Individual Preferences for Marine Ecosystem Quality, Attribute Based Methods and Shellfishery in the Dutch Wadden Sea

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Abstract

This study presents the first valuation study of shellfishery policy in the Dutch Wadden Sea. This theme was until recently politically very sensitive and high on the agenda of the Dutch government. The motivation for the study is a perceived problem between cockle fishery and the bird species populations, which need cockles as food. The study values different fishery policy scenarios across five groups of stakeholders. The latter include Dutch citizens, local residents, tourists, policy makers and natural scientists. The stated choice method was used, because it has the advantage that trade-offs between and values of attributes can be assessed. We compare the WTP values between and within the stakeholder groups. The results indicate various differences in preferences among the stakeholders-groups. Finally, we examine the influence of warm glow in willingness-to-pay responses. In fact, this paper is one of the first attempts to incorporate a combination of attitudinal information and warm glow in a valuation exercise using the stated choice method.

1. Introduction

A particular type of shell-fishery in the Netherlands, namely cockle-fishery in the Wadden Sea, has received much attention from both policy makers and environmentalists. Until the 1950s most of the catch resulted from fishing by hand. In the beginning of the 1960's the sector introduced mechanical techniques of fishing. According to environmental organizations (notably 'De Waddenvereniging'[1]), the process of mechanical shell fishing altered the sediment structure of the seabed in an irreversible way (Stichting Odus, 2001[2]). An additional negative impact of cockle fishery is that it withdraws a great amount of cockles from the food web in the Wadden Sea. Cockles constitute an important element of the diet of the bird population in the Wadden Sea (EVA II, 2003). This does not imply, however, that the relationship between cockle fishery and the environmental quality of the Wadden Sea is fully clear and understood. For a long time, it has been debated which policy measures should be taken. Some believed it is possible to make the cockle fishery more sustainable, while others pled in favor of forbidding the cockle-fishery entirely. Recently, the government has decided in favor of the latter, based on the advice of a special committee for assessing policy in the Wadden Sea (Meijer et al., 2004).

Since 1993, the main function of the Wadden Sea is to be a (national) natural area. This implies that human activities are allowed as long as they do not cause significant harm to natural values of the Wadden Sea. A relevant question that has never been answered is whether different stakeholders prefer similar or different levels of ecosystem quality. In this paper we want to address this question in a systematic way. In particular, it is assessed which policy measures and associated levels of environmental quality the different stakeholder groups prefer. Furthermore, the question who will benefit and lose from specific policies is addressed by measuring the welfare gains and welfare losses associated with them.

The stakeholders we wanted to include in the analysis covered cockle-fishermen, Dutch citizens, local residents, tourists, policy makers and natural scientists. The cockle-fisherman, however, were (the only group) unwilling to participate in the survey. Due to the fact that the Wadden Sea is a national natural area, Dutch citizens can be identified as a relevant stakeholder group. Local residents are the people living in the coastal area of the Wadden Sea. They include the inhabitants of the Dutch

[1] Source: http://www.waddenvereniging.nl.
[2] Source: http://www.wildekokkels.nl.

Wadden islands, and people who live less than five kilometer from the coast in the northern provinces of the Netherlands. The policy makers are local politicians, local and national civil servants, and members of lobby-groups who are involved in preparing formal policy[3]. Natural scientists include biologists at universities or other (scientific) research institutes who have shown a special interest in the Wadden Sea.

In order to assess and identify differences between individual preferences of the various stakeholders, we make use of the attribute based stated choice methodology (Louviere et al., 2000). This non-market, economic valuation method uses a questionnaire in which respondents choose between alternative goods, in the present context interpreted as different policy options. This study further attempts to measure consumer motivations for the act of giving, sometimes referred to as 'warm glow' (Nunes and Schokkaert, 2003). This is operationalized by including in the questionnaire a list of 26 attitudinal questions.

The paper is organized as follows. Section 2 describes the current situation concerning the management of the Wadden Sea and identifies the alternative policy scenarios in the survey. Section 3 describes the stated choice valuation method used, and discusses the valuation question as well as the econometric models on which the data analysis will be based. In addition, individual motivational profiles will be explained, where special attention is given to the 'warm-glow effect'. Sections 4 and 5 present the results. Section 6 concludes.

2. Statement of the marine resource problem

It is widely recognized that cockle-fishery causes potentially significant damage to the environmental quality of the Wadden Sea. This has two dimensions. First, cockles live on water-soils, which makes them very sensitive to soil movements and accumulation of water sediments. Since the harvest of shellfish implies soil movements, due to the use of mechanical and vibrating fishing equipment, negative impacts on the morphology, as well as on marine life functions of the Wadden Sea are inevitable. A second dimension relates to the fact that shell-fishing reduces food available to birds. The demand for cockles has increased rapidly over the last decades, notably due to increasing demand on the Spanish market, which has stimulated an

[3] This is an example of the 'polder-model', a consultation framework that underlies much of the public decision making in the Netherlands.

increase in cockle fishing efforts in the Wadden Sea (Dijkema, 1997). This has resulted in fewer cockles in the food chain, which in turn threatens the life of many birds in the Wadden Sea. For example, the population of the Oyster-Catchers, a migratory bird that chooses the Wadden Sea for breading, decreased from 260,000 in the 1980s to about 150,000 in 1998. The last few years have shown a small recovering trend in the number of birds. Today, the population of the Oyster-Catchers is about 170,000. Another bird that has been very much affected by the reduction of cockles in the Wadden Sea is the Eider-Duck. In fact, the Eider-Duck population has decreased from 130,000 to 100,000 over the last decade (EVA II, 2003).

In order to minimize the negative environmental impact of the shell-fishery, the current fishery is regulated by the central government. The overall objective is to define precise food requirements, on the advice of biological experts, for the bird species wintering in the Wadden Sea. These can be translated into harvest standards for the cockle fishery. A policy proposal on the government's agenda is identification of sensitive areas in the Wadden Sea, in which fishing is not allowed. Many individuals and organizations (including politicians and environmental groups such as de Waddenvereniging and Wilde Kokkels) propose a total ban of the cockle fishery in the Wadden Sea. Nevertheless, the perception and evaluation of the impacts of the cockle-fishery is not the same for all stakeholder groups. In fact, the recent public debate about cockle fishery in the Wadden Sea makes clear that opinions about whether current cockle fishery is ecologically sustainable differ.

So the current fishery policy involves two main restrictions on fishermen, namely fixed areas where fishing is not allowed; and quota to save food for birds. There is no consensus about whether these measures are sufficient in realizing ecological sustainability of the Wadden Sea ecosystem. In this study we propose additional, hypothetical but feasible, fishery management options for regulation of the cockle fishery in the Wadden Sea. We choose to include the following three groups of policy measures:

(1) *area policy measures* (‘*area’*) – these change the surface area where fishing is allowed;

(2) *quota policy measures* (‘*quota’*) – these reduce the maximum harvest of cockles the cockle-fishery sector is allowed to fish;

(3) *rotation policy measures* (‘*rotation’*) – these rotate the areas where fishing is not allowed.

The third policy option, ‘rotation’, has been proposed by the cockle fisherman. They see it as an opportunity to increase the harvest as well as improve the sustainability of fishing (Stichting Odus, 2001). Natural scientists, however, have argued that rotation implies a disturbance of the ecosystem that is more widely spread in the Wadden Sea.

We study individual preferences for alternative fishing management scenarios in the Wadden Sea, wherein we make a distinction between relevant stakeholder-groups. The latter include the cockle-fishery, Dutch residents, local residents, tourists, policy makers, and natural scientists. Despite various efforts on our side to stimulate the cockle-fishery sector to participate in this study they turned out to be unwilling to do so.

3. Stated choice method and model for data analysis

For assessing individual preferences and identifying which measures are the most preferred by the different stakeholders, we make use of the attribute based stated choice methodology (Louviere et al., 2000). This stated choice (SC) valuation method asks respondents to make a choice between alternative goods, defined in terms of their attributes. The stated choice method belongs to a family of attribute based methods (ABMs). These are a special case of Conjoint Analysis (CA). By incorporating price as an attribute, ABMs can be used for the purpose of applied welfare analysis of changes in the attributes, thus providing information about willingness to pay (WTP) (Holmes and Adamowicz, 2003). ABMs assume that a respondent’s WTP consistently relates to his of her underlying preferences. The stated choice method was originally developed by Louviere and Hensher (1982) and Louviere and Woodworth (1983). Hanley et al. (2001) give an overview of stated choice studies carried out in the field of environmental economics.

The use of this method allows us to estimate the value of an improvement in the environmental quality in the Wadden Sea, a non-market benefit, in monetary terms. In addition, as opposed to the older and much applied contingent valuation

method, this valuation method offers a wide range of information concerning benefit trade-offs between attributes (Adamowicz et al., 1998).

The questionnaire used in the stated choice valuation experiment consists of four parts. In the first part respondents are asked to report their behavior with respect to, among others, visiting the Wadden Sea area and food habitats in relation to the consumption of fish and shellfish. The second part of the questionnaire presents the context of the stated choice (SC) questions, after which a series of stated choice questions are posed. Each respondent faces nine stated choice questions, proposing all different tradeoffs among the attributes under consideration. More precisely, respondents are asked to compare the current fishing management practice with nine alternative policy options. In each question, the respondent is asked to choose one of both. In the third part of the questionnaire respondents are asked to state their opinion about alternative marine management policies in the Wadden Sea. Finally, the fourth part of the survey assesses the socio-economic characteristics of the respondents.

Table 1 gives an example of a stated choice question used. The attributes included in the SC question are the alternative cockle fishery policy options, the level of birds and the price level. The number of birds are regarded as an indicator of the environmental benefits of the policy measures, that is, as an indication of the quality of the ecosystem.

Table 1: Illustration of a stated choice question

Assuming that the following fishing management practices were the only practices available, which one of the two listed below would you consider more attractive for you, if either?		
	Current situation	Policy proposal
Policy measures:		
Surface area where fishing on cockles is allowed	Current area	Half of the current level
Allowed harvest of cockles	Current level	Lower level
Rotation	No rotation	No rotation
Ecosystem effect:		
Number of birds	Current level	More than the current level

Costs:		
Costs per household	0 euro	50,- euro
	❑ A	❑ B
		❑ No preference

In each stated choice question, three different policy measures for regulation of cockles fishery are presented to the respondent. These policy measures refer to the three different variables presented in Section 2: 'area', the surface area where fishing is allowed; 'quota', the number of cockles that is allowed to fish; and 'rotation', whether the areas where fishing is allowed are fixed or rotated (see Table 1). A fourth variable gives the changes in the number of birds, which are interpreted as a proxy for ecosystem quality. The last variable in the choice experiment is a monetary variable that refers to a one time lump-sum amount for an associated policy option. This gives a total of five distinct variables for our stated choice valuation exercise.

In Table 2, the attributes and their levels as used in the analysis are presented. To set the level of the attributes for the policy attributes and the level of birds attribute, advice by a marine biologist with expertise on the study area was used. This conformed that we did indeed capture the most important policy measures and that the number of birds is a good indicator for the ecosystem quality of the Wadden Sea. For the current situation, the price is always equal to zero (i.e. the price is normalized on the status quo). For the alternative situation, the price is always larger than zero. Including the current situation in each stated choice question allows us to identify whether stakeholders prefer to keep the status quo policy scenario.

The combination of all stated choice attributes, and respective attribute levels, allowed us to create a full factorial design. The outcome of such a procedure results in a very large choice set. We resized this by (1) eliminating all the dominant alternatives, and (2) eliminating all policy combinations that were internally inconsistent. We only constructed choice questions consisting of the current situation (status quo) combined with an alternative scenario. This results in 168 different choice sets. Presenting each respondent with 168 choice questions is not a feasible option. We choose to present eight different choice questions to each respondent. The

168 sets are then divided over 21 versions of eight questions, which were distributed randomly among respondents.

In addition, we consider an 'extreme policy scenario' (a ninth question). This reflects entirely banning the mechanical cockle fishery sector from the Wadden Sea area. To make this policy scenario realistic, the survey design always portrays to the respondents a higher level of birds associated with this scenario, indicating a better ecosystem quality. We worked with 16 different choice sets for 'the banning option' (1 policy measure × 2 levels of birds × 8 price levels).

Table 2: Attributes and their levels as used in the survey

Attribute	Levels
Policy measure: 'area'	The whole Wadden Sea
Surface area where it is allowed to fish on cockles	Current level
	Half of the current level
	No take (ban option)
Policy measure: 'quota'	
Allowed number of cockles harvest.	Current level
	Lower level
Policy measure 3: 'rotation'	
Rotation (or fixed) areas	Rotation
	No rotation
Indicator of the quality of the ecosystem:	
Number of birds	Lower level
	Current level
	More than in current situation
	Much more than in current situation.
Financial cost	
	Nine different bid amounts between 0 and 250 euro

For each choice question there are three possible answers, namely the current policy option, the alternative, and no choice (i.e. no preference). It is necessary to indicate the third no choice option, for two reasons: to deal with sample selection bias, and to develop demand models consistent with economic theory. Omission of this option can yield biased and misleading WTP estimates (Louviere and Street, 2000).

Before executing the survey, a series of pre-tests were done on students in order to check the overall level of comprehension. This showed that the proposed alternative scenarios were accepted and understood.

The data retrieved by carrying out a choice experiment can be analyzed by using as the theoretical framework the random utility (RU) model (McFadden, 1973). RU models estimate the probability that respondents will select an alternative based on its attributes. The probability that an individual, q, chooses alternative i is the same as the probability that the indirect utility of that alternative (U_{iq}) is greater than the utility of the other choice alternative, j (U_{jq}).

$$U_{iq} > U_{jq} \Rightarrow (V_{iq} + \varepsilon_{iq}) > (V_{jq} + \varepsilon_{jq}) \qquad \text{for all } j \neq i,\ j \in C_n \tag{1}$$

The error terms are unobserved. Rearranging equation 1 leads to the random utility model given in equation 2. The aim of this model is to estimate the value and statistical significance of the determinants of the utility function.

$$P_{iq} = P[\{\varepsilon_{jq} - \varepsilon_{iq}\} < \{V_{iq} - V_{jq}\}] \qquad \text{for all } j \neq i. \tag{2}$$

P_{iq} is the probability that respondent q choose option 1, given the indirect utility functions. To make this model tractable, the probability that an alternative is chosen needs to be between 0 and 1. This is the case when the error terms associated with each alternative are independently and identically distributed (IID) according to a type I extreme value distribution. This means that we should assume that the independence from irrelevant alternatives (IIA) condition holds. The IIA condition means that the probability ratio of two options should be unaffected by the inclusion or omission of other alternatives. Under these assumptions, the solution of the choice model becomes:

$$P_i = \exp(V_{iq}) \Big/ \sum_{j=1}^{J} \exp(V_{jq}) \tag{3}$$

The utility function of the Wadden Sea is defined as an additive function of the attributes, as shown in Equation 4.

$$V_i = C_i + \sum_{k=1}^{K} \beta_{iq} x_{ikq} \tag{4}$$

For all respondents we know the values of the attributes of the different alternatives (the values of the attributes vary over the respondents) as well as their choice with respect to the attributes. This model is estimated using the maximum likelihood procedure. The coefficient for an attribute is the marginal utility of that attribute. The (Hicksian) compensating variation (Hanemann, 1984) can be written as:

$$CV = -\sum_j V_{jq}^0 \sum_j V_{jq}^1 \Big/ \alpha \tag{5}$$

This model can be applied to predict individual choice behavior within the various stakeholder groups. Furthermore, it can be examined whether and to what extent preferences regarding the Wadden Sea differ among the different stakeholder groups.

A particular innovation is that the economic valuation exercise will combine socio-economic differences and (estimated) differences in warm glow motivation. The purpose of this is to test the significance of the warm glow effect. Warm glow is measured by using an attitudinal scale. In order to obtain internally coherent measures of warm glow motivation we use factor analysis to identify on the basis of the answers to the attitudinal questions a set of latent underlying motivations (the same for all individuals). In addition, we can estimate for each respondent his or her individual motivational profile. This in turn will allow the derivation of a consumer warm glow motivational profile. Together with the respondents' socio-economic characteristics, this provides a basis for understanding and predicting willingness to pay responses.

4. Analysis of the data

4.1 Some basic statistics of the questionnaire

Interviewers for the tourists and local residents were recruited among students. The tourists were interviewed in the summer of 2003, June till August, while the local

residents were interviewed in autumn 2003, October till November. The sample-sizes for the tourists and the locals are 332 and 420, respectively. Most of the tourists were interviewed on the Islands Texel and Vlieland, and on the ferries to these Islands. The local residents were interviewed on the Islands Schiermonnikoog and Terschelling and in the northern provinces Friesland, Groningen and Noord-Holland which border to the Wadden Sea.

The sample of policy makers was constructed by collecting relevant addresses via the Ministries of Agriculture and the Environment. To construct the sample of natural scientists, addresses were collected via dr. B. Ens, chairman of a large scientific research group responsible for an authoritative report on the impact of shell-fishery, commissioned by the Ministry of Agriculture. Both policy makers and natural scientists were sent the questionnaire by mail or email.

After having sent out the questionnaires, we were confronted with the 'political-sensitivity factor' of our research topic. Several policy makers gave their judgement about the questions (instead of answering them). One recurrent comment was that they were not aware of this research project (as if they should have been). Others could not discover in the questionnaire what was the purpose of our research, and neither what it adds to the current debate (so at least our aim to minimize strategic behavior was realized). Some of them appeared to be afraid of the influence of any results. And some asked who financed this research (which is the Netherlands Organization of Scientific Research), because they worried about partiality of the research. Nevertheless, 39 policy makers, who deal with Wadden Sea policy sent back their questionnaire.

At this stage, it became clear that fishermen and policy makers are in close (institutional) contact. Representatives of the shell-fishery sector received the questionnaire that was originally distributed among policy makers. They read it and even discussed it at a formal meeting of their organization. Before this meeting, we were in contact with a representative of this organization, and tried to make clear what we were doing. The fishermen organization interpreted this type of socio-economic analysis with a certain degree of hostility, as they felt that results could be used against them. Therefore, the fishermen decided that they did not want to participate in our research.

A few natural scientists made some comments on the questionnaire. They indicated that the survey described scenarios which were not completely 'correct'. Our response was that the scenarios are hypothetical and not meant to be 'correct', but just realistic. In total 29 natural scientists sent back a filled in questionnaire.

Table 3 summarizes some characteristics of the respondents representing the five stakeholder-groups. The characteristics of the different stakeholder groups differ. The policy makers and the natural scientists have on average a larger income than the other two groups. The local residents have on average the lowest income. It is striking to see that the natural scientists stakeholder group consumes most cockles. More than 50 % of the local residents know a fisherman. This is also the case for the policy-makers and natural scientists, but we guess that they know them from a work relation, while the local residents have private contacts. The average age of the policy makers and the natural scientists is higher than that of the tourists and locals.

Table 3: Information about the stakeholder groups

	Dutch citizens	Local residents	Tourists	Policy-makers	Natural scientists
Sample size	1558	420	332	39	29
Response rate	70%[1]	49 %	n.a.	42 %	54 %
Income					
Low income group (<1500 euro)	28 %	25 %	14 %	0 %	3 %
Middle income group	54 %	46 %	39 %	33 %	31 %
High income group (>3000 euro)	18 %	12 %	33 %	64 %	66 %
Consume fish	90%	85 %	90 %	97 %	90 %
Consume cockles	11%	6 %	4 %	21 %	48 %
Know fisherman	11%	51 %	13 %	62 %	52 %
Member of environmental association	34%	45 %	56 %	82 %	90 %
Average age	40.2	43.4	42.7	50.1	48.2

[1] The Dutch citizen sample was reached via the Internet. A contract with a internet research company promised 1500 respondents. After 1558 respondents filled in the questionnaire, access to the questionnaire was closed.

4.2 Valuation of the stakeholder preferences for alternative policy instruments

The random utility model is estimated with a conditional logit model. Instead of operationalizing the use of the qualitative attribute levels with the use of the 'status quo' as the omitted variable for each attribute, we made use of effect codes. In this way the omitted levels of each attribute can be estimated (see Holmes and

Adamowicz 2003). Table 4 presents the estimation results for Equation 4 for the five stakeholder groups. Preferences regarding policy measures differ among the stakeholders. Because a monetary variable is included in our valuation exercise, it is possible to estimate the welfare changes due to the different policy measures. Table 5 shows the welfare changes, measured in monetary terms and according to Equation 4, associated with the potential adoption of the alternative policy measures. In this section, we will discuss the results with respect to the constant term and the fishery policies. In Section 4.3, the results with respect to the ecosystem quality will be discussed.

The model specification allows us to capture consumer preferences with respect the status quo situation. A positive estimate indicates that choosing the status quo situation, independently of the proposed policy alternatives, increases respondents' indirect utility.

Table 4: Estimation results for different stakeholder groups[1]

	Dutch citizens	Tourists	Local residents	Policy-makers	Natural scientists
Constant term	0.56***	0.24*	0.711***	0.371	-0.455
	(7.94)	(1.93)	(6.19)	(0.944)	(-1.043)
Area where is it allowed to fish					
Whole area	-0.35***	-0.28***	-0.32***	-0.363	-0.777***
	(-7.41)	(-3.35)	(-4.08)	(-1.479)	(-2.908)
Half of the current area	0.20***	0.20***	0.15***	0.359**	0.674***
	(6.53)	(3.15)	(2.52)	(1.953)	(3.025)
Ban cockles fishery	-0.22***	-0.44***	-0.36***	n.a.	n.a.
	(-6.77)	(-6.74)	(-5.55)		
Quota					
Half of the current quota	0.01	0.04	-0.05	-0.0033	0.062
	(0.49)	(0.83)	(-1.30)	(-0.25)	(0.394)
Rotation					
Rotation present	0.11***	0.10*	0.08*	-0.091	-0.296*
	(4.40)	(1.91)	(1.88)	(-0.712)	(-1.900)
Level of birds					
Less birds	-0.955***	-1.48***	-0.59***	-0.953	-0.334
	(-8.57)	(-6.17)	(-3.01)	(-1.514)	(-0.580)
More Birds	0.684***	0.80***	0.50***	0.0053	0.012
	(15.13)	(8.35)	(6.13)	(0.020)	(0.044)
Much more birds	0.697***	0.98***	0.362***	0.870***	0.558*
	(13.86)	(9.06)	(3.99)	(2.930)	(1.768)
Price	-0.014***	-0.010***	-0.007***	-0.006***	-0.008***
	(-33.17)	(-16.19)	(-11.83)	(-3.085)	(-3.789)
Log likelihood	-7493	-1712	-2147	-180	-129
No. of observations	12981	2932	3578	293	218
Adjusted ρ^2	0.17	0.15	0.13	0.08	0.11

[1] The significance of the estimates is indicated by ***, ** and *, referring to the 1%, 5% and 10% level, respectively; t-values are between brackets.

In other words, respondents prefer the current cockle fishery situation. According to Table 4, Dutch citizens, tourists, local residents and policymakers have a positive estimate for the constant term. However, such an estimate only reveals to be statistically significant from zero for Dutch citizens, tourists and local residents. This estimation result can be interpreted as a signal indicating that these stakeholder groups are averse to a policy change, or that they prefer the way things are. On the contrary, natural scientists show a clear preference for a policy change since the constant term estimate is negative. Nonetheless, this parameter estimate is not significantly different from zero. These estimation results are consistent with the descriptive statistics provided in Section 3 where it was shown that 29% of the local residents are characterized by always choosing the current fishery policy scenario. In contrast, this kind of behavioral pattern is not found for any of the respondents in the natural scientist group.

Table 5: Marginal Willingness to Pay estimates (in Euro)[1]

	Dutch citizens	Tourists	Local residents	Policy-makers	Natural scientists
Constant term	41***	24*	101***	65	- 58
Area where is it allowed to fish					
Whole area	-25***	-28***	-45***	-51	-109**
Current area	-26	-51	-75	-1	-13
Half of the current area	15***	20***	21***	50*	94**
Ban cockles fishery	-16***	-44***	-51***	n.a.	n.a.
Quota					
Current quota	-1	-4	8	0	-9
Half of the current quota	1	4	-8	0	9
Rotation of the fishing area					
No rotation (current situation)	-8	-10	-12	-13	-41*
Rotation	8***	10*	12*	13	41
Level of birds					
Less birds	-70***	-146***	-84***	-133	-47
Current level of birds	-31	-30	-38	-14	30
More Birds	50***	80***	71***	1	2
Much more birds	51***	97***	51***	122***	78*

[1] The significance of the estimates is indicated by ***, ** and *, referring to the 1%, 5% and 10% level, respectively; t-values are given between brackets.

As far as the 'area' attribute is concerned, the preferences of the five groups are comparable. In fact, all stakeholder groups prefer the policy option characterized by cockle fishing 'half of the current area' over the 'current situation'. In addition, all

stakeholder groups show consistent preferences for the 'current situation' over a fishery policy that brings along with it the possibility to fish in the 'whole area' of the Wadden Sea. In short, the ranking of stakeholder preferences with respect to cockle fishing is 'half of the current area' over the 'current situation' over the 'whole area'. Furthermore, according to the monetary valuation results (see Table 5), natural scientists show the strongest (average) magnitude with respect to this type of preference order. In fact, the marginal willingness to pay for adoption of 'half of the current area' policy is about 94 Euro, whereas the marginal willingness to accept the no take ('ban') fishing option is 109 Euro.

One stated choice question includes the scenario regarding the ban of the totality of the cockle fishery activities of the Wadden Sea. This scenario is interpreted as an extreme policy option. It appears that Dutch residents, tourists and locals prefer the current situation over banning cockles fishery. The sample for policy makers and natural scientists is too small, which implies that the responses to the banning policy option by these stakeholders could not be included in the analysis. Due to this, we do not have (welfare) estimates for these groups.

Estimation results show that none of the stakeholders reveal a clear preference with respect to the 'quota' policy measure. In fact, Table 4 shows that the respective parameter estimates are not statistically significant from zero. We can conclude that the reduction of the current quota by half is an unattractive policy measure for all stakeholder groups. As mentioned, including rotation as a policy attribute in the management of the cockle fishery in the Wadden Sea has been originally proposed by the cockle-fishing sector. Table 4 shows that the introduction of a rotation principle is welcomed among Dutch citizens, tourists and local residents. On the contrary, this policy is strongly rejected by the natural scientists. According to the welfare estimates, Dutch citizens, tourists and local residents present a marginal WTP for the adoption of the rotation principle that ranges from 10 to 12 Euro. In contrast, a natural scientist has on average a WTP of 41 Euro to prevent the introduction of rotation. This results reiterates the validity of the information provided by Table 3 that 45% of the natural scientists rejected rotation completely. A possible explanation for this answering pattern can be the fact that lay-people perceive the rotation principle as positive. In contrast, expert individuals, such as natural scientists and policy makers, clearly see the disadvantages of such a procedure. These relate to a wider spread of

the human activity in the natural marine environment, creating an additional threat to many of the sensitive marine areas.

4.3 Valuation of the stakeholder preferences for environmental quality

Ecosystem quality changes in the Wadden Sea area are tackled by changes in the population of birds registered in that same area. For all stakeholders groups, 'more birds' and 'much more birds' are preferred to the current situation. This result can be interpreted as a clear signal that all stakeholders are in favor of an improved ecosystem quality of the Wadden Sea. A closer look at the estimation results shows that the intensity of stakeholder's preferences is not the same. In other words, the desired level of ecosystem quality of the Wadden Sea, measured in terms of the number of birds in the Wadden Sea, varies across the different stakeholders. In fact, with the exception of the local residents, all the stakeholders have preferences such that 'much more birds' are preferred over 'more birds'. For local residents the marginal WTP for 'more birds' is 72 Euro and thus higher than the marginal WTP for 'much more birds', which equals 51 Euro. These results can be interpreted as signalling a conservative propensity towards an improvement in the ecosystem quality of the Wadden Sea area. In other words, 'more birds' is their preferred level. Among the other stakeholders, 'much more birds' is the preferred level. Furthermore, policy makers is the stakeholder group that presents the highest marginal WTP to improve the environmental quality. According to Table 5, they are willing to pay 122 Euro to have 'much more birds' in the Wadden Sea area. Tourists and natural scientists value the 'much more birds' scenario as 96 Euro and 51 Euro, respectively. For the Dutch citizens, the difference in WTP to have ‘more birds’ and ‘much more birds’ is only one Euro.

A question that emerges from this analysis is to test formally whether stakeholder groups make a distinction between the different proposed changes in the environmental quality of the Wadden Sea. Bearing in mind Equation 3, we want to test the following hypotheses:

$$H_o : \beta^i_{\text{more birds}} = \beta^i_{\text{much more birds}}$$
$$H_a : \beta^i_{\text{more birds}} \neq \beta^i_{\text{much more birds}}$$

with *i* denoting the range of stakeholders in the analysis. We run a likelihood ratio-test (χ^2-test). Test results are presented in Table 6.

Table 6: Different valuation of 'more birds' and 'much more birds'[1]

	Dutch citizens	Tourists	Local residents	Policy-makers	Natural scientists
Likelihood ratio test	0	3.2*	2.8*	8.7***	3.1*

1 The significance is indicated by ***, ** and *, referring to the 1%, 5% and 10% level.

Likelihood ratio test results confirm that four stakeholder-groups make a distinction between 'more birds' and 'much more birds', at a 10% significance-level. Dutch citizens do not make a significant distinction between the two proposed changes in environmental quality.

As an example we will give a practical application of our estimation results. To do this, we will make use of the tourists data for which we estimated the model with only one variable for a higher level of birds, including 'more birds' and 'much more birds'. The results of this model gives a marginal WTP for a higher level of birds of 87 Euro per household. An estimate of the total welfare gain for the tourist's amounts to 31 million Euro. This value is calculated by dividing the value per household by the average number of persons in a household, and subsequently by multiplying this amount with the total number of individual visitors to the Wadden Sea area, estimated to be around 1 million (990.000 in 2002; Source CBS, 2003).[5] The remaining value can form the basis for compensating cockle fishermen so as to reduce their fishing effort, or adopting environmental sustainable fishing methods that are characterized by a lower productivity.

In this context, one could explore the idea of introducing an entrance fee to the tourists visiting the Wadden Sea area (for example, as an additional cost of the boat ticket or a tourist tax). The amount of such a fee would depend on both (i) discount rates and (ii) number of years that such a tax would be collected. The official Dutch discount rate used to account the net present value of public financed projects is 4%. The European Union advises a discount rate of 5%. In other Western European countries the discount rates varies between 3% (Germany) and 8% (France) (Ministry

[5] According to our survey responses, each household is composed of 2.75 persons (2.14 adults and 0.61 children).

of Finance, 1995: Eijgenraam et al., 2000). Table 7 presents some results, assuming that the entrance fee is set differently among the visitors, in particular that adults pay twice as much as children.

Based on these assumptions the entrance fee for adults ranges between 0.51 and 1.85 euro. The entrance fee per household (without extra assumptions) ranges between 1.24 and 4.54 euro.

Table 7: Individual entrance fee (in Euro)

Household WTP = 81.33 Euro	Discount rate	15 years	30 years
Category = Adults	3%	1.85	0.72
	4%	1.70	0.61
	5%	1.57	0.51
Category = Children	3%	0.92	0.36
	4%	0.85	0.30
	5%	0.78	0.25
Per household	3%	4.54	1.77
	4%	4.18	1.49
	5%	3.84	1.24

5 Testing for a warm glow effect in a stated choice behavior setting

5.1 Retrieving motivational profiles of warm glow

Following the methodological guidelines proposed by Nunes and Schokkaert (2003) to identify and measure warm glow in economic valuation surveys, the questionnaire of this study also included a list of 12 attitudinal questions to be answered by the respondents on a five point Likert-scale (Likert, 1976), with values ranging from 1 for "I disagree completely" to 5 for "I agree completely". The application of factor analytical methods allows the identification of consumer motivations regarding cockle fishing in the Dutch Wadden Sea in general, and of consumer warm glow motivation in particular. Formally, we use the following model:

$$\mathbf{av} = \Lambda\mathbf{f} + \Xi$$

where **av** is the matrix giving the answers of the sample respondents on the 12 attitudinal items as presented in the instrument survey; **f** captures the matrix of factor scores giving the position of the sample respondents on the three retained motivations; Λ captures the matrix of factor loadings showing the correlations between the answers on the 12 items and the respondents' factor scores; and Ξ captures the matrix of the residual terms. The varimax rotation estimation procedure is used to perform the factor analysis (see Nunes 2002 for additional details). This method allows an easy interpretation of the results, and attempts to construct 'factor loadings', which are interpreted as the correlation magnitude between the attitudinal questions and *latent* (unobserved) motivational profile (see Harman 1976 for technical details). The factor loadings after varimax rotation are shown in Table 8. The asterisks denote values above 0.45 (or 45 in the table, as all numbers are multiplied by 100).[6]

Table 8: Loading factors after varimax rotation (multiplied by 100)

Items		F1	F2	F3	F4
1	It is important that the Wadden Sea is intact	-47*	41	20	-20
6	It should be possible to use the Wadden Sea for commercial purposes	66*	-8	-9	18
7	Tapping Wadden Sea gas should be allowed.	82*	-13	-9	3
8	Military training in the Wadden Sea should be possible	78*	-15	0	6
9	The current number of birds in the Wadden Sea can be considered as a good indicator for the quality of the ecosystem.	-15	72*	5	-5
10	The Wadden Sea is the most important natural area of the Netherlands	-18	67*	16	12
11	To keep the birds population in tact, it is necessary that there are enough cockles.	-3	73*	5	-27
2	There are some funding campaigns to which my family and I show much sympathy and therefore do not hesitate to support by contributing with a donation.	-17	11	66*	-21
4	My family and I like admires individuals who, on a voluntary basis, participate in collecting donations for national programs for social aid and solidarity	-7	3	72*	11
12	I am happy with myself whenever I give a financial contribution to a charity organization	-2	16	76*	2
3	There are ecological risks related to cockle fishery in the Wadden Sea	-12	35	28	-58*
5	Cockle fishermen should have the possibility to earn enough for a living.	14	14	-8	78*

The main items loading on a given factor share the same conceptual meaning and items that load on different factors are associated with different conceptual

[6] The factor loadings are analogous to standardized regression coefficients. 0.45 is set as a minimum

meanings. The items loading on *factor 1* relate to the human, non-recreational use of the Wadden Sea.[7] Therefore, this latent variable is interpreted as the consumer 'non-recreational use' motivation. *Factor 2* is associated with items that indicate respondents' perception with respect to the ecosystem's quality of the Wadden Sea and the current bird population size. Therefore, this latent variable is interpreted as the consumer 'Wadden Sea natural quality' motivation profile.[8] *Factor 3* is associated with items that underpin a respondent's feeling of well being or satisfaction generated by the act of giving. We interpret it as the 'consumer warm glow motivation profile.[9] Finally, *Factor 4* is associated with items indicating the respondent's moral considerations with respect to the protection of the existing cockle-fishery community operating in the Wadden Sea. We interpret it as the consumer 'community' motivation profile.[10]

After having defined the content of the factors, the next step is to determine the position of the individuals on these latent motivational factors. These are given by the standardized *factor scores* (again with mean zero and variance equal to 1 – see Harman, 1976). For example, a higher value for Factor 3 indicates that the respondent has a stronger propensity for warm glow of giving. Then we are in a condition to introduce these latent variables in the valuation function and check whether they play a significant role in explaining reported WTP responses. Therefore, we estimate a full model with all explanatory variables, including individual motivational factor scores. We are interested in the valuation of environmental quality programs, and the effect of warm glow in that valuation process.

5.2 Estimation results

The estimation results of the warm glow effect in the multivariate setting are presented in Table 9. Most of the results speak for themselves and are quite similar to

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correlation. Items that have a low correlation with the common factors are not taken into consideration.

[7] The two largest ones are M7 ("Tapping Wadden Sea gas should be allowed") and M8 ("Military training in the Wadden Sea should be possible").

[8] The two largest ones are M9 ("The current number of birds in the Wadden Sea can be considered as a good indicator for the quality of the ecosystem.") and M11 ("To keep the birds population in tact, it is necessary that there are enough cockles.").

[9] The two main items are M4 ("There are some funding campaigns to which my family and I show much sympathy and therefore do not hesitate to support by contributing with a donation.") and M12 ("I am happy with myself whenever I give a financial contribution to a charity organization").

[10] The largest loading is for item M10 ("Despite the fact that my family and I may never see an Iberian lynx in its natural habitat, we are very happy to know that we have the guarantee that the lynx is kept safe from extinction in Portugal"). Items M22 and M6 convey the same idea for the eagle and the otter.

the ones already reported in Table 4. We therefore focus the attention here on the effects of the motivational factors scores.[11]

The overall pattern presents a remarkable econometric robustness and for this reason constitutes an important element explaining consumers' choices. In particular, we can see that evaluation of the environmental quality depends on the importance attached by the stakeholders to the different motivations. For example, the stronger is the individual's moral consideration regarding the right of the cockle-fishery community to operate in the Wadden Sea, factor 4, the lower is the respondent's propensity to endorse a governmental measure to promote the increasing of the bird population – see cross effect 'F4*more birds' and 'F4*much more birds'. This effect is valid for all the three stakeholders under consideration with the highest estimation magnitude when 'local residents' value a governmental measure that ensures the provision of 'much more birds' in the Wadden Sea. A similar result, however of a lower magnitude, is present for both 'Dutch residents' and 'tourists'. The effects of the 'community' motivational profile, i.e. factor 4, can be interpreted as signaling the support to the local fishermen community, which can be seen as an important cultural element of the Wadden Sea area which needs to be protected. All in all, the statistical significance of the influence of this motivational profile in choice behavior indicates that respondents are keen of multi-diversity of uses of the Wadden Sea, covering both the presence of a protected marine ecosystem and human economic activities such a fishing.

Equally interestingly, the estimated coefficients relating to the warm glow motivational factor are statistically significant in all stakeholder groups. We therefore can conclude that warm glow is present in the consumer responses to the stated choice valuation questions. Table 9 shows that the warm glow is captured by two different transmission mechanisms.

On one hand, we have the direct effect of the warm glow motivational profile on the choice of the specific environmental quality program, captured by 'F3*more birds' and 'F3*much more birds'. The respective parameter estimates capture the warm glow or moral satisfaction provided by contributing to a specific project, in this case to a specific environmental quality protection program. For this reason let us

[11] Since the valuation of environmental quality is in this survey portrayed in terms of the number of birds, we only include the explanatory factor score variables for the bird-levels and for price. Due to

name this effect as 'project specific warm glow'. According to the estimation results, the empirical magnitude of this 'warm glow mechanism' is particular significant for the 'Dutch citizens' sample. In fact, respondents belonging to this stakeholder type who are, *ceteris paribus*, relatively sensitive to warm glow, reveal a higher choice propensity for environmental quality. At a first sight the estimates in Table 9 suggest that the marginal effect of differences in the warm glow motivation profile, when measured in terms of the 'project specific valuation mechanism', is different across the two environmental quality protection programs under consideration. In other words, for the 'Dutch citizens' sample, the magnitude of the 'project specific warm glow' is weaker in the scenario with 'much more birds' than in the scenario with 'more birds'. Indeed, formal testing confirms this idea. The likelihood ratio test statistic for the restriction of equal warm glow effects is 4.503, well above the 95% critical level of the chi-square distribution with one degree of freedom. This result suggests that the marginal effect of differences in warm glow motivation on individual choices is not the same for the different environmental quality protection programs under consideration. In fact, it shows a marginal decreasing warm glow mechanism, i.e., warm glow effect increases with the proposed environmental quality protection program, however it increases at a decreasing rate.

Table 9: Full estimation model with individual latent motivational factors [1]

	Dutch citizens	Tourists	Local residents
Constant term	0.48***	0.17	0.68***
	(6.43)	(1.33)	(5.72)
Area where is it allowed to fish			
Whole area	-0.38***	-0.30***	-0.31***
	(-7.47)	(-3.41)	(-3.90)
Half of the current area	0.23***	0.21***	0.14***
	(6.75)	(3.11)	(2.33)
Ban cockles fishery	-0.26***	-0.49***	-0.41***
	(-7.51)	(-7.12)	(-5.96)
Quota			
Half of the current quota	0.02	0.05	-0.06
	(0.59)	(0.91)	(-1.29)
Rotation of the fishing area			
Rotation	0.12***	0.11**	0.09**
	(4.74)	(2.15)	(2.02)
Level of birds			

small sample sizes for policy makers and natural scientists, we only consider three stakeholder groups, namely Duch citizens, local residents and tourists.

Less birds	-1.06***	-1.49***	-0.64***
	(-9.22)	(-6.12)	(-3.17)
More Birds	0.73***	0.75***	0.56***
	(15.30)	(7.35)	(6.46)
Much more birds	0.76***	0.90***	0.37***
	(14.29)	(7.86)	(3.80)
Price	-0.018***	-0.015***	-0.008***
	(-31.20)	(-13.98)	(-11.07)
F1*more birds	0.10***	0.21***	0.05
	(3.95)	(3.55)	(1.03)
F1* much more birds	0.15***	-0.02	0.17***
	(5.49)	(-0.34)	(3.23)
F1*price	0.003***	0.003***	0.001
	(6.11)	(3.34)	(1.57)
F2*more birds	-0.12***	-0.13***	0.02
	(-4.70)	(-2.76)	(0.37)
F2* much more birds	-0.15***	-0.04	-0.13***
	(-5.49)	(-0.82)	(-2.67)
F2*price	-0.003***	-0.003***	-0.000
	(-5.28)	(-3.35)	(-0.69)
F3*more birds	0.23***	0.07	0.09**
	(8.58)	(1.42)	(2.15)
F3* much more birds	0.13***	0.16***	0.02
	(4.48)	(2.99)	(0.51)
F3*price	0.002***	0.001**	-0.000
	(4.04)	(2.08)	(-1.37)
F4*more birds	-0.20***	-0.04	-0.09**
	(-7.10)	(-0.83)	(-2.22)
F4* much more birds	-0.14***	-0.20***	-0.25***
	(-4.60)	(-3.54)	(-5.80)
F4*price	-0.002***	-0.002**	-0.001*
	(-4.44)	(-2.54)	(-1.77)
Log likelihood	-6549	-1574	-1975
No. of observations	12981	2932	3578
Adjusted ρ^2	0.27	0.22	0.20

[1] The significance of the preference weights is indicated by ***, ** and *, referring, respectively, to the 1%, 5% and 10% level, with t-value between brackets.

On the other hand, Table 9 shows an additional effect of the warm glow motivational profile. Such an effect is described by the impact of this psychological motivation on the cost and thus likelihood for contributing, which is captured by 'F3*price'. The respective parameter estimates capture the general feeling of warm glow of contributing, independently of the environmental quality protection program in question. For this reason let us name this effect as 'global warm glow'. The empirical magnitude of this warm glow mechanism is significant for both 'Dutch citizens' and 'Tourists' sub-samples. According to the estimation results for these stakeholders, respondents who are relatively sensitive to warm glow show a relatively low responsiveness to the financial cost by choosing independently of whether the environmental program refers to 'more birds' or 'much more birds'. In other words,

for the same financial cost (price), these respondents are more likely to choose for environmental protection rather than for the current situation, independently of the specific protection scenario under consideration.

Table 9 suggests that the magnitude of this warm glow mechanism is comparable for the two stakeholders 'Dutch citizens' and 'Tourists'. This result is confirmed by formal testing of the 'F3*price' parameter estimate across the two sub-samples. According to estimation results 'F3*price' is not statistically significant across the two sub-samples and for this reason may be polled to a single estimate. This idea is confirmed by Figure 1, which depicts the monetary estimates expressed for a 90% level of confidence. As we can see, Figure 1 shows a large overlap between the confidence intervals regarding the two interval estimates This confirms that the magnitude of the warm glow mechanism is comparable for the two stakeholders under consideration, i.e., 'Dutch citizens' and 'Tourists'.

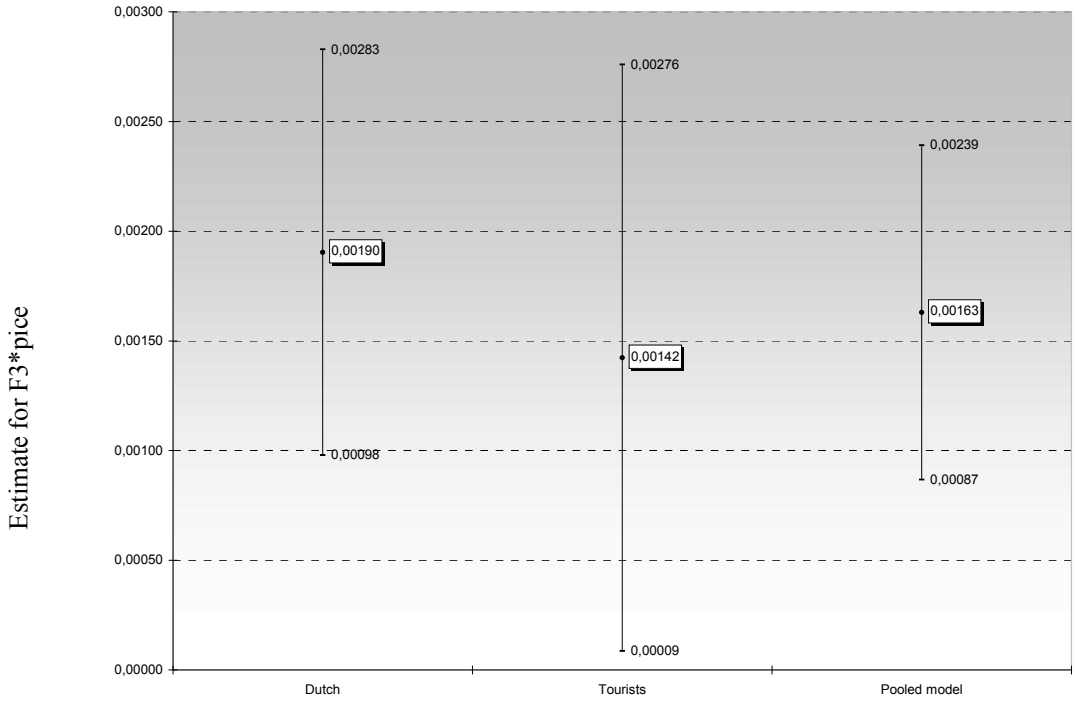

Figure 1: Monetary estimates for the warm glow-price cross effect

This result corresponds to the general feeling that respondents get moral satisfaction from the act of giving *per se* and that this feeling is present whenever the project refers to good causes, such as environmental protection of the Wadden Sea, and does not change much in terms of the specific type of intervention that is being proposed.

6. Conclusions

The aim of this paper was to assess the preferences of five stakeholder groups, namely local residents, tourists, policy makers and scientists, for management of cockles fishery in the Wadden Sea. An economic stated choice approach was used for this.

The estimation results show that the stakeholder groups clearly differ in terms of average preferences over the policy measures. While all groups prefer the policy measure that fishing is allowed in half the area, the tourists and the local residents do not like the 'extreme scenario' in which fishing is banned. The tourists and the local residents like the 'rotation' policy measure, whereas the policy-makers, and more so the natural scientists, dislike this measure. The latter believe that this fishery policy may destroy the ecosystem in the Wadden Sea.

In addition, the monetary values assigned by the different stakeholder groups to the different policy measures were estimated. Tourists and local residents prefer the current situation regarding the area where fishing is allowed. Policy makers and natural scientists prefer half the current area for fishing. The WTP for a smaller quota is zero or almost zero for all stakeholder groups. Tourists and local residents prefer the 'rotation' policy measure, while natural scientists prefer no rotation. The latter group has a negative willingness to pay (WTA) for rotation.

All respondents prefer more birds then in the current situation. Local residents prefer the option 'more birds' above 'much more birds'. The other stakeholder groups prefer the option 'much more birds' over 'more birds' and the latter over the current situation. The economic results for the level of birds, and related to this, the quality of the ecosystem in the Wadden Sea are that all stakeholder groups have a WTP for a higher level of birds. The WTP for local residents is the most for 'more birds', while the WTP of the other three groups is the highest for 'much more birds' (see Table 10).

Table 10: Ranking of policies

Stakeholder	Ranking (with $\succ$ ' preferred to' and $\approx$ 'indifferent to')
Dutch	Much more birds $\approx$ More birds $\succ$ Current situation
Tourists	Much more birds $\succ$ More birds $\succ$ Current situation
Locals	More birds $\succ$ Much more birds $\succ$ Current situation
Policy-makers	Much more birds $\succ$ More birds $\approx$ Current situation
Natural scientists	Much more birds $\succ$ More birds $\approx$ Current situation

Finally, the motivational information in the questionnaire has enabled us to retrieve individual motivational profiles for warm, which represent a general feeling of well-being or satisfaction generated by the act of giving. Inter-personal differences in warm glow motivation were estimated with factor analysis, performed on a list of attitudinal items. The results confirm the presence of a warm glow motivational factor and the respective parameter estimate reveals a robust effect on the stated choice answers. Moreover, the influence of warm glow on the economic valuation of the environmental protection programs for the Wadden Sea reveal to vary across the stakeholders under consideration. Bearing in mind the survey characteristics of present valuation exercise, we were able to test formally the nature of warm glow across different types of stakeholders as well as alternative protection programs. Formal testing confirms that the overall magnitude of the warm glow valuation mechanism depends both on the public good that is the object of it, as well as the individual stakeholder under consideration. Therefore, we can conclude that the use of direct attitudinal information may play a crucial role in obtaining a better understanding of the real content of stated choice answers, and respective policy options.

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