is a mammal, 0 otherwise	.15 (.36)	.04 (.20)
Turtle	1 for sea turtle, 0 otherwise	.27 (.44)	.06 (.24)
Otherspecies	1 for other species, 0 for turtle and mammal	.56 (.49)	.13 (.30)
Terrestrial	1 for terrestrial habitats, 0 otherwise	-	.32 (.47)
Marine	1 if marine habitat (beach, sea, watercourse, lake, river), 0 otherwise	-	.29 (.45)
Wetland	1 for wetlands, 0 otherwise	-	.07 (.26)
Otherhabitats	1 for other habitats/services, 0 for terrestrial & marine habitats, endangered species, wetlands	-	.06 (.25)
Nonuse	1 for primarily non-use, 0 otherwise	-	.77 (.41)
Socio-economic variables			
Income	Household income (PPP adjustment, 2006)	11,700 (11,815)	14,318 (17,258)
Geographic characteristics			
Australia	1 if the study in Australia, 0 otherwise	.12 (.33)	.19 (.39)
Philippin	1 if a study in the Philippines, 0 otherwise	.33 (.47)	.22 (.42)
Oceania	1 if a study in Oceanic countries, 0 otherwise	.12 (.33)	.21 (.40)
East	1 if a study in East Asian countries, 0 otherwise	.23 (.42)	.18 (.38)
Southeast	1 if a study in Southeast Asia, 0 otherwise	.56 (.50)	.44 (.48)
South	1 if a study in South Asia, 0 otherwise	.09 (.29)	.13 (.33)
Southwest	1 if a study in Southwest Asia, 0 otherwise	-	.04 (.19)
Other variables			
EEPSEA	1 if the study is funded by EEPSEA, 0 otherwise	.76 (.42)	.39 (.48)
Journal	1 if it is a published article, 0 otherwise	.23 (.42)	.47 (.49)
Year	Continuous: from 0 (2006) to 26 (1979)	2.11 (2.04)	6.36 (4.07)
No. of obs. (N)		**124**	**550**
No. of studies		**16**	**95**

Notes: EEPSEA = Environment and Economy Program for Southeast Asia

For our meta-regressions, we divided the dataset into two primary levels of scope, according to level of homogeneity of the good and methods used: Level 1: Endangered species; and Level 2: Biodiversity and nature conservation more generally. The endangered species data include WTP estimates from 16 studies using the CV method to value the preservation of single or multiple species. These CV studies typically ask how much local/domestic populations are willing to pay for various conservation programs for endangered species (e.g. WTP to conserve a viable population of sea turtles)[10]. 10 of the studies are funded by EEPSEA (hence the importance of the control variable discussed above). The species valued in these studies include sea turtles (several countries), black-faced spoonbill (Macau), rhinos (Vietnam), eagles and whale shark (Phillipines), and various species such as dugong dugong, elephants, rhinos, dolphins and tigers (Thailand). In addition we found six non-EEPSEA funded studies in the region using CV to value the preservation of the possum (a marsupial species native to Australia) and glider (the Mahogany Glider**:** a type of endangered possum), giant panda (China), and elephants (India, Sri Lanka)[11]. The 16 studies provide 124 estimates that will be used in meta-regression analysis. Although the species are different, we consider the preservation of them as a good with many similar attributes in valuation (i.e. a larger degree of homogeneity of the good), as compared to nature and biodiversity conservation more generally. In addition, methodological heterogeneity is reduced since all the studies in this level use CV.

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[10] A small number of studies survey foreign populations, e.g. Bandara and Tisdell (2005) study OECD citizens' WTP for the preservation of the Giant Panda in China.

[11] We found another valuation study on endangered species in Asia. Adhikari et al. (2005) use CM to investigate rhino conservation in Nepal, but was excluded since it does not provide welfare measures.

The second level of the data, include the studies from Level 1 and all the rest of the studies that value nature conservation more generally, with different types of methods (though the majority also use CV here). This dataset includes welfare estimates for a fairly heterogeneous good, however, not more so, it can be argued, than many other complex environmental goods studied in MA. Further, as almost all non-textbook goods in general (and environmental goods in particular) are heterogeneous to some degree, it is unclear from theory where to draw the line in practice. All in all the Level 2 dataset contains between 67 to 95 studies and 390 to 550 estimates, depending on the cleaning procedures used in the meta-regressions (see section on results below). The details of the Level 1 and 2 datasets are given in Tables A and B, respectively, in the appendix (reference, country, year, species/habitat/service types, method, survey mode, payment vehicle and format, number of values in the MA and WTP range). We will conduct several meta-regressions models based on these two levels of our data, to investigate the effects of heterogeneity.

Meta-regression model

We estimate meta-regression models to explain the variation in welfare estimates for conservation of species, biodiversity and nature more generally across studies in the literature. As most studies provide more than one WTP estimate, the data should most prudently be treated as a panel to account for the correlation between the errors of estimates from the same study[12]. Thus we used the procedure proposed by Rosenberger and Loomis (2000b) to check for panel structures in the data. The panel structure model, our empirical specification of equation (1) above, can be written as:

(2) $WTP_{ij} = \alpha + \sum_{i=1}^{n} \beta_i x_{ij} + \mu_{ij} + \varepsilon_i$

where WTP is the *i*'th observation from the *j*'th study, α is a constant, x_{ij} is a vector of explanatory variables (as defined in Table 4), with a panel effect μ_{ij} and an error ε_i ~N(0, σ_ε^2). We chose a double-log specification of (2), common in the MA literature, which fitted our data better than linear or other specifications. A Breusch and Pagan's Lagrange multiplier statistic test of whether panel effects are significant was conducted. The null hypothesis is that an equal effects model is correct ($H_0 : \mu_{ij} = 0$), and the alternative hypothesis that a panel effects model is correct $(H_1 : \mu_{ij} \neq 0)$. For a model with income as the only explanatory variable[13], this test showed that a model with equal effects ($H_0 : \mu_{ij} = 0$) was rejected, confirming the appropriateness of a panel estimation model (χ^2 = 274.90, p=0.000 with N=550 and j=95). In order to test whether a random effects specification (which has a panel specific error component) is outperformed by a fixed effects model (which keeps the panel specific error component constant), a Hausman χ^2 test was performed for the whole dataset. The results in Table 5 show that the random effects model (B) cannot be rejected, and thus, it is used in the next sections

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[12] We also tested two other stratifications of the data: by-survey and by-author. Results show that in many model specifications of these two stratifications equal effects (and random effects) cannot be rejected.

[13] A comprehensive test would have included other explanatory variables with different model specifications, but for sake of simplicity and brevity, we only present the model with the income variable here

Table 5 Test of random vs fixed effects panel structure (N=550, j=95)

	b Fixed effects model	B Random effects model	b-B	S.E.
Income variable	.0305127	-.0494427	.0799554	.2193994
p> χ^2: 0.7155				

We also performed the Hausman test for all the models used in this study (see next section for results), i.e. for different subsets of the data and different explanatory variables included, and find that a random effects model is the best estimation approach for Level 1 and 2 of our data.

Meta-regression results and discussion

Results of four random-effects GLS regression models for the Level 1 data (species) are reported in Table 6. Moving from Model 1 to Model 4, we include more explanatory variables in the models. Model 1 contains methodological variables only, Model 2 adds good characteristics, Model 3 adds country variables, and Model 4 includes socio-economic (income) and other variables (survey year). For all models we present both a full and reduced version, in which variables not significant at the 20 per cent level are taken out[14]. This reduced form is often used in MA-BT applications (see for example Rosenberger and Loomis 2000a, Lindhjem and Navrud (In press)), demonstrated in the next section. Going from Model 1 to 4, the models gradually explain more of the variation in WTP for species preservation. The methodological variables in Model 1 explain around 40 percent of the variation (R^2 = 0.398), while adding characteristics of the species explain another 14 percent of the variation (R^2 = 0.536). Adding country

[14] A range of models was tried using combinations of variables in Table 4. Models presented here were chosen to avoid collinearity (excluding e.g. the EEPSEA variable), to include dummies reflecting a significant share of the data (i.e. excluding region dummies for Level 1 data), to obtain best fit with the data and to enhance comparison between models and between Level 1 and Level 2 data.

specifics and income and year in Models 3 and 4 help explain another 22-27 percentage points of the variation. Model 4, the best fitting of the models, obtains an overall R^2 of 0.81, which is very high compared to other MA studies. It is comforting for our belief in the validity of the data and for the potential use of such value estimates for BT that around half of the explained variation in the best model is due to non-study specific, observable characteristics related to the good, geographical area, year of study and income level of the population surveyed. Note that the models are directly comparable since they all include the same observations.

Individual parameter estimates in the fully specified and best Model 4 confirm well with expectations, where such priors exist. The DC format tends to provide higher estimates than other formats, as expected. Monthly payment is significantly higher than other vehicles of payment, as expected. Non-parametric estimates are significantly lower than estimates using parametric methods, also as expected. Household payment is significantly higher than WTP from individual payment, though theoretical and empirical expectations here are not clear. Personal interview is not significantly different than other survey modes in the fully specified Model 4 (but significantly higher in the reduced model). Not controlling for good characteristics and other variables make interviews significantly lower, in Model 1. Valuation of turtle preservation is significantly lower than for other species (though insignificant in Model 2), while mammals are valued significantly higher[15]. Higher values for mammals can be explained by their higher degree of "charisma" than for other, lower-profile species. The result for sea turtles, on the other hand, is somewhat puzzling. Australian studies

[15] We also tried other groupings or specifications of types of species, such as size, degree of "charisma" across types of species etc, but found that using the biological classification "mammal" worked best in our models. Adding dummies for each species is not feasible due to the limited number of observations for each.

provide higher values than studies in other countries in Model 3, but when controlling for income level, this parameter becomes negative and significant. Studies conducted in the Philippines are likely to give lower values (though only significant in Model 3) than studies conducted in other countries. The income parameter, i.e. the income elasticity of WTP in our double-log formulation, is 0.85 and highly significant. Income elasticity of WTP in the 0-1 range is commonly found in the CV literature (e.g. Kriström and Riera 1996). In Model 4 more recent studies yield significantly higher WTP estimates, reflecting perhaps increased scarcity or greening of preferences over time.

Table 6 Meta-regression models for Level I: Endangered species studies

Variables	Model 1		Model 2		Model 3		Model 4	
	Full	**Reduced**	**Full**	**Reduced**	**Full**	**Reduced**	**Full**	**Reduced**
Constant	1.298*	1.779***	2.413***	3.347***	1.493	2.488***	-9.365***	-9.867***
	(.095)	(.010)	(.002)	(.000)	(.156)	(.000)	(.001)	(.000)
DC	1.517*	1.992***	.695		1.187	1.797***	1.555***	1.567***
	(.064)	(.004)	(.374)		(.102)	(.004)	(.002)	(.000)
Hholdpay	.855		.038		.563		1.722***	1.775***
	(.295)		(.961)		(.438)		(.003)	(.000)
Month	.168		.657		1.116*	.785	.140	
	(.810)		(.274)		(.092)	(.101)	(.788)	
Nonpara.	-.259**	-.264**	-.278**	-.265**	-.273**	-.300***	-.281***	-.286***
	(.032)	(.028)	(.022)	(.027)	(.016)	(.010)	(.010)	(.009)
Interview	1.525***	1.419***	.113		.729		-.972	-1.105**
	(.004)	(.004)	(.873)		(.375)		(.192)	(.025)
Turtle			-.363		-.675	-1.347***	-.954***	-.919***
			(.470)		(.151)	(.001)	(.001)	(.000)
Mammal			1.740**	2.038***	.856		1.569***	1.678***
			(.035)	(.000)	(.277)		(.004)	(.000)
Australia					.698		-2.048**	-2.221***
					(.415)		(.019)	(.000)
Philippin.					-.982***	-1.143***	-.126	
					(.000)	(.000)	(.699)	
LnIncome							.854***	.895***
							(001)	(.000)
LnYear							2.189***	2.309***
							(.000)	(.000)
Summary statistics:								
R^2: within	0.044	0.044	0.044	0.044	0.157	0.157	0.231	0.230
R^2: betw.	0.604	0.541	0.785	0.673	0.879	0.690	0.961	0.961
R^2: overa.	**0.398**	**0.391**	**0.536**	**0.438**	**0.757**	**0.548**	**0.810**	**0.810**
Sigma_u	.841	.867	.674	.701	.614	.611	.330	.248
Sigma_e	.470	.470	.470	.470	.444	.444	.425	.423
Rho	.761	.772	.672	.689	.656	.654	.376	.255
N	124	124	124	124	124	124	124	124
# studies	16	16	16	16	16	16	16	16

Note: *p < 0.10, **p < 0.05, ***p < 0.01. STATA Version 9.2 used. # Red. models exclude variables with p>0.20.

In Table 7 we present results of four random-effects GLS regression models using the more heterogeneous Level 2 data (nature and biodiversity conservation), in this case with the fuller range of explanatory variables, but using different subsets of the data. We keep the same methodological variables (except we include the dummy for stated preference values) for the sake of comparing the robustness of the results with Level 1. Further, we include the habitat/good characteristics variables that are significant across at least one of our four models. Finally, geographic region dummies were included if

significant or if data from these regions dominate our dataset. Model 1 investigates the full dataset of 550 observations (27 obs. <0 or outside 2 std. dev. of the mean range were screened out initially as described in a previous section). This full dataset is contained in Table A and B in the Appendix. Model 2 excludes observations from studies that did not report income information, a procedure sometimes used in MA. In Model 1 GDP/capita was substituted for the missing income information. Model 3 contains the Model 2 observations, excluding values estimated using other methods than CV, CM, and TCM (i.e. market price and hedonic pricing methods), as these methods typically estimate conceptually different (and typically higher) welfare measures. Model 4 contains studies of endangered species only (the same observations as in Model 4 from Level 1), for sake of comparison. As for the Level 1 data we use both full and reduced forms of the models. For the most heterogeneous version of the data in Model 1 R^2 (overall) is 16 percent, which is somewhat lower but comparable to the 25-26 percent obtained in two national level MA studies of an apparently more homogenous good; recreation activity days in the USA (see Rosenberger and Loomis (2000a) and Shresta and Loomis (2003))[16]. Our R^2 for the full dataset is generally higher than Jacobsen and Hanley's (2007) random-effects MA models of international biodiversity studies. Excluding the studies from Model 1 for which a crude GDP/Capita measure was substituted for missing income information, more than doubles the explained variation (Model 2, $R^2 = 0.34$). This is an indication that mean WTP is more sensitive to reported sample income than GDP/capita, as expected (though Jacobsen and Hanley (2007) somewhat surprisingly finds the opposite result).

[16] Since R^2 obtained from random-effects models is not directly comparable to standard R^2 OLS, the comparison should be interpreted with caution.

Table 7 Meta-regression models for Level 2: Biodiversity and nature conservation

Variables	Model 1		Model 2		Model 3		Model 4	
	Full	**Reduced#**	**Full**	**Reduced**	**Full**	**Reduced**	**Full**	**Reduced**
Constant	3.455**	3.672***	4.058***	4.854***	3.448***	4.798***	(dropped)	(dropped)
	(.022)	(.000)	(.001)	(.000)	(.002)	(.000)		
SP	-.450	-.448*	-1.713***	-1.828***	-1.769***	-1.779***	(dropped)	-5.837***
	(.149)	(.092)	(.000)	(.000)	(.000)	(.000)		(.000)
DC	.580***	.473**	.0114		-.065		-1.856	
	(.007)	(.022)	(.950)		(.642)		(.163)	
Hhldpay	.335		.025		.008		-2.270**	
	(.248)		(.923)		(.976)		(.032)	
Month	.606	.549*	1.377***	1.188***	1.448***	1.253***	2.893***	1.776***
	(.108)	(.066)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Nonpara	-.252		-.209		-.220*	-.227*	-.307***	-.315***
	(.300)		(.229)		(.078)	(.068)	(.006)	(.005)
Interview	.080		-.009		.176		1.749**	
	(.778)		(.970)		(.442)		(.049)	
Turtle	-.026		-.117		-.275		-.912**	-.878***
	(.968)		(.811)		(.579)		(.014)	(.002)
Mammal	1.666***	1.838***	1.885***	1.715***	1.715***	1.745***	1.710***	2.185***
	(.007)	(.001)	(.000)	(.000)	(.001)	(.000)	(.002)	(.000)
	0**							
Marine	.888***	.963***	.562**	.532**	.554**	.717***	(dropped)	(dropped)
	(.004)	(.001)	(.035)	(.017)	(.042)	(.001)		
Wetland	-.991**	-.822**	1.258	1.282***	1.218***	1.307***	(dropped)	(dropped)
	(.021)	(.036)	(.003)***	(.001)	(.003)	(.000)		
Nonuse	.057		-.240		-.084		(dropped)	(dropped)
	(.809)		(.269)		(.639)			
Oceania	.755*	.910***	.677 *	.755***	.588	.720***	(dropped)	(dropped)
	(.099)	(.003)	(.095)	(.006)	(.146)	(.006)		
East	-.204		.180		-.105		-3.825	
	(.622)		(.612)		(.776)		(.108)	
Southeast	-.766*	-.758***	-.323		-.841**	-.801***	-3.997*	
	(.063)	(.004)	(.364)		(.028)	(.000)	(.080)	
Eepsea	-.449**		-.561*	-.695***	.188		(dropped)	-.680***
	(.024)		(.070)	(.001)	(.609)			(.010)
Journal	-.318		-.263		-.017		-5.309	
	(.351)		(.387)		(.956)		(.373)	
LnIncome	-.022		.062		.103		.867***	.873***
	(.863)		(.558)		(.260)		(.000)	(.000)
LnYear	.281		.213		.180		.791	
	(.234)		(.270)		(.342)		(.818)	
Summary statistics								
R^2 within	0.124	0.101	0.124	0.109	0.212	0.203	0.227	0.222
R^2:betwen	0.172	0.169	0.550	0.530	0.572	0.564	0.953	0.924
R^2:overall	**0.159**	**0.145**	**0.337**	**0.311**	**0.459**	**0.448**	**0.790**	**0.779**
Sigma_u	.955	.909	.708	.669	.764	.710	.396	.325
Sigma_e	1.083	1.111	.809	.811	.582	.583	.440	.439
Rho	.437	.401	.434	.404	.632	.596	.447	.354
N	550	550	431	431	390	390	124	124
# studies	95	95	70	70	67	67	15	15

Notes: *p < 0.10, **p < 0.05, ***p < 0.01. STATA Version 9.2 used. # Red. models exclude variables with p>0.20.

Enhancing methodological homogeneity in Model 3 increases the explained variation further to 46 percent, the same level as for example found in Brander et al's (2006) MA of international wetland valuation studies. Finally, in Model 4, using the Level 1 dataset, with the more complete range of explanatory variables does not change R^2 much compared to Model 4 in Table 6 (though the signs of the DC and Hhldpay

parameters are not preserved). Despite a higher degree of heterogeneity than for the Level 1 dataset, the data show some degree of regularity, and many of the parameters have the expected signs. Stated preference (SP) methods tend to give lower estimates than revealed preference (RP) methods, as expected. It is also as expected that monthly payments yield higher estimates than other payment vehicles and that non-parametric estimates are lower than parametric ones, like for the Level 1 dataset. The other methodological parameter estimates (i.e. household WTP, personal interview) are not robust across models and there are no strong priors for their signs. The signs and significance of the turtle and mammal parameters are preserved from the Level 1 models. Marine habitats are valued significantly higher than other habitats across Models 1-3, while the wetland parameter is not robust. Estimates with primarily non-use values are only lower in Models 2 and 3 (not significant). Studies conducted in Oceania (mostly Australia) tend to yield significantly higher values (most significant in reduced model versions), after controlling for the higher income level, which may be an indication of "greener" preferences. Studies from Southeast Asia (significant) and East Asia (not significant) give lower values, compared to other regions. Interestingly, studies funded by EEPSEA give lower values than studies funded by other institutions. Published papers seem to yield lower estimates (not significant), a possible indication of the more conservative valuation methods and reported values in the published literature. The income parameter is positive for studies that have reported income information from their samples, but only significantly so in Model 4 for the endangered species data. Year is positive but not significant in any models.

Increasing the degree of homogeneity of our data in terms of good characteristics and methods, then, generally increases the explanatory power of the models, as expected. For the more homogenous Level 1 data, observable characteristics of the type of

species, region and other variables (income, year) add significantly to the explanatory power of the models. Even with the fairly heterogeneous Level 2 dataset, the models are still able to explain a significant part of the variation giving some credibility to pooling valuation estimates drawn from a varied base of studies for MA. Many of the parameter signs (and significance) are preserved when going from Level 1 to Level 2. The explanatory power of our Level 2 models is comparable and our Level 1 models in the high range, compared to other MA studies in environmental economics. For example, the R^2 for our Level 2 Model 3 is only about 10-15 percentage points lower than Van Houtven et al's (2007) MA of water quality valuation studies in the USA. They screened 300 publications related to water quality valuation and found only 11 studies (96 observations) they considered "sufficiently comparable" to include in an MA. Their protocol used for excluding studies is not very transparent. In contrast, we chose to follow the recommendation to "err on the side of inclusion" (Stanley and Jarrel 2005: p137) and exclude studies only by clear criteria. Given the degree of confirmed validity of our data, the next, and directly policy relevant question, is how the MA models will perform forecasting values for unstudied sites, i.e. used for BT. This is the question we turn to in the next section.

A check of the transferability of nature conservation values

MA-BT involves transferring one or more estimated meta-regression equations (2) to an unstudied policy site, and insert values from this site for the geographic, socio-economic, good characteristics variables and relevant year, and predict or forecast annual WTP per household. The values of methodological variables would typically be set at some best practice level, at the average sample value or drawn from the MA sample (Johnston et al. 2006), since there is no such information for an unstudied policy

site. To the extent that observable characteristics of the habitats/good valued and the population, and not only the methodological differences between the studies, explain a significant portion of the variation in WTP, it gives us confidence that MA-BT may be a credible alternative to a new valuation study or other BT techniques as input for example in cost-benefit analysis. The performance of MA-BT can only be accurately assessed if we knew the "true value", or an estimate of this, for a range of sites, and then used the MA models to predict the value at those sites, and calculate so-called transfer errors (TE)[17]. Lindhjem and Navrud (In press) and a few other studies referenced therein, use different "benchmark" values from within their sample or from new studies to "simulate" the true value to assess TE performance. We will not conduct a full such investigation, but only carry out a first check on how our MA models forecast nature conservation values for our two datasets. We use a jacknife data splitting technique, introduced in BT by Loomis (1992) and used in MA e.g. by Santos (1998) and Brander et al (2006), where we estimate n-1 separate meta-regression equations to predict (or forecast) the value of the omitted observation in each case (i.e. "the site" we predict). We then calculate the percentage difference between observed and predicted values, the TE in our simple exercise, and the overall median and mean TE for all observations[18]. This measure gives a first indication of how far off our MA models would be in a real

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[17] $TE = \frac{|WTP_T - WTP_B|}{WTP_B}$, where T = Transferred (predicted) value from study site(s), B = Estimated true value ("benchmark") at policy site.

[18] The mean prediction error is often termed Mean Absolute Percentage Error (MAPE).

BT exercise. We start by reporting the results for the four models using the Level 1 and Level 2 data (Table 8 and 9 below, respectively)[19].

Table 8 Median and mean transfer error (percent) for full and reduced models Level 1: Endangered species

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Full	Reduced	Full	Reduced	Full	Reduced	Full	Reduced
Median	61	69	59	44	33	68	24	25
Mean	108	108	85	77	58	103	46	44
N	124	124	124	124	124	124	123	123

Table 9 Median and mean transfer error (percent) for full and reduced models Level 2: Biodiversity and nature conservation

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Full	Reduced	Full	Reduced	Full	Reduced	Full	Reduced
Median	68	67	52	58	46	46	22	26
Mean	7344	10449	377	279	89	86	45	44
N	547	547	428	428	387	387	121	121

Introducing variables other than study-specific methodological variables in the Level 1 models, reduces median TE from 61 percent (full Model 1) to 24 percent for the best-fitting Model 4 (Table 8). Mean TE for Model 4 is 46 percent. This is fairly low compared to other studies performing this check, e.g. Lindhjem and Navrud (In press) (62-266 percent), and Brander et al (2006; 2007) (74-186 percent), indicating a level of precision that could be acceptable for policy use. Such levels would have to be determined on a case-by-case basis, but a general level of 20-40 percent has been suggested (Kristofersson and Navrud 2007). Precision increases with the more fully

[19] To account for econometric error in transforming ln(WTP) to WTP using antilog, we add standard deviation ($s^2/2$), which estimate varies when the sample changes, prior to transformation of ln(WTP) (see e.g. Johnston et al. 2006). Some of the observations were dropped by STATA performing the TE estimations in Tables 8-9 as compared to Tables 7-8..

specified models. There is no clear relationship between mean and median TE and the reduced vs. full models[20].

For the Level 2 data median TE is comparable to the Level 1 results across all models, but the Level 2 data produce more high TE values (i.e. the mean is much higher than the median) (Table 9). Reducing methodological heterogeneity for the Level 2 data from Model 2 to 3 reduces median TE from around 52 percent to 46, while mean TE comes down from an unacceptably high level of 279-377 percent to a more reasonable 86-89 percent. For both Level 1 and 2 models there is an inverse relationship between the level of explained variation and TE, as expected. Hence, increasing degree of homogeneity of the data in terms of good characteristics (biodiversity and nature conservation in general to endangered species) increases the precision, as does the enhanced homogeneity of valuation methods used within Level 2. However, even with a heterogeneous dataset, TE may approach acceptable levels for policy use. The plot of observed WTP values (estimates sorted in ascending order, lnwtp06) vs. predicted (zig-zag line, wtp_p) for Model 4 (Level 1 data) is illustrated in Figure 1. The forecasts follow the observed values well except at the extremities of the data, a characteristic of forecasting models. For comparison, Model 1 (the whole dataset, 550 observations) for Level 2 is plotted in Figure 2. This plot shows a lower level of precision than for Level 1 in Figure 1 (though the scale is different).

[20] We also ran the same TE simulations using a rule-of-thumb of p>0.1 instead of p>0.2 for the reduced models, detecting no clear(er) relationship with TE.

Figure 1 Plot of predicted ("wtp_p") vs observed WTP ("lnwtp06p"), Model 4 full form (Level 1)

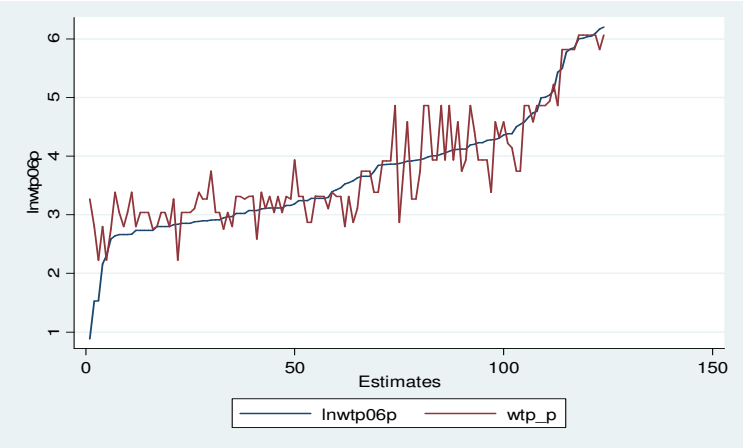
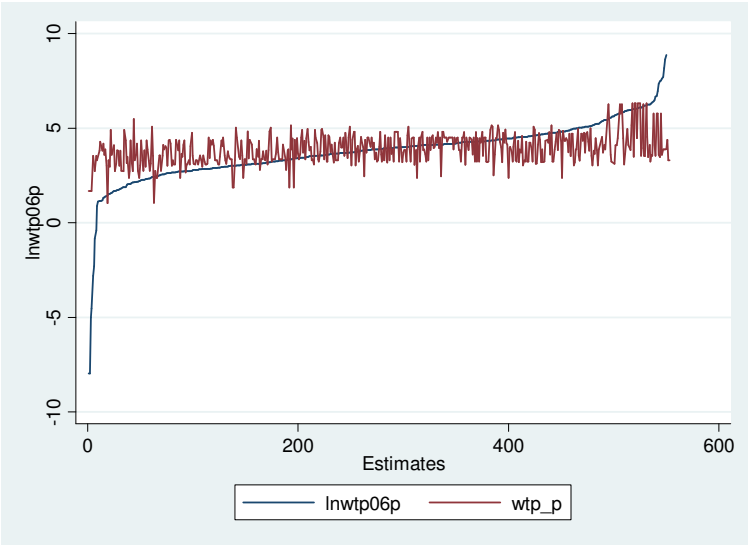


Figure 2 Plot of predicted ("wtp_p") vs observed WTP ("lnwtp06p"), Model 1 full form (Level 2)



We also break down estimated median and mean TE from Tables 8 and 9 for the full models only, for different subsets of the Level 1 and 2 data, i.e. by different characteristics of the good (Levels 1 and 2), valuation methods and geographical region (Level 2). First, TE for the four Level 1 models predicting values for preservation of turtles, mammals and other species, are given in Table 10. Precision increases from Model 1 through to 4 for all species types. WTP for mammal preservation is predicted

with a median (mean) precision of 16 (17), percent, while for other species median TE doubles.

Table 10 Median (mean) transfer error in percent for full models for types of species, Level 1: Endangered species data

	Turtle	**Mammal**	**Other species**
Model 1	45 (169)	50 (120)	67 (75)
Model 2	52 (114)	43 (86)	65 (71)
Model 3	32 (97)	36 (61)	33 (39)
Model 4	24 (69)	16 (17)	32 (43)
# of obs.	**34**	**19/20**	**70**

In Table 11 we split the estimated TE for species and different types of habitats for the Level 2 data. The precision is generally higher for the endangered species (median TE of 36 percent in Model 3 and 22 percent in Model 3). Model 3 predicts WTP for terrestrial and marine habitats with the same median error of 40-46 percent (means around 100 percent), while wetlands and other habitats have higher median errors. The mean TEs, however, show a different pattern (species have lowest TE). To the extent endangered species can be argued to be a more homogenous good than the habitat types specified here, this may be a reason why WTP for their preservation are predicted with less noise. Santos (1998) argues that the prediction errors he obtains in a MA of CV studies of landscape conservation are higher than those estimated in Loomis' (1992) study of rivers within the same US state, due to landscapes being a more heterogeneous good.

Table 11 Median (mean) transfer error for full models for endangered species and types of habitat, Level 2 data

	Terrestrial habitats	**Marine habitats**	**Endangered species**	**Wetlands**	**Other habitats**
Model 1	86 (545)	63 (605)	47 (85)	71 (92838)	77 (184)
Model 2	62 (1134)	44 (105)	36 (60)	77 (116)	78 (79)
Model 3	46 (104)	40 (106)	36 (57)	71 (119)	81 (75)
Model 4	-	-	22 (45)	-	-
# obs.	81- 173	129-162	121-129	31-41	17-37

Enhancing methodological homogeneity from Model 2 to 3 (i.e. removing estimates using market price or hedonic methods) reduces TE especially for terrestrial habitats, while TE for the other habitats are around the same level. This is an indication that other valuation methods introduce substantial noise for terrestrial habitat valuation in the MA. In Table 12 we break down TE by valuation methods used. WTP estimates derived by CV has a median (mean) TE of 41 (71) percent in the most homogenous Model 3. CM has lower median TE than this, but double mean TE. Estimates derived by TCM or other valuation methods generally have higher TE than stated preference methods.

Table 12 Median (mean) transfer error for full models for different valuation methods, Level 2 data

	CV	**CM**	**TCM**	**Others**
Model 1	64 (157)	70 (159)	73 (104785)	93 (1776)
Model 2	41 (81)	78 (167)	101 (141)	84 (3882)
Model 3	41 (71)	26 (149)	105 (145)	-
Model 4	22 (45)	-	-	-
# of obs.	121-423	50	17-37	37

Finally, breaking the TE estimates down by region shows that using the model to predict values in Southeast Asia produces the lowest TE, which is partly due to the larger number of estimates from this region. Except for some very high TE estimates pulling up the mean, median TE for transfers to all regions is below 80 percent and approaching acceptable levels for policy use.

Table 12 Median (mean) transfer error for full models for different valuation methods, Level 2 data

	Southeast Asia	**Oceania**	**East Asia**	**South Asia**	**Southwest Asia**
Model 1	59 (16000)	80 (209)	66 (163)	80 (1605)	45 (76)
Model 2	42 (102)	61 (81)	68 (304)	67 (3184)	44 (43)
Model 3	37 (90)	59 (76)	68 (110)	21 (27)	36 (36)
Model 4	23 (44)	31 (50)	28 (57)	15 (17)	-
# of obs.	69-244	16-116	26-99	10-41	12-21

Concluding remarks

Pushing the boundaries of meta-analysis (MA) in environmental economics, we have taken stock of studies estimating willingness to pay for conservation of endangered species, biodiversity and nature more generally in Asia and Oceania. Our literature review shows that nature conservation is highly valued, probably more so in many cases than the opportunity costs of increasing conservation efforts in the region, though such a comparison is beyond the scope of our study. Dividing our dataset into two levels of heterogeneity in terms of good characteristics and valuation methods, we show that the degree of regularity and conformity with theory and empirical expectations as well as the explanatory power of our MA models is higher for the more homogenous dataset of endangered species values, as expected. In fact, though the species are different, the values to preserve them generally follow predictable patterns. For example, we find that mammals are generally valued higher than other species, likely due to the "charismatic" nature of this family. Further, WTP increases significantly with income (elasticity equals 0.85). The analysis of the endangered species data show that around half of the variation in the best model is due to non-study specific observable characteristics of the good and population surveyed, boding well for use of such data in benefit transfer (BT) applications.

However, importantly, increasing the scope of the MA, i.e. gradually including more heterogeneous observations, generally preserves much of the regularity and the explanatory power of some of our models is in the range of other MA studies of goods typically assumed to be more homogenous (such as national water quality, recreation days, etc). Judging whether the relatively low variation of value estimates across types of goods and regions can be interpreted as a sign of invalid values (WTP for example an expression of "moral dump" or "purchase of moral satisfaction" (Kahneman and Knetsch 1992)), or that total values may have a large share of non-use values expected

to stay more constant across social groups and environmental domains (e.g. as hypothesised in Kristofersson and Navrud (2007) and Brouwer (2000)), is an unsettled issue and beyond the scope of this study. In any case, it is generally easier to detect sensitivity of WTP to the scope of a good within individual studies than across a range of studies in a MA. However, even within single studies, it is hard to define and communicate the important dimensions of scope of complex goods such as endangered species or biodiversity to the respondent (see e.g. discussion in Carson and Hanemann (2005: p912-914) and Lindhjem (2007), and Loomis (2006) for use of such welfare estimates in cost-benefit analysis).

Subjecting both our dataset levels to a simple check of level of transfer error (TE), using the MA models to predict observations one-by-one when excluded from the datasets, show median (mean) TE of 24 (46) percent for the endangered species data and 46 (89) percent for the more heterogeneous nature and biodiversity data. This is in the low range compared to other MA studies. Results suggest that such levels of forecasting errors may approach acceptable levels for policy use. However, caution should be exercised in using values for single species for benefit transfer, as such estimates may include values of biodiversity or habitats more generally (see e.g. Veisten et al. (2004)).

The common practice in MA to exclude a large amount of valuation studies and estimates based on subjective, often arbitrary and not very transparent criteria of "acceptable level of heterogeneity", is in any case not to be recommended (Stanley and Jarrel 2005), but our results show that the loss of explanatory and predictive power of MA models from accepting a higher level of heterogeneity may be lower than expected. The more prudent approach we follow is first to include all value estimates in a gross dataset, and increase the degree of homogeneity by varying model specifications and

data subsets to investigate sensitivity. While it is appealing to include studies of exactly the same good (if such a good exists outside the textbook) using the same valuation methods, the strength of MA is that such differences to some extent can be controlled for in a transparent way in the regression analysis. This study is, to our knowledge, one of the first attempts to systematically investigate the issue of heterogeneity in MA for environmental valuation. More research for other goods and geographical areas is needed to inform the development of a more consistent and generally applicable MA methodology, especially as MA is gradually being applied for BT to inform policy. Use of MA in economics is growing and the aim should be to move more of the methodological choices out of the black box.

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Appendix

Table A Studies of endangered species used in meta-analysis (MA)

Name of references	Country	Year[a]	Species	Method	Mode	Vehicle[b]	Payment format	# of values[c]	WTP (USD)[d]
Jakobsson and Dragun (2001)	Australia	2000	Possum	CV: DC, PC	Mail	M	Year	12	14-72
Tisdell et al. (2005)	Australia	2002	Glider	CV: OE	Mail	V	One-off	3	13-19
Kontoleon and Swanson (2003)	China	1998	Panda	CV: DC	Interview	M&V	Visit	3	5-17
Jianjun et al.(2006)[e]	China	2005	Turtles	CV: PL	Drop-off	M	Month	5	5-6
Jianjun (2006)	China	2005	Spoonbill	CV: DC	Drop-off	M&V	Month	17	4-19
Jianjun et al. (2006)[e]	Philippines	2005	Turtles	CV: DC	Drop-off	M&V	Month	5	1-3
Harder et al. (2006)	Philippines	2005	Eagles	CV: DC	Drop-off	M&V	Month	30	1-3
Indab (2006)	Philippines	2005	Shark	CV: DC	Drop-off	M	Month	5	2-4
Bandara and Tisdell (2004)	Sri Lanka	2002	Elephants	CV: DC	Drop-off	V	Month	4	20-40
Bandara and Tisdell (2005)	Sri Lanka	2001	Elephants[f]	CV: DC	Interview	V	Month	6	34-41
Jianjun et al. (2006)[e]	Thailand	2005	Turtles	CV: DC	Drop-off	M&V	Month	5	3-8
Nabangchang (2006)	Thailand	2005	Multiple[g]	CV: DC	Interview	M&V	One-off	7	43-64
Jianjun et al. (2006)[e]	Vietnam	2005	Turtles	CV: DC	Drop-off	M	Month	4	0.2-4
Thuy (2006)	Vietnam	2005	Rhino	CV: DC	Drop-off	M&V	Month	2	13-14
Tuan et al. (2008)	Cn,Pp,Th,Vn[h]	2005	Turtles	CV: DC	Drop-off	M&V	Month	16	1-5
Ninan and Sathyapalan (2005)*	India	2000	Elephants	CV:DC	Interview	M	Year	5	341-1830
Total number of studies=16								**129**	

Notes: *4 of 5 observations from this study were excluded by the screening criterion (2x STD of mean) for the Level 1 data, but included in the Level 2 dataset (see Table B)

[a] Year of data.

[b] Payment vehicle: mandatory (M) or voluntary (V).

[c] Number of WTP values used in MA.

[d] WTP values in US$. The WTP formats are given as reported (i.e. lump sum, per month, per year, per visit, per individual or household). WTP values in local currencies are converted to US$ using PPP adjustments; and values from different years are converted to 2006 prices using CPI.

[e] Jianjun et al. (2006) has four separate country case study components.

[f] Abundance of elephants.

[g] Multiple species: Dugong dugong, elephants, rhinos, Irawaddy dolphin, tigers.

Table B Studies of nature and biodiversity conservation used in meta-analysis (MA)

Name of references	Country	Year[a]	Habitat/service type	Method	Mode	Vehicle	Payment format	# of values	WTP (USD)
Jakobsson and Dragun (2001)	Australia	2000	Flora & fauna	CV: DC, PC	Mail	M	year	7	24-175
Bennett et al. (1998)	Australia	1996	Wetlands	CV: DC	Mail	M	One-time	2	122-187
Bennett (1984)	Australia	1979	Nature reserve	CV: OE	Interview	M&V	One-time	1	33
Blamey et al. (1999)	Australia	1999	Water	CA	Interview	M	Year	4	29-116
Cameron and Quiggin (1994)	Australia	1991	Parks	CV: IB	Interview	M		4	228-664
Carr and Mendelsohn (2003)	Australia	2000	Reefs	TCM	Interview		Year	1	391
Carson et al. (1994)	Australia	1990	parks	CV: DBDC	Interview	M	Year	4	30-129
Hundloe (1990)	Australia	1986	Reefs	TCM	Interview		Year	1	8
Kuosmanen et al. (2003)	Australia		Parks	TCM	Mail		Year	6	54-418
Lockwood and Carberry (1998)	Australia	1997	Vegetation	CM, CV	Mail	M	One-time	8	35-90
Lockwood and Tracy (1995)	Australia	1993	Parks	CV: OE	Mail	V	One-time	1	21
Lockwood (1999)	Australia	1995	Parks	CV: OE	Computer	V		4	14-450
Lockwood (1996)	Australia		Natural environm.	CV: DC	Mail	V		9	5-123
Loomis et al. (1993)	Australia		Forests	CV: OE, DC	Mail		Year	6	34-89
Morrison et al. (2002)	Australia	1997	Wetlands	CM	Mail	M	One-time	18	25-117
Nillesen et al. (2005)	Australia		Parks	TCM	Mail		Year	1	86
Streever et al. (1998)	Australia	1996	Wetlands	CV: OE	Mail	M		1	151
Greiner and Rolfe (2004)	Australia	2000	Parks	CV: OE	Interview	M	Visit	3	23-39
Campbell and Reid (2000)	Australia	1996	Fisheries	CV: DC	Interview	M	Year	3	212-517
Flatley and Bennett (1995)	Vanuatu	1994	Forest	CV	Interview	V	One-time	2	33-36
Flatley and Bennett (1996)	Vanuatu	1994	Forest	CV	Interview	V	One-time	1	18
Chen et al. (In press)	China	1999	Beaches	TCM	Interview	M	Visit	1	64
Day and Mourato (2002)	China	1997	Rivers	CV: DBDC	Interview	M		4	51-94
Gong (2004)	China	2002	National reserve	CV: BG	Interview	M		2	5-16
Guo et al. (2001)	China	1997	Ecosystem services	TCM	Interview		Visit	3	20-40
Jim and Chen (2006)	China	2003	Urban green spaces	CV: PC	Interview			1	15
Yaping (1998)	China	1996	Lakes	CV:OE& TCM	Interview	M	Visit Year	7	77-114 6-15
Zhongmin et al. (2003)	China	2001	Ecosystem services	CV: PC	Interview	M&V	Year	3	8-87
Zhongmin et al. (2006)	China	2003	Watershed	CV:DC, DBDC	Interview	M&V	Year	2	71
Wang et al. (2007)	China	2006	Water	CV:DC	Interview	M	Month	2	
Xu et al. (2007)	China	2002	Eco-services	CM	Interview	M	Year	7	51-134
Gundimeda and Kathuria (2003)	India	2003	Water	HPM	Interview			2	149-377

Hadker et al.(1997)	India	1995	Parks	CV: DC	Interview	V	Month	2	6-8
Kohlin (2001)	India	1995	Woodlots	CV: DC, OE	Interview		Month	11	4-6
Maharana et al. (2000)	India	1998	Lakes	CV: IB & TCM	Interview		Year	4	5-43
Nallathiga (2004)	India	1995	Rivers	CV: PC	Interview	M	Year	2	22-25
Butry and Pattanayak (2001)	Indonesia	1996	Forests	CV:OE, PC & MP	Interview	M	Year	3	23-2006
Pattanayak (2001)	Indonesia	1996	Ecological services	CV: DC	Interview	M	Year	1	20
Pattanayak and Kramer (2001)	Indonesia	1996	Watershed	CV: DC	Interview	M	Year	10	7-21
Walpole et al. (2001)	Indonesia	1995	Parks	CV: DBDC	Interview	M	Year	1	78
Amirnejad et al.(2006)	Iran	2004	Forests	CV: DC	Interview	M	Month	1	9
Fleischer and Tsur (2000)	Israel	1997	Landscapes	TCM	Interview		Year	2	179-367
Shechter et al. (1998)	Israel	1993	Parks	CV: OE, DC	Telephone	V	One-time	12	28-57
Tsgue and Washida (2003)	Japan	1998	Natural areas of the Sea.	CV: DC	Internet		One-time	6	132-159
Nishizawa et al. (2007)	Japan	2003	Eco-services	CVM:DC	Mail	M		2	13-14
Kwak et al. (2003)	Korea	2001	Forests	CV: DC	Interview	M	Year	4	3-6
Lee (1997)	Korea	1996	Nature-based tourism resources	CV: DC	Interview	M	Year	2	12-13
Lee and Han (2002)	Korea	1999	Parks	CV: DC	Interview	M	Year	10	8-23
Lee and Mjelde (2007)	Korea	2005	Eco-services	CV:DC	Interview	M	Year	2	22-26
Eom and Larson (2006)	Korea	2000	Water	CV	Interview	M	Year	2	35-62
Lee and Chun (1999)	Korea	1994	Forest recreation	CV:DC	Mail	V	Year	3	445-787
Othman et al.(2004)	Malaysia	1999	Forests	CM	Interview		Year	5	0.5-8
Yeo (2002)	Malaysia	1998	Parks	CV: OE	Interview		Year	6	6-12
Mourato (2002)	Malaysia	1997	Water	CV: PL	Interview	M	Month	2	3
Naylor and Drew (1998)	Micronesia	1996	Mangroves	CV	Interview	M	Month	4	174-556
Khan (2004)	Pakistan	2003	Parks	TCM	Interview		Visit	2	13-18
Manoka (2001)	P.N.Guinea	1999	Forests	CV: OE, DC	Mail	V	Year	10	11-101
Arin and Kramer (2002)	Philippines	1997	Marine sanctuary	CV: PC	Interview	M	Year	3	21-34
Calderon et al. (2005)	Philippines	2003	Watersheds	CV: DC	Interview	M	Month	36	2-6
Choe et al. (1996)	Philippines	1992	Water	CV: DC, BG, OE	Interview		Month	18	0-13
Pattanayak and Mercer (1998)	Phillippines	1994	Soil	MP	Interview		Year	2	195-306
Subade (2005)	Philippines	2002	Reefs	CV: DC	Interview & drop-off	V	Year	12	15-83
Amponin et al. (2007)	Philippines	2006	Watershed	CV:DC	Interview	M	month	9	3-6
Wei-Shiuen and Robert (2005)	Singapore	2002	Beaches	TCM & CV	Interview		Year	14	0.1-485
Bogahawatte (1999)	Sri Lanka	1997	Forests	MP	Interview	Year	Year	30	1-437

Ekanayake and Abeygunawardena (1994)	Sri Lanka	1992	Forests	CV: OE	Interview		Year	2	41-131
Chang and Ying (2005)	Taiwan	2001	Agri. lands	CV: DBDC	Telephone	M	Year	1	103
Chen (1998)	Taiwan		Agri. lands	CV:OE, DC	Mail		Month	6	0.3-7
Hammit et al (2001)	Taiwan	1993	Wetlands	CV: DC, OE	Interview	V	Year	4	46-173
Cushman (2004)	Thailand	2001	Beaches	CM	Interview	M	Year	5	17-526
Isangkura (1998)	Thailand	1996	Parks	CR & CV: OE	Interview	M	Year	9	2-28
Seenprachawong (2002)	Thailand	2002	Coastal ecosystem	CM	Interview	V	Year	5	9-188
Seenprachawong (2001)	Thailand	2000	Reefs	CV:DC &TCM	Interview	V	Year	3	31-555
Tapvong and Kruavan (1999)	Thailand	1998	Rivers	CV: DC	Interview	M	Month	2	9-10
Pham and Tran (2000)	Vietnam	2000	Reefs	CV:PC & TCM	Interview	M	Year	5	7-170
Pham et al. (2000)	Vietnam	2003	Reefs	TCM CV	Interview	M	Year	4	17-390
Phuong and Gopalakrishnan (2004)	Vietnam	2001	Water	CV: PC	Interview	M	Year	7	4-40
Do (2007)	Vietnam	2006	Wetlands	CM	Interview		Year	2	4-12
Nam et al. (2001)	Vietnam	1999	Forests	CV & MP	Interview	M	Year	9	24-1807
Total number of observations*								**421**	

Notes: * The total number of observations using the least strict screening criterion (WTP>0 and within 2x STD of the mean), i.e. 129 (Level 1) + 429 (Level 2) = 550 observations. Blank space means that information was not reported in the study. See also notes to Table A above.

References

Adhikari, B., W. Haider, O. Gurung, M. Poudyal, B. Beardmore, D. Knowler and P. Van Beukering (2005), 'Economic incentives and poaching of the one-horned Indian rhinoceros in Nepal: Stakeholder Analysis', *PREM Working paper*.

Amirnejad, H., S. Khalilian, M. H. Assareh and M. Ahmadian (2006), 'Estimating the existence value of north forests of Iran by using a contingent valuation method', *Ecological Economics* **58**(4): 665-675.

Amponin, J. A. R., M. E. C. Bennagen, S. Hess and J. D. S. d. Cruz (2007), 'Willingness to pay for watershed protection by domestic water users in Tuguegarao City, Philippines', *PREM 07/06 Working paper*.

Arin, T. and R. A. Kramer (2002), 'Divers' willingness to pay to visit marine sanctuaries: an exploratory study', *Ocean Coastal Manage.* **45**(2-3): 171-183.

Bandara, D. and C. Tisdell (2004), 'The net benefit of saving the Asian elephant: a policy and contingent valuation study', *Ecological Economics* **48**: 93- 107.

Bandara, R. and C. Tisdell (2005), 'Changing Abundance of Elephants and Willingness to Pay for their Conservation', *Journal of Environmental Management* **76**: 47-59.

Bateman, I. J. and A. P. Jones (2003), 'Contrasting conventional with multi-level modeling approaches to meta-analysis: Expectation consistency in UK woodland recreation values', *Land Economics* **79**(2): 235-258.

Bennett, J., M. Morrison and R. Blamey (1998), 'Testing the validity of responses to contingent valuation questioning', *Australian Journal of Agricultural and Resource Economics* **42**(2): 131-148.

Bennett, J. W. (1984), 'Using Direct Questioning to Value the Existence Benefits of Preserved Natural Areas ', *Australian Journal of Agricultural Economics* **28**(2/3): 136-152.

Bergstrom, J. C. and L. O. Taylor (2006), 'Using meta-analysis for benefits transfer: Theory and practice', *Ecological Economics* **60**: 351-360.

Blamey, R., J. Gordon and R. Chapman (1999), 'Choice Modelling: Assessing the Environmental Values of Water Supply Options', *Australian Journal of Agricultural and Resource Economics* **43**(3): 337 - 357.

Bogahawatte, C. (1999). *Forestry Policy, Non-timber Forest Products and the Rural Economy in the Wet Zone Forests in Sri Lanka*. Research report, EPPSEA,

Boyle, K. J. (2003), 'Contingent valuation in practice', in P. A. Champ, K. J. Boyle and T. C. Brown, eds, *A primer on nonmarket valuation.* Kluwer Academic Publishers.

Brander, L. M., R. J. G. M. Florax and J. E. Verrmaat (2006), 'The Empirics of Wetland Valuation: A Comprehensive Summary and a Meta-Analysis of the Literature', *Environmental & Resource economics* **33**: 223-250.

Brander, L. M., P. van Beukering and H. Cesar (2007), 'The recreational value of coral reefs: a meta-analysis', *Ecological Economics* **63**(1): 209-218.

Brouwer, R. (2000), 'Environmental value transfer: state of the art and future prospects', *Ecol. Econ.* **32**(1): 137-152.

Butry, D. T. and S. K. Pattanayak (2001). *Economic Impacts of Tropical Forest Conservation: The Case of Logger Households around Ruteng Park*, Environment and Natural Resource Economics Program, Research Triangle Institute, North Carolina

Calderon, M. M., L. D. Camacho, M. G. Carandang, J. T. Dizon, L. L. Rebugio and N. L. Tolentino (2005). *A Water User Fee For Households in Metro Manila, Philippines*. EEPSEA research report, No. 2005-RR2,

Cameron, T. A. and J. Quiggin (1994), 'Estimation Using Contingent Valuation Data From A Dichotomous Choice With Follow-Up Questionnaire', *J.Environ.Econ.Manage.* **27**(3): 218-234.

Campbell, H. P. and C. R. M. Reid (2000), 'Consumption Externalities in a Commercial Fishery: The Queensland Beam Trawl Fishery', *Economic Record* **76**(232): 1-14.

Carr, L. and R. Mendelsohn (2003), 'Valuing Coral Reefs: A Travel Cost Analysis of the Great Barrier Reef', *Ambio* **32**(5): 353-357.

Carson, R. T., N. E. Flores, K. M. Martin and J. L. Wright (1996), 'Contingent valuation and revealed preference methodologies: Comparing the estimates for quasi-public goods', *Land Economics* **72**(1): 80-99.

Carson, R. T. and M. Hanemann (2005), 'Contingent valuation', in K.-G. Mäler and J. R. Vincent, eds, *Handbook of Environmental Economics, Volume 2*. Elsevier.

Carson, R. T., L. Wilks and D. Imber (1994), 'Valuing The Preservation Of Australia Kakadu Conservation Zone', *Oxf. Econ. Pap.-New Ser.* **46**: 727-749.

Chang, K. and Y. Ying (2005), 'External Benefits of Preserving Agricultural Land: Taiwan's Rice Fields', *The Social Science Journal* **42**: 285-293.

Chen, W., H. Hong, Y. Liu, L. Zhang, X. Hou and M. Raymond (In press), 'Recreation Demand and Economic Value: An Application of Travel Cost Method for Xiamen Island', *China Economic Review*.

Chen, Y. (1998). *Biodiversity in the Framework of Ecological Economics*. Ph.D., University of Wisconsin Milwaukee**:**

Choe, K. A., D. Whittington and D. T. Lauria (1996), 'The economic benefits of surface water quality improvements in developing countries: A case study of Davao, Philippines', *Land Econ.* **72**(4): 519-537.

Cushman, C. (2004). *External costs from increased island visitation: case study from Southern Thailand*, Department of Resource Economics, University of Massachusetts

Day, B. and S. Mourato (2002), 'Valuing River Water Quality in China ', in D. Pearce, C. Pearce and C. Palmer, eds, *Valuing the Environment in Developing Countries: Case Studies.* Edward Elgar.

Desvousges, W. H., F. R. Johnson and H. S. Banzhaf (1998), *Environmental policy analysis with limited information: Principles and applications of the transfer method.* Cheltenham, UK: Edward Elgar.

Do, N. T. (2007). *Impacts of dykes on wetland values in Vietnam's mekong river delta: a case study in the plain of reeds*. Research report submitted to EEPSEA, IDRC,

Ekanayake, E. R. M. and P. Abeygunawardena (1994), 'Valuation of Conservation Commodity of the Sinharaja Forest: Towards Total Economic Value', *Sri Lanka Journal of Agricultural Economics* **2**(1): 115-129.

Engel, S. (2002), 'Benefit Function Transfer versus Meta-analysis as Policy-Making Tools: A Comparison', in R. J. G. M. Florax, P. Nijkamp and K. G. Willis, eds, *Comparative environmental economic assessment.* Cheltenham, U.K. and Northampton, Mass.: Edward Elgar, pp. 133-53.

Eom, Y.-S. and D. M. Larson (2006), 'Valuing housework time from willingness to spend time and money for environmental quality improvements', *Review of the Economics of the Household* **4**: 205-227.

Flatley, G. and J. Bennet (1995). *International Values of Tropical Forest Conservation: A Cross-cultural Contingent Valuation Experiment*. Perth, Western Australia,

Flatley, G. W. and J. W. Bennet (1996), 'Using Contingent Valuation to Determine Australian Tourists' Values for Forest Conservation in Vanuatu', *Economic Analysis and Policy* **26**(2): 111-127.

Fleischer, A. and Y. Tsur (2000), 'Measuring the recreational value of agricultural landscape', *Eur Rev Agric Econ* **27**(3): 385-398.

Fromm, O. (2000), 'Ecological structure and functions of biodiversity as elements of its total economic value', *Environmental and Resource Economics* **16**(3): 303-328.

Glass, G. V., B. McGaw and M. L. Smith (1981), *Meta-analysis in Social Research.* Beverly Hills: Sage.

Gong, Y. (2004). *Distribution of Benefits and Costs among Stakeholders of a Protected Area: An Empirical Study from China*. EEPSEA Research Report 3, IDRC

Greiner, R. and J. Rolfe (2004), 'Estimating consumer surplus and elasticity of demand of tourist visitation to a region in North Queensland using contingent valuation', *Tourism Economics* **10**(3): 317-328.

Gundimeda, H. and V. Kathuria (2003), 'Estimation of Economic Value of Water scarcity and quality in Chennai, India: The Hedonic Approach', *South Asian Network of Economic Initiatives Project*.

Guo, Z., X. Xiao, Y. Gan and Y. Zheng (2001), 'Ecosystem functions, services and their values - a case study in Xingshan County of China', *Ecological Economics* **38**(1): 141-154.

Hadker, N., S. Sharma, A. David and T. R. Muraleedharan (1997), 'Willingness-to-pay for Borivli National Park: Evidence from a contingent valuation', *Ecol. Econ.* **21**(2): 105-122.

Hammit, J. K., J.-T. Liu and J.-L. Liu (2001), 'Contingent Valuation of a Taiwanese Wetland', *Environment and Development Economics* **6**: 259-268.

Harder, D. S., R. Labao and F. I. Santos (2006). *Saving the Philippine eagles: How much will this cost and are Filipinos willing to pay for it?* Singapore

Hoehn, J. P. (2006), 'Methods to address selection effects in the meta regression and transfer of ecosystem values', *Ecological Economics* **60**(2): 389-398.

Hundloe, T. (1990), 'Measuring the Value of the Great Barrier Reef', *Australian Parks and Recreation* **26**(3): 11-15.

Indab, A. (2006). *Rationalizing WTP for whale shark conservation in Sorsogon province*. Cebu, the Philippines

Isangkura, A. (1998). *Environmental Valuation: An Entrance Fee System for National Parks in Thailand*. Economy and Environment Program for Southeast Asia, IDRC

Jacobsen, J. B., J. H. Boiesen, B. J. Thorsen and N. Strange (2007), 'What's in a name? The use of quantitative measures versus 'Iconised' species when valuing biodiversity', *Environmental & Resource Economics* **39**(3): 247-263.

Jacobsen, J. B. and N. Hanley (2007). *Are there income effects on global willingness to pay for biodiversity conservation?* Working Paper.

Jakobsson, K. M. and A. K. Dragun (2001), 'The Worth of a Possum: Valuing Species with the Contingent Valuation Method', *Environmental and Resource Economics* **21**: 287-302.

Jianjun, J. (2006). *Economic valuation of the Black-faced Spoonbill conservation in Macao*. Singapore

Jianjun, J., A. Indab, O. Nabangchang, T. D. Thuy, D. Harder and R. Subade (2006). *WTP for Marine Turtle Conservation: A Cross-country Comparison in Asia*

Jim, C. Y. and W. Y. Chen (2006), 'Recreation - Amenity Use and Contingent Valuation of Urban Greenspaces in Guangzhou, China', *Landscape and Urban Planning* **75**(1-2): 81-96.

Johnston, R. J., E. Y. Besedin, R. Iovanna, C. J. Miller, R. F. Wardwell and M. H. Ranson (2005), 'Systematic variation in willingness to pay for aquatic resource improvements and implications for benefit transfer: a meta-analysis', *Canadian Journal of Agricultural Economics* **53**(2-3): 221-248.

Johnston, R. J., E. Y. Besedin and M. H. Ranson (2006), 'Characterizing the effects of valuation methodology in function-based benefits transfer', *Ecological Economics* **60**(2): 407-419.

Kahneman, D. and J. L. Knetsch (1992), 'Valuing Public-Goods - The Purchase Of Moral Satisfaction', *Journal of Environmental Economics and Management* **22**(1): 57-70.

Khan, H. (2004). *Demand of eco-tourism: estimating recreational benefits from the Margalla Hills national park in the northern Pakistan,*

Kohlin, G. (2001), 'Contingent valuation in project planning and evaluation: the case of social forestry in Orissa, India', *Environment and Development Economics* **6**(02): 237-258.

Kontoleon, A. and T. Swanson (2003), 'The Willingness to Pay for Property Rights for the Giant Panda: Can a Charismatic Species Be an Instrument for Nature Conservation?' *Land Economics* **79**(4): 483-499.

Kristofersson, D. and S. Navrud (2007), 'Can Use and Non-Use Values be Transferred Across Countries?' in S. Navrud and R. Ready, eds, *Environmental Value Transfer: Issues and Methods.* Kluwer Academic Publishers.

Kriström, B. and P. Riera (1996), 'Is the income elasticity of environmental improvements less than one?' *Environmental and Resource Economics* **7**: 45-55.

Kuosmanen, T., E. Nillesen and J. Wesseler (2003). *Does Ignoring Multi-Destination Trips in the Travel Cost Method Cause a Systematic Downward Bias?*

Kwak, S. J., S. H. Yoo and S. Y. Han (2003), 'Estimating the public's value for urban forest in the Seoul metropolitan area of Korea: A contingent valuation study', *Urban Studies* **40**(11): 2207-2221.

Lee, C.-K. and S.-Y. Han (2002), 'Estimating the Use and Preservation Values of National Parks' Tourism Resources Using a Contingent Valuation Method', *Tourism Management* **23**: 531-540.

Lee, C.-K. and J. W. Mjelde (2007), 'Valuation of ecotourism resources using a contingent valuation method: The case of the Korean DMZ', *Ecological Economics* **63**: 511-520.

Lee, C. K. (1997), 'Valuation of nature-based tourism resources using dichotomous choice contingent valuation method', *Tourism Management* **18**(8): 587-591.

Lee, H.-C. and H.-S. Chun (1999), 'Valuing environmental quality change on recreational hunting in Korea: A contingent valuation analysis', *Journal of Environmental Management* **57**(1): 11-20.

Lindhjem, H. (2007), '20 Years of stated preference valuation of non-timber benefits from Fennoscandian forests: A meta-analysis', *Journal of Forest Economics* **12(4)**: 251-277.

Lindhjem H and Navrud S (2008a) Asking for Individual or Household Willingness to Pay for Environmental Goods: Implication for aggregate welfare measures. Forthcoming in *Environmental and Resource Economics*.

Lindhjem H and Navrud S (2008b) Internet CV surveys - a cheap, fast way to get large samples of biased values?, Department of Economics and Resource Management, Norwegian University of Life Sciences

Lindhjem, H. and S. Navrud (2008c), 'How Reliable are Meta-Analyses for International Benefit Transfer?' *Ecological Economics* **66(2-3)**: 425-435.

Lockwood, M. (1996), 'Non-compensatory preference structures in non-market valuation of natural area policy', *Aust. J. Agric. Econ.* **40**(2): 85-101.

Lockwood, M. (1999), 'Preference structures, property rights, and paired comparisons', *Environmental and Resource Economics* **13**(1): 107-122.

Lockwood, M. and D. Carberry (1998). *Stated Preference Surveys of Remnant Native Vegetation Conservation*, Johnstone Centre, Albury, NSW

Lockwood, M. and K. Tracy (1995), 'Nonmarket Economic Valuation Of An Urban Recreation Park', *Journal of Leisure Research* **27**(2): 155-167.

Loomis, J. (2006), 'Use of contingent values of wildlife and habitat preservation in policy and cost-benefit analysis', in A. Alberini and J. R. Kahn, eds, *Handbook on contingent valuation.* Edward Elgar.

Loomis, J., M. Lockwood and T. Delacy (1993), 'Some Empirical-Evidence On Embedding Effects In Contingent Valuation Of Forest Protection', *Journal of Environmental Economics and Management* **25**(1): 45-55.

Loomis, J. B. (1992), 'The Evolution Of A More Rigorous Approach To Benefit Transfer - Benefit Function Transfer', *Water Resources Research* **28**(3): 701-705.

Loomis, J. B. and D. S. White (1996), 'Economic benefits of rare and endangered species: Summary and meta-analysis', *Ecological Economics* **18**(3): 197-206.

Maharana, I., S. C. Rai and E. Sharma (2000), 'Valuing ecotourism in a sacred lake of the Sikkim Himalaya, India', *Environmental Conservation* **27**(3): 269-277.

Manoka, B. (2001). *Existence Value: A Re-appraisal and Cross-Cultural Comparison*. Economy and Environment Program for Southeast Asia (EEPSEA) Research Report No. 2001-RR1, IDRC,

Millennium Ecosystem Assessment (2005), *Synthesis Report.* Washington DC: Island Press.

Moeltner, K., K. Boyle and R. W. Paterson (2007), 'Meta-analysis and benefit transfer for resource valuation - addressing classical challenges with Bayesian modeling', *Journal of Environmental Economics and Management* **53**: 250-269.

Moeltner, K. and R. Rosenberger (2008). *Meta-Regression and Benefit Transfer: Data Space, Model Space, and the Quest for 'Optimal Scope'*

Morrison, M., J. Bennett, R. Blamey and J. Louviere (2002), 'Choice modeling and tests of benefit transfer', *Am. J. Agr. Econ.* **84**(1): 161-170.

Mourato, S. (2002), 'Valuing Improvements to Sanitation in Malaysia', in D. Pearce, C. Pearce and C. Palmer, eds, *Valuing the Environment in Developing Countries: Case Studies.* Cheltenham: Edward Elgar, pp. 67 - 113.

Nabangchang, O. (2006). *Motivations for Charitable Behavior for Protection of Wildlife and Endangered Species of Thailand*.

Nallathiga, R. and R. B. Paravastu (2004). *Benefit Estimation of River Water Quality Conservation Using Contingent Valuation Survey: a Case-Study in the Yamuna River Sub-basin*. Budapest, Hungary

Nam, M. V., N. T. Nhan, B. V. Trihn and P. L. Thong (2001). *Forest Management Systems in the Mekong River Delta, Vietnam*. EEPSEA research report,

Navrud, S. and R. Ready, Eds. (2007), *Environmental Value Transfer: Issues and Methods,* Dordrecht: Kluwer Academic Publishers.

Naylor, R. and M. Drew (1998), 'Policy Options: Valuing mangrove resources in Kosrae, Micronesia', *Environment and Development Economics* **3**: 471-490.

Nillesen, E., J. Wesseler and A. Cook (2005), 'Estimating the Recreation-Use Value for Hiking in Bellenden Ker National Park, Australia', *Environmental Management* **36**(2): 311-316.

Ninan, K. N. and J. Sathyapalan (2005), 'The economics of biodiversity conservation: a study of a coffee growing region in the Western Ghats of India', *Ecological Economics* **55**(1): 61-72.

Nishizawa, E., T. Kurokawa and M. Yabe (2007), 'Policies and resident's willingness to pay for restoring the ecosystem damaged by alien fish in Lake Biwa, Japan', *Environmental Science & Policy* **9**: 448-456.

Othman, J., J. Bennet and R. Blamey (2004), 'Environmental values and resource management options: a choice modelling experience in Malaysia', *Environment and Development Economics* **9**: 803–824.

Pattanayak, S. K. (2001). *How Green Are These Valleys? Combining Revealed and Stated Preference Methods to Account for Ecosystem Costs of Deforestation*, Environment and Natural Resource Economics Program, Research Triangle Institute

Pattanayak, S. K. and R. A. Kramer (2001), 'Pricing ecological services: Willingness to pay for draught mitigation from watershed protection in eastern Indonesia', *Water Resour. Res.* **37**(3): 771-778.

Pattanayak, S. K. and D. E. Mercer (1998), 'Valuing soil conservation benefits of agroforestry: contour hedgerows in the Eastern Visayas, Philippines', *Agricultural Economics* **18**(1): 31-46.

Pearce, D. (2005). *Economists and biodiversity conservation: What can we contribute?* Bremen

Pham, K. N. and V. H. S. Tran (2000). *Recreation Value of the Coral-surrounded Hon Mun Islands in Vietnam*. Economy and Environment Program for Southeast Asia, IDRC,

Phuong, D. M. and C. Gopalakrishnan (2004), 'Optimal Management of Water for Sustainable Fisheries and Aquaculture ', *International Journal of Water Resources Development* **20**(4): 493-506.

Rosenberger, R. and R. J. Johnston (2007). *Selection effects in meta-valuation function transfers*. Sønderborg, Denmark

Rosenberger, R. and J. Loomis (2000b), 'Panel stratification in meta-analysis of economic studies: an investigation of its effects in the recreation valuation literature', *Journal of Agricultural and Applied Economics* **32**(1): 131-149.

Rosenberger, R. and T. D. Stanley (2007). *Is the literature biased? Publication selection effects in recreation valuation*. Portland, Oregon

Rosenberger, R. S. and J. B. Loomis (2000a), 'Using meta-analysis for benefit transfer: In-sample convergent validity tests of an outdoor recreation database', *Water Resources Research* **36**(4): 1097-1107.

Santos, J. M. L. (1998), *The Economic Valuation of Landscape Change. Theory and Policies for Land Use and Conservation.* Cheltenham: Edward Elgar.

Seenprachawong, U. (2001). *An Economic Analysis of Coral Reefs in the Andaman Sea of Thailand*. EEPSEA research report,

Seenprachawong, U. (2002). *An Economic Valuation of Coastal Ecosystems in Phang Nga Bay, Thailand*. EEPSEA Research Report No. 2002-RR5, IDRC,

Shechter, M., B. Reiser and N. Zaitsev (1998), 'Measuring Passive Use Value: Pledges, Donations and CV Responses in Connection with an Important Natural Resource', *Environmental and Resource Economics* **12**: 457-478.

Shrestha, R. K. and J. B. Loomis (2003), 'Meta-Analytic Benefit Transfer of Outdoor Recreation Economic Values: Testing Out-of-Sample Convergent Validity', *Environmental & Resource economics* **25**: 79-100.

Smith, V. K. and S. K. Pattanayak (2002), 'Is Meta-Analysis a Noah's Ark for Non-Market Valuation?' *Environmental and Resource Economics* **22**: 271-296.

Stanley, T. D. and S. D. Jarrel (2005), 'Meta-Regression Analysis: A Quantitative Method of Literature Surveys', *Journal of Economic Surveys* **19**(3): 299-308.

Strand, J. (2007), 'Public-good valuation and intrafamily allocation', *Environmental and Resource Economics* **38**(4): 527-543.

Streever, W., J. M. Callaghan-Perry, A. Searles, T. Stevens and P. Svoboda (1998), 'Public attitudes and values for wetland conservation in New South Wales, Australia', *Journal of Environmental Management* **54**: 1-14.

Subade, R. F. (2005). *Valuing Biodiversity Conservation in a World Heritage Site: Citizens' Non-Use Values for Tubbataha Reefs National Marine Park, Philippines* Economy an Environment Program for Southeast Asia (EEPSEA), IDRC,

Tapvong, C. and J. Kruavan (1999). *Water Quality Improvements: A Contingent Valuation Study of the Chao Phraya River*. EEPSEA, IDRC,

Thuy, T. D. (2006). *Willingness to Pay for Conservation of Vietnamese Rhinoceros*. Cebu, the Philippines

Tisdell, C., C. Wilson and H. S. Nantha (2005), 'Policies for Saving a Rare Australian Glider: Economics and Ecology', *Biological Conservation* **123**: 237-248.

Tsuge, T. and T. Washida (2003), 'Economic valuation of the Seto Inland Sea by using an Internet CV survey', *Marine Pollution Bulletin* **47**: 230-236.

Tuan, T. H., T. D. Thuy, J. Jianjun, A. Indab and O. Nabangchang (2008). *WTP for Marine Turtle Conservation in Four Countries: Benefit Transfer Testing.*

Van Houtven, G., J. Powers and S. K. Pattanayak (2007), 'Valuing water quality improvements using meta-analysis: Is the glass half-full or half-empty for national policy analysis?' *Resource and Energy Economics* **29**(3): 206-228.

Veisten K, Hoen H F, Navrud S and Strand J (2004) Scope insensitivity in contingent valuation of complex environmental amenities. *Journal of Environmental Management* **73**(4): 317-331.

Walpole, M. J., H. J. Goodwin and K. G. R. Ward (2001), 'Pricing policy for tourism in protected areas: Lessons from Komodo National Park, Indonesia', *Conserv. Biol.* **15**(1): 218-227.

Wang, X., J. Bennett, C. Xie, Z. Zhang and D. Liang (2007), 'Estimating non-market environmental benefits of the Conversion of Cropland to Forest and Grassland Program: A choice modeling approach', *Ecological Economics* **63**(1): 114-125.

Wei-Shiuen, N. and M. Robert (2005), 'The impact of sea level rise on Singapore', *Environment and Development Economics* **1002**: 201-215.

Xu, Z. M., G. D. Cheng, J. Bennet, Z. Q. Zhang, A. H. Long and H. Kunio (2007), 'Choice modeling and its application to managing the Ejina Region, China', *Journal of Arid Environments* **69**: 331-343.

Yaping, D. (1998). *The Value of Improved Water Quality for Recreation in East Lake, Wuhan, China: Application of Contingent Valuation and Travel Cost Methods,* . Economy and Environment Program for Southeast Asia, IDRC.

Yeo, B. H. (2002), 'Valuing a Marine Park in Malaysia', in D. Pearce, C. Pearce and C. Palmer, eds, *Valuing the Environment in Developing Countries: Case Studies.* Edward Elgar.

Zhongmin, X., C. Guodong, Z. Zhiqiang, S. Zhiyong and J. Loomis (2003), 'Applying Contingent Valuation in China to Measure the Total Economic Value of Restoring Ecosystem Services in Ejina Region', *Ecological Economics* **44**: 345-358.

Zhongmin, X., J. Loomis, Z. Zhiqiang and K. Hamamura (2006), 'Evaluating the performance of different willingness to pay question formats for valuing environmental restoration in rural China', *Environment and Development Economics* **11**: 585-601.