TI 2002-057/3
Tinbergen Institute Discussion Paper

Measuring the Economic Value of a Marine Protection Program against the Introduction of Non-Indigenous Species in the Netherlands

Paulo A.L.D. Nunes[1]
Jeroen C.J.M. van den Bergh[1,2]

[1] *Department of Spatial Economics, Faculty of Economics and Business Administration, Vrije Universiteit Amsterdam,*
[2] *Tinbergen Institute.*

Tinbergen Institute
The Tinbergen Institute is the institute for economic research of the Erasmus Universiteit Rotterdam, Universiteit van Amsterdam and Vrije Universiteit Amsterdam.

Tinbergen Institute Amsterdam
Keizersgracht 482
1017 EG Amsterdam
The Netherlands
Tel.: +31.(0)20.5513500
Fax: +31.(0)20.5513555

Tinbergen Institute Rotterdam
Burg. Oudlaan 50
3062 PA Rotterdam
The Netherlands
Tel.: +31.(0)10.4088900
Fax: +31.(0)10.4089031

Measuring the economic value of a marine protection program against the introduction of non-indigenous species in the Netherlands: results from a joint travel cost – contingent valuation survey*,**

Paulo A. L. D. Nunes
Jeroen C. J. M. van den Bergh

Department of Spatial Economics
Faculty of Economics and Business Administration
Free University
De Boelelaan 1105
1081 HV Amsterdam
The Netherlands

pnunes@feweb.vu.nl
jbergh@feweb.vu.nl

* This research was sponsored by the Netherlands Organization for Scientific Research, under the Priority Research Program *Sustainable Use of Marine Living Resources* (Project 885-10.302).

** Forthcoming at the discussion paper series from the Tinbergen Institute.

CONTENTS

Abstract

Harmful algal bloom species are the cause of important damages to marine living resources and human beings. These marine species are primarily introduced in North-European waters through ballast water, i.e. water transported across the oceans so as to keep a vessel in balance. Port authorities can impose standards on ballast water treatment, which are associated with costs. This, in turn, leads to the question which benefits are associated with the commitment of such standards. Monetary valuation can provide information on this. This article reports a monetary valuation study of a marine protection program. The program focuses on the prevention of harmful algal bloom species along the coastline of the Netherlands. It entails the construction of a ballast water disposal treatment in the Rotterdam harbor, and the implementation of a monitoring program of the water quality in the open sea along the North-Holland beaches. The valuation survey is based on a questionnaire undertaken at Zandvoort, a famous Dutch beach resort. Since the economic value of the marine protection program includes non-market benefits associated with beach recreation, human health and marine ecosystem impacts, both contingent valuation and travel cost methods are used.

Keywords: Contingent valuation; Harmful algal blooms; Marine management; Monetary valuation; Travel cost method.

JEL classification: C24, C25, Q25, Q26

1 Introduction

This study performs an economic valuation of a marine protection program targeted at the prevention of harmful algal blooms species (HABs) along the North-Holland open sea coastline of the Netherlands. The term ‘harmful’ refers to a set of algae species that have a negative impact on humans and marine ecosystems. In general terms, three categories of negative effects can be associated with HABs: risks to human health, constraints on tourism and recreation, and bio-ecological effects. The latter includes the so-called ‘red tides’, which are responsible for the destruction of marine living resources.

Algae are primarily introduced in North European waters through ballast water of ships, i.e. water that is transported by ships across the oceans so as to keep a vessel in balance (van den Bergh *et al.* 2002). It therefore makes perfect sense for port authorities to impose standards on ballast water treatment. Evidently, costs are associated with this activity. In the Dutch context, the annual marine water quality monitoring costs are 680,000 €, representing about 0.5% of total shellfish production. This, in turn, leads to the question which benefits are associated with the commitment of such standards. The present valuation exercise is target at the provision of monetary valuation can provide information on the benefits connected to the introduction of ballast water standards. The valuation exercise presents distinctive features that justify particular attention:

- North Sea in general, and the North-Holland coastal area in particular, have seen relatively few applications of economic value assessment of marine-coastal management programs.
- Evaluation of the alternative economic valuation methodologies in accordance to their degree of suitability with respect to the multifaceted nature of the non-market benefits generated by the introduction of ballast water standards.
- Use of travel costs so as to measure recreation benefits derived from the prevention of HABs in the beach.
- Use of contingent valuation so as to measure human health and bio-ecological benefits.
- Management of different qualitative and quantitative methodological and informational settings and analyze their impact on the economic value of the different non-market benefits generated by the ballast water standards.

- Combining contingent and travel cost valuation results so as to arrive at a complete picture of the benefits provided by the marine protection program, which can serve as a basis for regulation of ballast water.

The organization of the paper is as follows. Section 2 discusses the nature of the HABs as a problem for marine resources. This relates to the review of newly recorded phytoplankton species in the North-European waters, the identification of its negative impacts and examination of the most suitable economic valuation methodology. Section 3 discusses the design and execution of the questionnaire used to assess the economic valuation of the marine protection program in the Netherlands. Section 4 presents travel cost estimation results that will permit the calculation of the recreational benefits. Section 5 presents the valuation results derived from the use of the contingent valuation method that will shed light on non-recreational values, including the bio-ecological and human health benefits of the marine protection program. Finally, section 6 integrates the economic value estimates relating to recreation, human health and bio-ecological effects and discusses policy implications associated with the use of such monetary information in the formulation of solid, accurate and efficient ballast water standards.

2 Statement of the HABs resource problem

2.1 Invasion of HABs in the North-European waters

Harmful algae bloom species are invasive exotic species that can affect mollusks, shellfish and fishes. Moreover, they can also cause a variety of risks to human health, ranging from gastrointestinal disorders, through the consumption of contaminated seafood, to skin irritations, due to direct contact with the algae in the water (e.g. at the beach). Certain HABs cause important constraints on marine tourism and recreation due to the production of thick foams with repellent odors repulsive and coloration of the beach water. [1]

There is a long history of invasions of exotic micro-algae in North European waters. This history begins with the diatom *Odentella sinensis*, presumably imported in the North Sea with ship's ballast water in the beginning of the 20th century (Ostenfeld 1908). A number of micro-algae collectively known as 'flagellates' have caused considerable ecological and economic damage in the past 30 years. Ballast water transfer from Argentina has also been involved with the introduction of *Gymnodinium catenatum* in North-European waters Nehring 1995, Wyatt 1995, Nehring 1998). The *Gyrodinium aureolum* was considered a native northeast American species when it caused massive kills of fish and bottom-living animals in northwestern Europe from 1968 onwards (Boalch 1987). Ship ballast water has also been the supposed entry mechanism for *Fibrocapsa japonica*, a micro-alga responsible for massive fish mortalities as well as for vast destruction of seaweeds and invertebrate animals (Billard 1992). There is compelling empirical evidence that it has been introduced from Tasmanian waters (McMinn *et al.* 1997), coinciding with the start of bulk wood ship export from Tasmania. These species produce potent neurotoxins that accumulate through the food web, which has led to the death of marine life in the North Sea (Hallegraeff and Fraga 1998, Scholin *et al.* 2000). Mussels, and other shellfish, accumulate those toxins when filtrating phytoplankton. Humans become sick after eating these contaminated shellfish; they show neurological disorders, or may even die of what is called *Paralytic Shellfish Poisoning* or PSP. In 1976 nearly 200 cases of PSP occurred in Galicia, Northern Spain (Lüthy 1979). The economic significance of shellfish production at the Galician coast is considerable with an estimated 200 million kg cultured mussels per year, equivalent to 132 € million (Mariño *et al.* 1998).

Port authorities have recently implemented monitoring water quality programs and have proposed the introduction of standards on ballast water treatment. Both types of measures are associated with financial costs. This raises the question which benefits are associated with the implementation of such policies. This question can be answered by considering avoided damages due to ballast water treatment policy.

2.2 Harmful algal blooms as a source of ecological-economic damage

In a conceptual framework, one can define the total value (TV) of the damages in terms of the use value (UV) and nonuse value (NU) related to the damages caused by HABs. The former can be further divided into direct and indirect use values (DUV and IUV). Direct use values of damages caused by HABs include: (a) the loss of marine tourism and coastal recreation benefits; (b) the loss of natural and cultured marine species with commercial value; and (c) value of risks to human health – see Table 1. Indirect use values of damages caused by HABs refer to damages that relate to the functioning of the marine ecosystem and the survival of marine living resources, even if these have no direct commercial value. Finally, nonuse values of damages caused by HABs can be divided into a bequest value (BV) and an existence value (EV). Bequest value refers to the benefit accruing to any individual from the

[1] For a complete taxonomic classification of HABs see Appendix I.

Table 1. Classification of economic damages caused by HABs

Value component		Example of damages	Most suitable valuation technique
Use value (UV)	Direct use value (DUV)	Loss of tourism and recreational benefits, e.g. visits to the beach, swimming and sailing	Travel cost method
		Effects on marine resources with commercial value, e.g. destruction shellfish and mollusk	Aggregate price analysis*
		Effects on human health, e.g. skin allergies and gastrointestinal disorders	Contingent valuation
	Indirect use value (DUV)	Effects on marine ecosystem, e.g. unbalancing local chemical composition of the water, loss of local marine living resources diversity	Contingent valuation
Nonuse value (NUV)	Bequest Value (BV)	Risk of loss of legacy benefits, e.g. no legacy of marine living resources for future generations	Contingent valuation
	Existence value (EV)	Risk of loss of existence benefits, e.g. no knowledge guarantee that some marine living resources are locally extinct	Contingent valuation

Note: * Market price valuation technique

knowledge that future generations might benefit from a marine ecosystem being free from HABs. Existence value refers to the benefit derived simply from the knowledge that marine species are protected without even being used.

A monetary assessment of the damages of HABs requires the application of specific monetary valuation tools. This allows benefit-cost-analysis for policy guidance and thus a ranking of alternative marine policy options. In addition, monetary valuation allows marine resource damage assessment and proper pricing of marine living resources (Perrings *et al.* 2000, Davis and Gartside 2001, Nunes and van den Bergh 2001). However, valuation techniques have not yet been applied to value HABs damages. Bearing in mind the classification of value damages and valuation technique, Table 1 shows the most suitable valuation methodology for each type of damage. As one can see, the travel cost method is the most suitable valuation method for monetary value assessment of damages caused by HABs that relate to beach recreation. In addition, contingent valuation (CV), a survey based valuation technique that is widely used in the context of environmental valuation (Carson *et al.* 1992, NOAA 1993), can fulfill an important role in the overall assessment of damages associated HABs. Indeed, CV can be applied to assess the monetary value of most of the types of damages caused by HABs, and it is the only valuation method that is capable of shedding light on bequest and existence values related to damages caused by HABs. Furthermore, CV has the advantage that marine policies may be valued even if they have not yet been adopted (*ex ante* valuation) or lie outside the current institutional arrangements. Thus, it offers much scope and flexibility for specifying different marine restoration and amelioration programs. Questionnaire surveys are used to collect data on the number of visits that households make to a site and on the travel expenditures and time. A third method mention in Table 1, aggregate price analysis, will not be applied here, as the values related to the HABs damages on marine resources with commercial value is not part of the valuation approach adopted. In fact, we adopt a valuation approach, which is anchored in the use of a questionnaire, designed to value HABs' recreation-related damages – through the use of the TC method –, and to value HABs' marine ecosystem and non-use damages, making the use of the CV method.

3 Survey instrument and survey execution

3.1 Questionnaire design

Two major parts characterize the structure of the questionnaire.[2] The one collects respondents' travel data. This information is used to shed light on the recreation benefits of the marine protection program. The second part includes the contingent valuation exercise. The contingent valuation exercise is designed to assess the economic vale of marine ecosystem non-market benefits of the marine protection program. Since respondents will be unfamiliar with such benefits, the marine protection program needs to be carefully described. This occurs in terms of: (a) construction of a ballast water disposal treatment complex in the Rotterdam harbor, an internal circuit where ballast water will be transferred to and submitted to an appropriate physical-chemical treatment, to kill all HABs, before being discharged into the sea; and (b) implementation of an algae monitoring program of the water quality in the open sea along the North-Holland beaches. The benefits of such a protection program are described in terms of its bio-ecological effects, including the protection from the so-called red tides, which are responsible for the destruction of marine living resources.

[2] Appendix II provides a complete summary of the structure of the final survey instrument. A copy of the original survey is available in Appendix III.

Successfully describing the protection program is a necessary condition, thought not sufficient, to guarantee the validity of the valuation exercise. Decisions concerning the (i) choice of welfare measurement, (ii) the choice of the payment vehicle, as well as (iii) the choice of elicitation method must also be taken. The literature suggests two alternative measures that can be used to assess the magnitude of the welfare change as described by the introduction of the new regulation, and thus to obtain a gain in the marine environmental quality level. These are the Hicksian compensating surplus and the equivalent surplus (Hicks 1943). As we can see in Table 2, in the scenario of an increase in the marine environmental quality, the Hicksian compensation surplus carries with it implicitly the property-rights assumption that the individual has a payment obligation if the new (and higher) environmental quality level is to be pursued.

Table 2. Hicksian welfare measures and the property rights distribution

Marine environmental quality	Hicksian Equivalent (HE) surplus: Implied property rights in the change	Hicksian Compensating (HC) surplus: Implied property rights in the status quo
Increase	WAC to forgo	WTP to obtain*
Decrease	WTP to avoid	WAC to accept

In the present study we adopted the Hicksian equivalent surplus, corresponding to the change in income that reflects the consumer's maximum willingness to pay (WTP) – see "WTP to obtain" in Table 2. This implies that the present distribution of property rights is respected, so that individuals have to pay for an improvement of environmental quality due to the marine protection program.

In addition, one needs to choose the payment method. The crucial point is to find a scheme that best fits the environmental change in a way that: creates a plausible situation, convincing to respondents as an appropriate way to pay for the described program; and regarded as a fair method of payment, so that all respondents, independently of their socio-economic characteristics, life experiences and residential localization, are equally compelled to pay. Furthermore, the respondents are informed that the current budgets of shipping companies are insufficient to allow the implementation of prevention and monitoring schemes. In view of these conditions, we adopted a national tax collection scheme, rejecting alternatives, such as beach entrance fees. Moreover, the survey narrative makes clear to the respondent that the money raised will be exclusively allocated to the protection of program as described in the survey instrument and thus not subject to waste or fraud.

As far the elicitation method is concerned, we followed closely the National Oceanic and Atmospheric Administration guidelines (NOAA 1993) and adopted the referendum elicitation question format. This means that each respondent is faced with a specific cost, as stated in the survey instrument, and asked whether she is willing to pay that amount, a yes-or-no response, so as to prevent the development plan (Cameron and James 1987, Cameron 1988, Cameron 1991). In the present study, we used the double-bounded dichotomous choice question (Cameron and Quiggin 1994) so as to increase the statistical efficiency of the estimates (Hanemann *et al.* 1991). The use of referendum questions involves the design of a range of bids, i.e., the development of a scheme that specifies, for each respondent, the initial bid and the respective follow-ups. Thus, we have to decide how many bids to use, the lowest and the highest bid, how the bids should be spaced and what proportion of respondents should be offered each bid. These were chosen in accordance to the answering results to an open-ended WTP question used in a small number of pilot interviews in this study. Table 3 offers the full range of bid amounts used in the survey instrument.

Table 3. Bid amounts used in the survey *

Bid Cards	Initial Bid	Increased Bid	Decreased Bid
Card 1	6.5 €	20 €	2.5 €
Card 2	14 €	34 €	7 €
Card 3	20 €	52 €	11 €
Card 4	40 €	123 €	16 €

* Originally formulated in Dutch Guilders.

3.2 The survey administration

The administration of the questionnaire took place during August 2001 at the Zandvoort area, which is located at the North-Holland province of the Netherlands. During the summer Zandvoort is a coastal resort ideal for beach recreation activities, ranging from swinging to sailing. Zandvoort is one of the most popular beaches in the Netherlands, easily accessible by private and public transport. In general terms the Zandvoort beach area is characterized by two different zones: the beaches around the city center of Zandvoort and the beaches of Bloemendaal, where the coast is not so heavily urbanized and includes the natural park the Kennemer Dunes.

An interviewer with fieldwork experience conducted the survey. We opted for an in-person survey because it does not only lead to the highest survey response rates but also it is the most suitable when using double dichotomous willingness to pay elicitation format.

Table 4 offers the distribution of the number of interviews over time, including both weekdays and weekends. Before the execution of survey a first draft of the questionnaire was written and tested in a number of pilot interviews. This enabled us to check for the comprehensibility of the proposed valuation exercise and improve the language used in the narrative.[3]

Table 4. Distribution of the number of interviews

Wed 8th	Thu 9th	Sat 11th	Tue 14th	Wed 15th	Fri 17th	Sat 18th	Sun 19th	Wed 22nd	Thu 23rd	Fri 24th	Sun 26th	Sat 1st Sept
10	10	22	22	28	24	14	13	23	25	25	24	2

The selection of respondents was done according to a random coverage of visitors per beach house.[4] This process yielded a random coverage of visitors per beach house, thus contributing to the representativeness of the sample. The interviewer contacted 352 group of visitors from whom we received a total of 242 completed surveys. The non-participation rate is 31 percent, i.e. on average about two out three interviews were completed. Unlike many other survey applications the most often mention reason for refusal is “not speaking Dutch”; in fact foreign tourists accounted for one third of all refusals.

3.3 Descriptive statistics of the survey responses

The interviewer contacted 352 group of visitors, 242 of which completed the questionnaire. The non-participation rate is therefore 31 percent. Unlike many other survey applications the most often mentioned reason for refusal is “not speaking Dutch”. Tourists from abroad accounted for one third of all refusals. The questionnaire’s demographics and socio-economic characteristics indicate that the median respondent is between 40 and 41 years old, has completed the HAVO studies, lives with a partner, and has a household monthly net income is in the range of 1,800 € – 2,300 €. We also verified that the majority of the respondents were women, corresponding to 57.3 percent of the sample. When confronting the data of our survey with socio-demographic statistics for the Netherlands we are unable to find major differences. For example, the distribution of the levels of education in the sample is very

[3] For example, the pilot interviews played a crucial role in downsizing the original questionnaire, which proved to be too long for administration.

[4] A beach house refers to a zoning unit of the Zandvoort beach area. Appendix IV presents information about the localization of Zandvoort and provides a list of selected beach visitors.

similar representative. In addition, the sample average number of persons per household, 2.456, is close to the average for the Netherlands, which is 2.3.[5] In other words, the sample is representative for the Netherlands.

Survey responses on the travel data show that more than 50 percent of the respondents took a car to travel to Zandvoort, 20 percent arrived by public transport (i.e. train), 10.7 percent came by bicycle, and 15.6 percent of the respondent arrived to the beach on foot. We used public domain software[6] of the Dutch Railways to computed travel time for public transport. The sample results show that beach visitors that traveled by train spent on average two hours and twenty-five minutes on the two-way journey.[7] Each respondent traveling by car was asked to the postal zip code of their address, the brand and model of their car, the size of the engine, the type of fuel used, and the costs of parking at the beach. On the basis of this information we were able to compute individual travel costs for all visitors that used a car to reach the *Zandvoort* beach area. This shows that visitors who came by car traveled on average 104 kilometers and spent one hour and twenty-three minutes on the two-way journey.[8] The median respondent used a car powered by gasoline with a medium size engine and spent about 4.5 € in parking. Finally, respondents were asked to express whether they had incurred on-site expenditures. About 40 percent of the respondents indicated they had rented parasols or windshields and 48 percent that they had spent money on drinks or food in the terraces. Table 5 offers a more detailed classification of the on-site expenditures.

Table 5. On-site expenditures (%)

	Less than 5 €	6 to 9 €	10 to 22 €	More than 23 €
Beach materials	25.0	35.9	34.8	4.3
Food and drinks	43.8	26.7	17.1	12.4

Note: * Includes the costs due to the rent of parasols and windshields.

[5] Nevertheless, the survey sample reveals to be slightly skewed towards young respondents. See Appendix V for more detailed information.

[6] Available at www.ns.nl/reisinfo.

[7] The train station of Zandvoort is less than five minutes walking from the beach. As the origin we used the closest train-station to the zip code reported by the respondent. For respondents living far from a railway station we included an extra twenty minutes for transport from home to the railway station.

[8] Information obtained with *Microsoft AutoRoute Express 2000* software.

Descriptive data relating to the WTP questions are as follows. As one would expect from economic theory, the proportion of 'yes-yes' responses falls sharply with the amount the respondent is asked to pay. As we can see from Table 6, 15.5 percent of the respondents are willing to pay more than 20 € for the protection program, while only 3.8 percent of the respondents states a willingness to pay above 123 €. Such a low sample proportion at the highest bid is here interpreted as a signal that the bid card is well designed since it has captured the range of respondent's unobserved willingness to pay[9]. In addition, and as we would expect, the proportion of 'no-no' responses increases the bid amount. In fact, at the lowest bid card we register a 4.2 percent of "no-no" response whereas this proportion increases to 6.7 percent at the highest bid card. However, Table 6 also shows that lowest "no-no" sample proportion relates to the 20 € bid card and not to the 40 €, the highest bid card. This fact signals the need for analysis of the reasons underlying the "no-no" respondents.[10] The remaining answering patterns, "yes-no" ("no-yes") responses, indicate that the respondent's maximum WTP lies between the initial bid amount and the increased (decreased) bid amounts: 4.6 percent of the WTP lies between 15 and 20 € and 5.9 percent of the respondents' WTP lies between 16 and 40 €.

Table 6. Bid cards: money amounts and responses

Monetary amounts				Distribution of the WTP responses (in %)			
Bid card	Initial	High	Low	Yes-yes	Yes-no	No-yes	No-no
n. 1	6.5 €	20 €	2.5 €	15.5	4.6	0.4	4.2
n. 2	14 €	34 €	7 €	11.7	6.7	0.8	5.9
n. 3	20 €	52 €	11 €	10.5	10.9	0.8	2.5
n. 4	40 €	123 €	16 €	3.8	9.2	5.9	6.7

Finally, respondents were asked to state their opinion about priorities in coastal and beach management. Table 7 shows that coastal management activities related to 'keeping the sand beach clean from rubbish' received the highest priority, followed by 'protecting the marine ecosystem from water pollution' and 'ensuring seawater quality that does not provoke skin allergies'. Such a ranking pattern confirms the relevance of the present valuation study of damages caused by HABs.

[9] A "rule of the thumb" accepted in the literature suggests that if less than 10 percent of the respondents answer *yes* to the highest bid, then the bid vector has captured the range of the WTP distribution well. (see Boman and Bostedt 1995)

[10] The empirical literature on contingent valuation shows that this group of respondents is likely to include respondents that say "no" independently of the bid amount: these respondents are considered as *protest bidders.* An extensive analysis of reasons for protest is provided in Section 5.

Table 7: Opinion of the respondents with respect to alternative marine management actions

Ranking		Index*
N.1	Ensure that the beach is clean from rubbish such as cans and cigarettes.	18.6
N.2	Ensure that the marine ecosystem is not threatened by water pollution.	18.4
N.3	Ensure that the quality of the seawater is such that it does not provoke skin allergies.	17.6
N.4	Ensure that the dunes continue to be recreational areas and not for housing.	17.5
N.5	Ensure that some dunes are protected as areas for nature and closed to the public.	15.2
N.6	Ensure that the sand along the waterfront of the beach is clean from algae and foams.	12.5
N.7	Ensure that parking lots, bars and restaurants are sufficient for the number of beach visitors.	10.6

* The ranking index was computed by weighting response percentages to each possible response, assigning a weight of 20 to 'very important'; 15 to 'important'; 10 to 'somewhat important' and, finally, 0 to 'of little importance'.

4 Estimation results of the travel cost method

4.1 Travel costs: transportation and travel time

The cornerstone of the recreation travel cost model is the inversely related relationship between the individual (yearly) number of visits and the travel costs associated with each visit. In other words, we expect a decrease in the demand of yearly visits per individual as the total costs per visit increases. The generalized travel costs of a visit are defined as the sum of two components: out-of-pocket costs and the costs of travel time. Out-of-pocket travel costs include transportation costs and (site) entrance fees. Since in the present study the beach visitors do not face any entrance fee, the total cost of a visit is the sum of transportation and travel time costs.

4.1.1.1 Transportation costs

The transportation cost is calculated as a function of the respondent's means of transport; in this case (i) car, (ii) train, (iii) bicycle and (iv) walking. For the latter two categories the transportation costs are assumed to be zero. The train costs are estimated for a two-way train ticket between the Zandvoort train station and the closest train station to the respondent's residence. Finally, for respondents traveling by car, the monetary transportation costs are computed as a two-way trip length in kilometers times the car-cost per km. The latter depends on the brand, model, engine size and the type of the fuel used by the car of the respondent. The car-cost/km is calculated with possible approaches, namely the fuel-cost and the user-cost approach. The first refers to the marginal cost of one additional kilometer only in terms of fuel use. The user-cost approach in covers also maintenance, insurance and capital depreciation.[11] Table 8 offers the results of both approaches, for a range of cars as reported by the respondents.

Table 8: Some examples of fuel-cost and user-cost monetary values

Brand	Model	Engine size	Fuel	Fuel-cost (€/Km)	User-cost (€/Km)
BMW	316i	1600	Gasoline	0.104	0.450
Saab	95	2300	Gasoline	0.141	0.728
Peugeot	406	1900	Diesel	0.068	0.436
Aston Martin	V8	5400	Gasoline	0.377*	2.582*
Mazda	Denio	1300	Gasoline	0.091	0.333
VW	Passat	1900	Diesel	0.073	0.441
Citroen	Saxo	1100	Gasoline	0.045**	0.254**
Opel	Vectra	1600	LPG	0.054	0.337
Volvo	S40	1800	Gasoline	0.109	0.463
Peugeot	306	1900	Diesel	0.073	0.300
Renault	Megane	1600	LPG	0.054	0.372
Peugeot	607	3000	Gasoline	0.140	0.873
Chrysler	G. Chrysler	2500	Diesel	0.113	0.600

* (**) Maximum (minimum) valued registered in the sample

4.1.1.2 Travel time cost

The time cost is estimated by multiplying the amount of time that a respondent spends on the two-way trip to Zandvoort and her value of time. The latter is regarded as a function of the respondent's monthly income, the selected means of transport and the purpose of the trip. As we can see from Table 9, the value of time can range from 3.645 € per hour for a respondent in the lowest income category and traveling by train, to 11.541 € per hour for a respondent belonging to the highest income category and traveling by car.

Table 9. Value of time by income and travel mode (€)

Travel mode	Gross monthly income categories			
	Less than 1 350 €	1 350 € – 2 250 €	2 250 € – 3 400 €	More than 3 400 €
Car	4.236	5.090	6.268	11.541
Train	3.645	4.200	4.718	7.627

Source: Gunn *et al.* (1998)

[11] As a source for the user-cost approach *"De AutoGids* - Kostprijs per kilometer 2001" was used. In addition we assumed that that the respondent holds the car for a period of four years, and drives on average 15.000 kilometers per year.

4.2 Recreation demand function and estimation results

In addition to the individual travel cost data, socio-economic-demographic variables and site attributes are included in the recreation demand function. The latter can be formally written as

$$V = f(\mathbf{X_s}, \mathbf{X_a}; \boldsymbol{\beta}, \boldsymbol{\Omega}) \tag{1}$$

Here V denotes the number of visits to the *Zandvoort* beaches during the past twelve months, $\mathbf{X_s}$ denotes the vector of socio-economic-demographic characteristics of the respondents, $\mathbf{X_a}$ the vector of attributes related to the *Zandvoort* beaches, $\boldsymbol{\beta}$ the vector of parameters to be estimated, and $\boldsymbol{\Omega}$ the error-term vector. In order to achieve robust, non-biased estimates of β the econometric model specification and estimation method need to respect the intrinsic characteristics of the travel cost data. In particular, they need to take into account the fact that the number of visits is nonnegative, i.e. the dependent variable is truncated at zero (Hellerstein 1992). Therefore, we work with the following semi-logarithmic specification[12] (Model I):

$$V = e^{\beta_0 + \sum_s \beta_s x_s + \sum_a \beta_a x_a + \varepsilon} \tag{2}$$

Here the β_i are the parameters to be estimated, with β_s and β_a denoting the parameters of the socio-economic-demographic characteristics of the respondents and the attributes of the *Zandvoort* beaches, respectively. ε denotes the error term. OLS results of the are presented in Table 10. An additional characteristic of the travel cost data is that since it draws from on-site surveys, meaning that frequent visitors are more likely to be interviewed. As a consequence, the econometric model specification and estimation method for Equation 1 needs to be corrected for self-selection bias. Therefore, we estimate a count data model, correcting for both truncation and self-selection. This gives rise to model specification (Model II):

$$\text{Prob}(V = j) = F_p(j) = e^{(-\lambda)\lambda^j} \big/ j! \tag{3}$$

with

[12] There are other non-linear functional forms, such as the quadratic and double-logarithmic, all of which are consistent with the underlying theory of demand, in which the larger the travel cost variable, the smaller the marginal effect of price on the number of trips demanded. The semi-logarithmic specification has a unique (interpretational) advantage in that the average consumer surplus per trip simply is the inverse of the estimated coefficient of travel cost (Loomis and Walsh 1997).

$$\lambda = e^{\beta'_0 + \sum_s \beta'_s x_s + \sum_a \beta'_a x_a + \varepsilon}$$

Here j denotes the possible values for the annual visits to the *Zandvoort* beaches *(j=1, 2 …)*, $F_p(.)$ the cumulative distribution function of the standard Poisson probability model, and λ (non-negative) Poisson parameter to be estimated (see Greene 2000).[13]

The estimation results are as follows. Independently of the transport cost approach and the econometric specification, all the three variables that represent the generalized travel cost have a negative sign, reflecting theoretical expectations. In particular, for Model I, fuel-cost approach, both travel time and transport expenditure estimates reveal to be statistically significant different from zero. In other words, the empirical evidence confirms the economic relevance of the transport expenditures and travel time in explaining consumer recreational behavior, i.e. in determining the number of annual visits to the beach. The results show that the demand function for annual visits to the beach is particularly sensitive to the respondent's travel time: an increase of 1 € in the travel time is associated with a decrease of 1.16 % in the annual visiting rate. This result indicates the relevance of having an efficient transport network. An increase in traffic congestion, for example, would reduce the number of visitors to the beach of *Zandvoort*. Note that the roads in this part of the Netherlands – the province of North-Holland – are generally very congested.

Table 10 also shows that the demand of visits to the beach reveals not to be economically sensitive to income, although the magnitude reveals to be statistically different from zero. An increase of the net household monthly income of 100 € corresponds to an increase of 0.1 percent in the total annual visits. With regard to personal characteristics, the estimation results show that the number of visits is expected to be lower for male, older respondents living with a partner than for other respondents. Furthermore, visitors who plan to stay all day long at the beach have a higher annual visit frequency than respondents who visit the beach for half-a-day or a couple of hours. Moreover, estimation results indicate that respondents who visit the beach of Bloemendaal, which refers to the location of the natural park of the Kennemer dunes, have a higher annual visit frequency than respondents that visit the beaches of Zandvoort.

Finally, estimation results in terms of both sign and statistical significance of parameters estimates for the specification based on user-cost does not differ much from that for fuel-cost ones. The only exception is the parameter of the variable "transport", which is only

[13] Estimation results for the Poison regression are presented at Appendix VI.

Table 10. Demand function estimation results – MODEL I [(a)]

Variables	Transport cost approach					
	Fuel-cost approach			User-cost approach		
	Estimate	Std. Error	p-val.	Estimate	Std. Error	p-val.
Intercept	4.036*	0.639	0.00	3.717*	0.639	0.00
Travel costs						
Transport	– 0.0064**	0.007	0.08	– 0.0002	0.003	0.89
Travel time	– 0.0116**	0.015	0.10	– 0.0211*	0.016	0.00
Parking	– 0.0002	0.025	0.98	– 0.0068	0.026	0.57
Site characteristics						
Bloemendaal beach	1.098*	0.512	0.03	1.1337*	0.522	0.03
Sunny weather	– 0.0005	0.347	0.99	0.0316	0.350	0.93
Week-end	– 0.4353	0.361	0.22	0.3978	0.368	0.28
Respondent's characteristics						
Male	– 0.3875	0.327	0.20	– 0.2994	0.317	0.34
Age	– 0.0080	0.012	0.53	– 0.0083	0.013	0.52
Net income (by the hundreds of €)	0.0010*	0.082	0.00	0.0012*	0.082	0.00
Field of studies: Economics	– 0.3407	0.310	0.27	– 0.3744	0.314	0.23
Living with a partner	– 0.6496**	0.380	0.08	– 0.6574**	0.385	0.09
Stay at the beach all day	0.6623**	0.352	0.06	0.6860*	0.355	0.05
Adjusted R^2		0.248			0.232	
A.I.C.		4.043			4.065	
F test (p-value)		0.000			0.000	

Notes: [(a)] Calculations are performed using count data models in *LIMDEP*®.
* Significant at 5%
** Significant at 10%

statistically significant for the fuel-cost approach. Note that this approach represents best individual behaviour.

4.3 Demand curve and calculation of recreation benefits

The assessment of the individual recreation benefits is performed by deriving a standard Marshallian demand curve for yearly visits to the Zandvoort beach area. We evaluate all the explanatory variables of the demand function at their sample mean, with the exception of the individual travel costs variable. Furthermore, the computation of the demand curve refers only to the explanatory variables associated with p-values lower than 10%. In other words, the computation of the demand curve is based on all explanatory variables that, with a ten percent confidence interval, are statistically significant different from zero. The underlying consumer recreation corresponds to area underneath the resulting demand curve. For Model I and the fuel-cost approach we obtain[14],

[14] See Appendix VII for more details.

$$P^{Model\ I}_{fuel-\cos t} = 61.2086 - 16.2338 \times \log N \tag{4}$$

where P denotes the full travel cost and N the yearly number of trips. For the user-cost approach we obtain

$$P^{Model\ I}_{user-\cos t} = 160.4740 - 46.0532 \times \log N \tag{5}$$

If we repeat this exercise for Model II, we get, respectively for the fuel-cost and the user-cost approaches, the following inverse demand curves,

$$P^{Model\ II}_{fuel-\cos t} = 67.7153 - 41.6777 \times \log N \tag{6}$$

$$P^{Model\ II}_{user-\cos t} = 201.9832 - 124.1927 \times \log N \tag{7}$$

Integrating equations (4), to (7) allows computation of the total recreation benefits. Table 11 lists the full range of recreation benefits estimates.

Table 11. Annual gross recreation benefit per individual

Econometric model specification	Transport approach	
	Fuel-cost approach	User-cost approach
Model I	115 €	280 €
Model II	55 €	164 €

According to Model I, the gross recreation benefits per individual are estimated to be 115 € and 280 € per year for the fuel-cost and user-cost approaches, respectively. Alternatively, for Model II, which corrects for self-selection bias, the recreational welfare loss for each beach visitor ranges from 55 € to 164 € per year. Bearing in mind that:

a) Model II is interpreted as the most appropriate one to our study since it controls for both truncation and self-selection bias, i.e., fact that frequent visitors are more likely to be interviewed; and
b) Fuel-cost approach receives stronger empirical evidence as a model formulation to analyze individual recreational behavior related to the number of annual visits to the beach of Zandvoort,

we can predict that if the beach area of Zandvoort is closed to visitors for an entire year, due to a biological pollution event involving algae, the total recreational welfare loss is approximately of 55 € per visitor per year.

5 Estimation results of the WTP responses

5.1 The "no-no"-zero willingness to pay responses

This section discusses the WTP responses. Respondents who state "no" to both dichotomous choice questions, which represent about 19 percent of the sample. All respondents that answered "no-no" faced a follow-up, open-ended WTP question. If the response to this was a zero willingness-to-pay, then the respondent is asked to indicate her major motivation for this choice. The results are listed in Table 12.

Table 12: Reasons for a zero WTP (%)

I do not believe in the proposed project	10.6
The proposed project is not worth so anything	0.0
The ship companies have to pay all the costs	74.5
The government has to pay everything out from the regular budget	14.9
My income does not allow me to pay anything	0.0

The most important motivation for not willing to pay anything is, by far with 74.5 percent, that the financial costs should be entirely met by shipping companies. The second most important motivation is that the government should cover the costs. These two arguments – as opposed to the remaining ones – reflect zero protests, i.e. do not reflect a zero valuation of the program that rather reflect a disapproval of the proposed payment mechanism. Finally, some respondents simply did not believe that the program would work. The latter is supported by explicit statements by respondents like: "Do not believe in the ship monitoring activities", "Do not believe the risk will go down with 90%", "The program also needs to be planned for Amsterdam and Antwerp harbors", "The program needs to be to be arranged on a European level, otherwise it will not work", and "There should come a program on world-level; Holland does not have to be the first mover".

5.2 WTP estimation results

5.2.1 Double bounded dichotomous choice model

According to the double bounded response model, for each *j* respondent four possible response outcomes are possible: "no/no", "no/yes", "yes/no" and "yes/yes" respectively coded as ${r_{nn}}^j$, ${r_{ny}}^j$, ${r_{yn}}^j$ and ${r_{yy}}^j$ binary indicators variables. The contribution to the (log)likelihood function from one observation is then (Cameron and Quiggin 1994)

$$ {r_{nn}}^j \ln F\left(b_l^j;\theta\right)+{r_{ny}}^j \ln\left[F\left(b_i^j;\theta\right)-F\left(b_l^j;\theta\right)\right]+{r_{yn}}^j \ln\left[F\left(b_h^j;\theta\right)-F\left(b_i^j;\theta\right)\right]+{r_{yy}}^j \ln\left[1-F\left(b_h^j;\theta\right)\right] \qquad (8) $$

Here *F(.)* is a statistical distribution function with parameter vector $\theta \equiv (\beta, \sigma)$, where β and σ denote the location and scale parameters of the distribution. *F(.)* can be interpreted as the cumulative distribution function of the respondents. The sum of these contributions to the likelihood function $L(\theta)$ over the sample is maximized, where,

$$ L(\theta)=\sum_{j=1}^{N}\left\{{r_{nn}}^j \ln F\left(b_l^j;\theta\right)+{r_{ny}}^j \ln\left[F\left(b_i^j;\theta\right)-F\left(b_l^j;\theta\right)\right]+{r_{yn}}^j \ln\left[F\left(b_h^j;\theta\right)-F\left(b_i^j;\theta\right)\right]+{r_{yy}}^j \ln\left[1-F\left(b_h^j;\theta\right)\right]\right\} \qquad (9) $$

The ML estimator for the double-bounded model, $\hat{\theta}$, is the solution to the equation $\partial L\left(\hat{\theta}\right)/\partial\theta = 0$. To come up with such estimates it is necessary to assume that the stated WTP responses are distributed according to a particular distribution family. Since the "true" underlying distribution of the WTP is unknown, the choice of the distribution family is in important choice in the estimation of the willingness to pay function. We explore the analysis of the willingness to pay responses making use of two families of distributions; the Lognormal and Weibull, which are frequently used in the contingent valuation literature.[15] Before, however, we will explore the study of the 'no-no' responses so as to control for potential protest voters.

For a univariate model with a lognormal distribution, the mean WTP is given by $WTP = e^{\hat{\beta}+\frac{1}{2}\hat{\sigma}^2}$, where $\hat{\beta}$ and $\hat{\sigma}$ represent the location and scale of the lognormal distribution, respectively. Maximizing the likelihood function for the double-bounded WTP

[15] One reason is that these when compared with other distribution families, such as Loglogistic and Exponential, present the lowest Loglikelihood statistic values, which in turn is interpreted as a signal of the highest goodness of fit (Akaike 1973, Nunes 2002).

data allows us to estimate the location and scale parameters of a parametric distribution, $\hat{\beta}$ and $\hat{\sigma}$, and in this way allows us to compute the mean of the population distribution (Johnson and Kotz 1970). As we can see in Table 13, the lognormal mean WTP estimate is 76.2 €.

Table 13: Lognormal mean and median WTP estimates

Parameters	Estimate	Standard Error
Location (β)	4.6221	0.08856
Scale (σ)	0.9997	0.08081
Log-Likelihood	-205.430	
	Point estimate	90% Confidence interval estimate
Mean	76.2 €	[58.2 € – 101.5 €]
Median	46.2 €	[39.9 € – 53.5 €]

The $\hat{\beta}$ and $\hat{\sigma}$ standard errors indicate that the parameters are estimated precisely. This is also reflected by the 90 percent confidence intervals.[16] Conversely, the median estimates are particularly sensitive to the left-hand-side of the distribution, and thus the respondents who say "no-no" to the stated bids. Since a great deal of respondents say "no" to both WTP questions, this drags down substantially the median estimates (when compared to the mean values), given median estimates that vary from 39.9 € to 53.5 €.

For a model with a Weibull distribution, the mean WTP is given by $WTP = e^{\hat{\beta}}\Gamma(1+\hat{\sigma})$. Once again the goal is to use the parameters estimates, $\hat{\beta}$ and $\hat{\sigma}$, to compute the mean of the population distribution. Maximizing the likelihood function for the double-bounded WTP data yields the parametric estimates as reported in Table 14. The median WTP estimates for the Weibull and Lognormal distribution are all quite close, 49.1 € and 46.2 €, respectively. Since the heavy right tail of the Weibull distribution is the primary determinant of the estimate of the mean, the mean estimates are much higher than the median estimates. Furthermore, when compared with the Lognormal, the mean for the Weibull distribution is about 22 percent lower. Bearing in mind their 90% confidence interval estimates, we can observe an interval width overlapping, which suggests that the Lognormal and Weibull WTP estimates may not be statistically significant – see Figure 1.

Finally, in order to improve the statistical quality of the double bounded dichotomous choice WTP estimates we explore the use of mixed econometric models, combining the use

Table 14: Weibull mean and median WTP estimates

Parameters	Estimate	Standard Error
Location (β)	4.9563	0.07786
Scale (σ)	0.7444	0.06093
Log-Likelihood	-203.470	
	Point estimate	90% Confidence Interval estimate
Mean	59.3 €	[50.9 € – 69.3€]
Median	49.1 €	[44.8 € – 53.8 €]

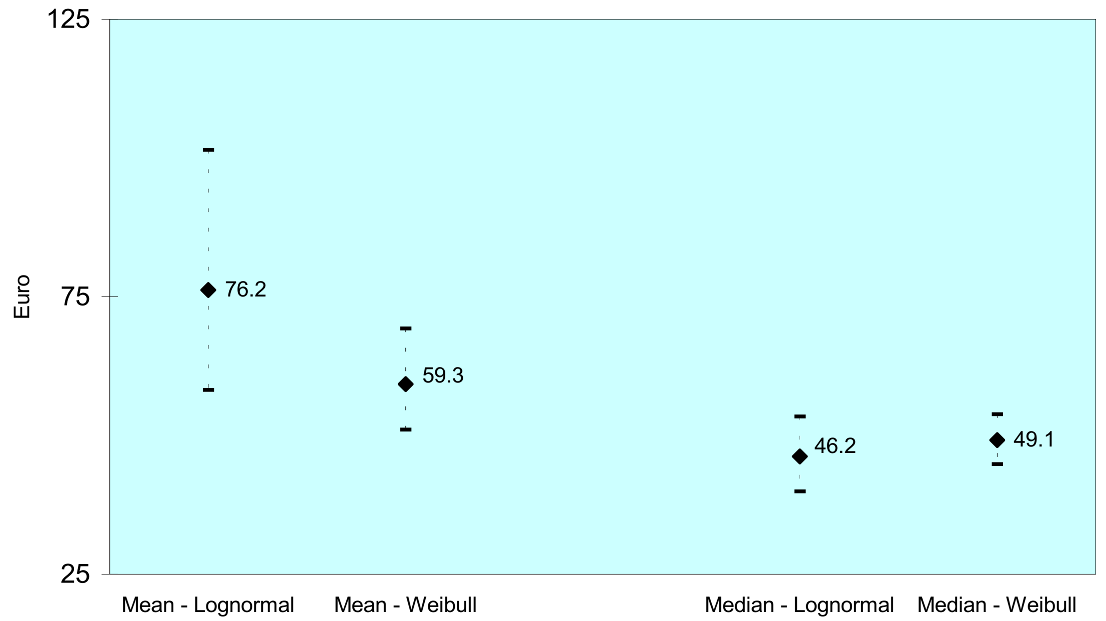

Figure 1: WTP estimates for the double bounded dichotomous choice model

of double bounded dichotomous choice responses with the open-ended follow-ups to the "yes-yes" and "no-no" answering patterns. These are discussed in the following subsection.

5.2.2 Mixed response model type I

The combination of Double Bounded Dichotomous Choice (DBDC) responses with the Open-Ended (OE) follow-ups to the "yes-yes" answering pattern allows the development of a of a mixed response model. This model is characterized by expanding the original DBDC data by introducing the WTP information obtained with the OE elicitation question. We shall

[16] Calculations are performed using the PROC LIFEREG procedure in *SAS*®.

label this model as the Mixed model type I, or shortly Mixed I (MI) model.[17] Furthermore, since now we have individual information related to the open-ended WTP question, we are able to compare respondents' stated bid-amount with their net monthly income, as reported in the questionnaire. Therefore, we are able to trim the original sample and exclude all the respondents who report a willingness to pay higher than 5% and 2.5% of their net monthly income. Table 15 reports the mean estimates for the MI model.

Table 15: Mean and median WTP estimates

Lognormal	Mean	90% CI	Median	90% CI
Mixed model type I	38.8 €	[18.0 € – 84.0 €]	32.7 €	[15.5 € – 68.5 €]
Mixed model type I and 5% trimmed	35.7 €	[32.5 € – 39.5 €]	30.8 €	[28.5 € – 33.0 €]
Mixed model type I and 2.5% trimmed	29.8 €	[27.0 € – 33.0 €]	26.6 €	[24.5 € – 28.5 €]

The comparison of the original double bounded dichotomous-choice WTP estimates with the Mixed I WTP estimates delivers two important results. First, the mean and median WTP point estimates provided by the MI-model are lower than the point mean estimate resulting from the DBDC model. This is in accordance with the state-of-art in the literature, which considers the OE as an elicitation question that generates lower WTP estimates when compared with the WTP estimates calculated with the dichotomous choice question format.[18] Second, the estimation results show that the median (mean) WTP estimate confidence interval is smaller (larger) in the MI model than in the original DBDC format. In order to test the present mixed empirical evidence with respect to the precision of the WTP estimates, we propose to look at an additional mixed model that also explores the use of the follow-up open-ended WTP question This model will be discussed in the following subsection.

5.2.3 Mixed model type II

Unlike mixed model type I, the present econometric model is not characterized by translating the OE-follow-up WTP responses into the DBDC model structure. On the contrary, OE-follow-up WTP response data is now combined, in its original format, with the DBDC data into an integrated estimation structure process that makes use of both types of WTP data. Therefore this model structure respects the statistical nature of each elicitation question

[17] The DBDC-OE-follow-up estimates were calculated with the help of SAS by translating the OE-follow-up WTP responses into the DBDC model structure and assuming that the underlying distribution is a Lognormal.

[18] The dichotomous format may encourage the "yes saying" where the posted bid is accepted as a hint of what is a reasonable payment - see Holmes and Kramer (1995).

formats. We shall label this model a Mixed model type II. Table 16 offers the respective WTP estimates.

Table 16: Mean and median WTP estimates

Lognormal	Mean	90% CI	Median	90% CI
Mixed model type II	50.1 €	[44.7 € – 58.8 €]	43.6 €	[40.1 € – 47.4 €]
Mixed model type II and truncated at 5%	45.4 €	[41.0 € – 50.5 €]	40.6 €	[37.6 € – 43.9 €]
Mixed model type II and truncated at 2.5%	38.8 €	[35.5 € – 43.6 €]	36.0 €	[32.4 € – 38.9 €]

The estimation results show us that the mean WTP is 50.1 € and the median WTP is 43.6 €. As in Mix model type I, the estimation results are lower than in the original DBDC model. Second, the degree of precision of the WTP estimates is higher than in the original DBDC model. As a consequence, the respective 90 percent confidence intervals are now narrower. Finally, the WTP estimates for the truncated sub-samples[19] show lower WTP estimates, for example when truncation is performed at 2.5% the mean WTP decreases from 50.1 € to 38.8 €.

Finally, a comparison of the confidence between both models shows overlap indicated by the area between the horizontal dashed lines in Figure 2. The related WTP values can be regarded as the most robust welfare estimates for the marine ecosystem protection benefits. They are reported in Figure 2. The results show that an annual welfare loss is estimated to be on average at least of 58.2 € per respondent.

5.2.4 A comparison of the DBDC and mixed model estimates

If we proceed to the comparison of the WTP estimates that result from the DBDC model structure with the estimation results with obtained with the Mixed model type II structure, what is the synthesis properties for the WTP estimates? A simple exercise consists in plotting the confidence intervals of each model structure and look for possible overlapping, i.e. intervals estimates that are valid for both model structures. Horizontal dash lines in Figure 2 confirm the presence of such overlapping confidence intervals. Such WTP value estimates reveal to be robust to both double dichotomous and mixed model structures and for this reason we shall name these as WTP-synthesis estimates, which can be interpreted as a robust

[19] All respondents are included in the WTP computations but now whenever the reported OE-open-ended WTP response exceeds a certain fixed proportion of their net monthly income, their responses are truncated. For example, if a given respondent reports more than 5% of her household net income and her net income is 2000 € per month, them we truncate her WTP to 100 € (= 5% of 2000 €).

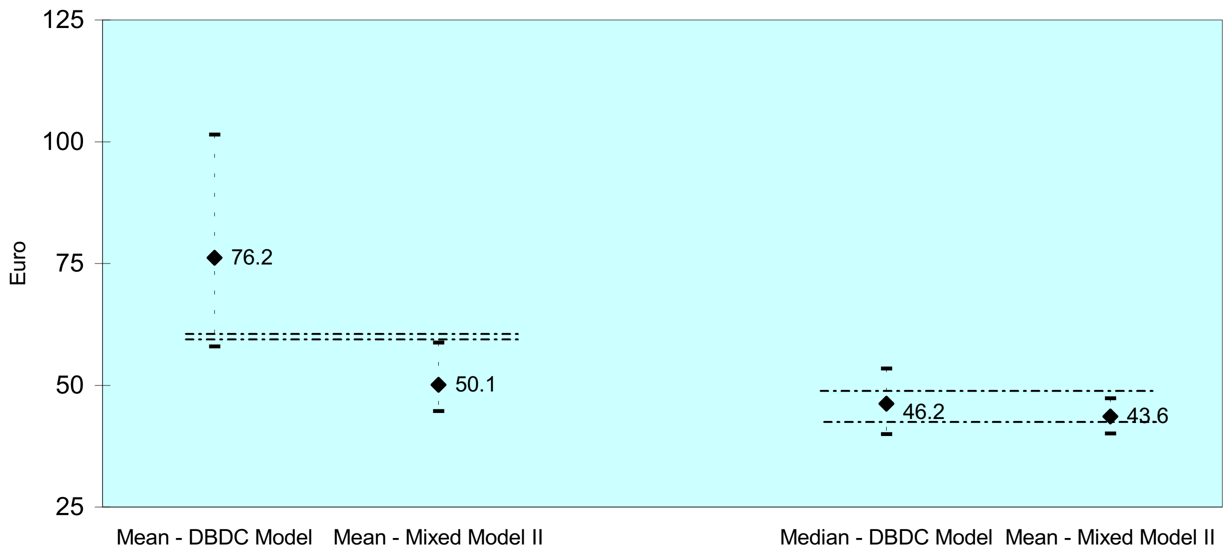

Figure 2: WTP estimates: double bounded dichotomous choice mode and mixed model II

welfare estimates for the marine ecosystem protection benefits. These are reported in Table 17 and show that:

- An annual welfare loss is estimated to be, at least, of 58.2 € for each respondent;
- If the described protection is voted in a referendum and its approval implies an annual payment of 40.1 € for the next two years by beach visitors, the majority of the voters will say "yes" and the program will be adopted.

Table 17: Summary of the WTP estimates

Welfare measurement	Range
Mean	58.2 € – 58.8 €
Median	40.1 € – 47.4 €

5.3 Estimation of the WTP function

A large number of possible predictors are available to be integrated in the valuation function. In the present analysis, we selected the following variables: (i) the geographical location of the beach and the day of the interview; (ii) the beach recreational profile of the respondent, including the number of annual trips to the *Zandvoort* area, the time planned to stay at the beach, whether the respondent visits the beach during the winter season, and the number of adults in the group; (iii) the respondents opinion about priorities in coastal and beach management; (iv) the travel costs and on-site expenditures; and (v) the socio economic characteristics of the respondents, gender, age, and education. The estimation results are reported in Table 18. The following conclusions can be drawn:

- Respondents who visit the *Zandvoort* beaches two to three times per year – which corresponds to the second lowest visiting frequency presented – and plan to stay at the beach the whole day are willing to pay more for the marine protection program than the average respondent.
- Respondents who visited the beach during the weekends and choose to stay at the *Bloemendaal* beach are willing to pay more than the average respondent.

Table 18: WTP function[(a)]

	Estimate	p-value
Beach attributes		
Area: *Bloemendaal*	0.206	0.53
Day of the interview: week-end	0.418**	0.08
Recreational profile of the visitor		
Number of adults in the group	0.093	0.30
Presence of a child in the group	0.086	0.77
2 or 3 visits per year	0.633*	0.04
Visits in the winter season	– 0.534*	0.02
Time planned to stay on the beach: all day	0.427**	0.08
Marine management policy options		
Nature reserves closed to the public	0.271**	0.09
Infrastructure support	0.358*	0.01
Socio-economic characteristics		
Age	– 0.005	0.52
Income	0.008	0.61
University degree	0.169	0.48
Education in economics or business management	– 0.288**	0.20
Travel costs and on-site expenditures		
Transport	0.003	0.55
Travel time	– 0.014**	0.20
Parking fee	– 0.056*	0.01
Expenditures on beach materials	0.021**	0.06
Expenditures on food and drinks at the beach-house	0.005**	0.18
Lognormal parameters		
Intercept	3.323	
Scale	0.870	
Log-Likelihood	– 116.401	

Notes: [(a)] Calculations are performed using the PROC LIFEREG procedure in *SAS*®.
* Significant at 5%
** Significant at 10%

- Respondents who visit the site during the winter are willing to pay, on average, less for the described protection program. This may be due to the fact that the marine biological pollution, as described in the questionnaire, is less likely in the winter than in the summer, because of the lower temperature of the water.
- Respondents who ranked the protection of coastal reserve areas 'the most important' priority for beach management are willing to pay more for the marine protection program than the average respondent. Such estimation result confirms the relevance of the valuation of welfare impacts that are not directly with recreation since the marine protection program and this management activity are presented in the survey so to identify and measure consumer preferences with respect to marine ecosystem benefits and nonuse impacts caused by HABs.
- Respondents who spent a longer time traveling or who incurred higher parking costs have lower WTP. This suggests that the values obtained with the TC and CV methods are largely complementary. In other words, the TC exercise ahas captured other value categories than the CV exercise.

6 Synthesis and policy recommendations

This article has offered an assessment of the non-market benefits associated with the impact of a marine protection program in beach recreation. This program focuses on the prevention of harmful algal blooms species along the coastline of the Netherlands. It entails the construction of a ballast water treatment complex in the Rotterdam harbor and the implementation of a monitoring program of the water quality in the open sea along the North-Holland beaches. The analysis is based on a questionnaire undertaken at *Zandvoort*, a famous Dutch beach resort. According to the travel cost model estimates, if the beach area of *Zandvoort* is closed to visitors for an entire year, due to a biological pollution event involving HABs, the loss of recreational benefits would range from 55 € to 115 € per visitor per year. The travel cost effect is particularly strong since the region of the study in the Netherlands is severely affected by traffic congestion. The contingent valuation of the willingness to pay responses indicates that non-market benefits' estimates range from 58 € to 101.5 € per respondent per year. The combination of TC and CV estimation results shows that respondents with relatively high travel costs, mainly car users that travel from far, have a relatively low WTP for the marine protection program. This result suggests that some budget constraint is active, and that TC and CV estimates are, to some extent, complementary in terms of achieving a complete picture of the overall monetary value.

Finally, travel cost and contingent valuation results show that if no policy action is undertaken so as to prevent a HABs marine pollution event in the coast of the Netherlands a significant welfare loss may result. If we add the values we arrive at an upper bound estimate of the total welfare value of 539,085,000 € (431,268,000 €)[20] per year, which corresponds to 0.13 percent of the Dutch GDP, measured at market prices for the year of 2000. This figure can be regarded as an upper bound to the cost of implementation of an efficient marine protection program.

[20] This value is obtained by multiplying of the individual mean welfare loss by the total number of visitors to the North–Holland coastline, about 2,400,000 per year (CBS). The value between brackets gives a lower valuation bound and the welfare loss and it is obtained if we admit that the overall percentage of respondents that refuse to participate in the survey have a zero valuation.

Appendix I: Classification of the negative impacts of HABs

Table 1 presents a taxonomic classification of HABs with (1) *Cyanobacteria* refers to all HABs able to photosynthesize; (2) *Diatoms* refers to all HABs able to produce the amino-acid glumate toxin; (3) *Dinoflagellates* refers to all HABs able to produce toxins that cause ciguatera disease; (4) *Prymnesiophytes* refers to all HABs connected to toxins that range from the neurotoxic to haemolytic groups; (5) *Raphidophytes* refers to all HABs able to produce toxins that cause massive fish mortality; and, (6) *Pelagophytes* refers to all harmful but not toxin-producing HABs.

Table 19. Types of harmful algae species and impacts

Causative micro-organism	Algae species	Toxicity*	Impacts: Human health	Tourism	Ecological
(1) Cyanobacteria	*Anabena circinalis*	●	●	○	○
	Nodularia spumigena	●	●	●	○
	Microcystis aeruginosa	●	●	○	○
(2) Diatoms	*Chaetoceros* spp.	○	○	○	●
	Cylindrotheca closterium	●	○	●	○
	Pseudo-nitzchia spp.	●	●	○	●
	Skeletonema costatum	●	○	○	●
	Thalassiosira spp.	○	○	○	●
(3) Dinoflagellates	*Alexandrium* spp.	●	●	○	●
	Alexandrium taylori	○	○	●	●
	Cochlodinium polykrikoides	●	●	○	○
	Dinophysis spp.	●	●	○	○
	Heterocapsa triquetra	●	○	○	●
	Gambierdiscus toxicus	●	●	○	○
	Gonyaulaux spp.	●	●	○	○
	Gymnodinium breve	●	●	○	●
	Gymnodinium catenatum	●	●	○	○
	Gyrodinium aureolum	●	○	●	●
	Gymnodinium mikimotoi	●	●	○	●
	Noctiluca scintillans	●	○	●	●
	Pyrodinium bahamense var. *compressum*	●	●	○	○
	Pfiesteria piscicida	●	●	○	○
	Prorocentrum spp.	●	●	○	○
(4) Prymnesiophytes	*Chrysochromulina* spp.	●	○	○	●
	Phaeocystis spp.	○	○	●	●
	Prymnesium spp.	●	○	○	●
(5) Raphidophytes	*Fibrocapsa japonica*	●	○	○	●
	Heterosigma akashiwo	●	○	○	●
	Chattonella spp.	●	○	○	●
(6) Pelagophytes	*Aureococcus anophagefferens*	○	○	●	●
	Aureoumbra lagunensis	○	○	○	●

* *Note:* the symbol ● (○) denotes that the respective alga is (not) toxin producing.

Source: van den Bergh *et al.* (2002) and Anderson (1994).

Appendix II: Structure of the survey instrument

This appendix presents a description of the structure of the survey instrument used for the economic valuation of a marine protection in the North-Holland coast of the Netherlands. Seven sections characterize the narrative of the survey instrument:

- Section A, which are addressed to elicit the respondent's beach related recreational profile;
- Section B, which are focused on retrieving respondent's travel cost and expenditure data;
- Section C, where respondent's opinion with respect to different issues related to coastal and beach management is tackled;
- Section D, which focus on assessing the respondent's maximum willingness to pay for the described regulation program;
- Section E, which seeks to measure the respondent's socio-economic-demographic profile;
- Section F, which are targeted to evaluate the overall comprehension of the survey instrument.

Section A: recreational behavior questions

The first part of the survey instrument consists of questions regarding respondent's recreational behavior with respect to the visits to the beach along the North-Holland coastline. As a matter of fact, the interviewers were given strict instructions to start the questionnaire stating:

> *Good-morning/good-afternoon. My name is* ***[the interviewer shows an ID card]*** *and I am working with the Vrije Universiteit in Amsterdam. This short questionnaire is part of a research project that has the goal to study the recreational behavior of visitors at North-Holland beaches. May I kindly ask you some questions about your attitudes and opinions?*

The questionnaire starts by encouraging the respondent to:

> *Please think careful about each question and give your best answer. There are no right or wrong answers, only personal answers.*

and respondents were asked:

> ***Q1.*** *How many persons are in your group (including yourself)?*
> ***Q2.*** *During one full year, how often do you visit this beach?*

To help respondents, the survey instruments includes a closed-form response: on one hand, respondent can state that she visited the beach "less than once a month" or, on the other hand, state that she visited the beach "at least once a month". Bearing in mind respondent's answer to **Q2**, interviewers present right away an answering card where she is able to fine-tune her initial answer.[21] The questionnaire continues with:

> ***Q3.*** *Why did you come to the beach today (the main reason)?*
> ***Q4.*** *How long do you plan to stay at the beach?*
> ***Q5.*** *Do you also come to this beach during the winter period (if yes, state the main reason)?*

As before, the interviewers make use of closed-form response formats. As expected, the respondent is able to state any additional reason whenever this reason is not originally contained in the survey instrument.

Section B: travel cost and expenditures questions

In the second section of the survey instrument, the interviewers present a sequence of questions so as to describe the travel to the beach as well as to portray the set of expenditures that she incurred during her visit. Therefore we have:

> ***Q6.*** *Where do you live?*
> ***Q7.*** *How did you come to the beach?*
> ***Q8.*** *Do you have a perception of how much did it cost to you to travel today to the beach (all the family)?*
> ***Q9.*** *Did you hire or buy anything at the beach (sun-umbrella, chairs, windshield)?*
> ***Q10.*** *Did you buy anything at the beach (drinks or food)?*

These questions, together with Q2 answering pattern, will provide us crucial information with which we are able later to develop a travel cost model (see Section 4).

Section C: coastal and beach management questions

This section consists of a sequence of ten questions related to different aspects of coastal and beach management:

> *In a preliminary study we verify that beach recreationists have expressed different opinions with respect to the degree of importance regarding the priority of alternative beach management aspects. For each aspect, I would like you to tell me whether you think it is very important, important, little important, or not importance.*

[21] The card ranges from "once a year", "two to three times a year", "three to six times a year", "more than six times a year" to "two to three times a month", "one time per week", "two to three times a week", "more than three times a week" and "almost everyday".

Without having the ambition of being exhaustive, these include water quality, housing, nature and marine ecosystem protection, beach infrastructure and zoning. The respondent's answers, which range from "not important" to "very important", will provide the information necessary to evaluate and rank different aspects of coastal and beach management according to their importance of governmental action. In particular we have:

> ***Q11.*** *Ensure that the quality of the seawater is such that it does not provoke skin allergies.*
> ***Q12.*** *Ensure that the sand along the waterfront of the beach is clean from algae and foams.*
> ***Q13.*** *Ensure that the dunes continue to be recreational areas and not for housing.*
> ***Q14.*** *Ensure that some dunes are protected as areas for nature and closed to the public.*
> ***Q15.*** *Ensure that the marine ecosystem is not threatened by water pollution.*
> ***Q16.*** *Ensure that parking lots, bars, restaurants and ice-cream stands are sufficient for the number of beach visitors.*
> ***Q17.*** *Ensure beach recreation zoning where volleyball fields, bike paths, windsurfing and boating is allowed to visitors.*
> ***Q18*** *Ensure that the beach is clean from rubbish such as cans and cigarette bull.*
> ***Q19.*** *Ensure beach zoning where nudity is allowed to visitors.*
> ***Q20.*** *Ensure beach zoning where dogs are allowed to get in together with their owner.*

In order to avoid any sequence bias, the questions are randomly rotated at each interview.

Section D: contingent valuation questions

In this the survey instrument narrows down to the discussion of protection of seawater and beach of the North-Holland coastline against biological pollution, in general, and toxic algae, in particular. These toxic algae constitute an important source of biological pollution causing important risks to marine ecosystems (mass mortalities of commercial fish) as well as risks to humans (ranging from skin allergies to fish poisoning).

> *Recent scientific measurements show the presence of microscopic toxic algae in the seawater along this coast. With the increase of the water temperature registered during the summer, these toxic algae can reproduce rapidly, potentially creating the so-called 'red-tides' on open sea and 'algae blooms' on the beaches. At this moment this beach is highly exposed to the risk of a biological pollution event.*
>
> ***Q21.*** *Were you informed about the risk of water pollution in this beach related to biological pollution incidents such as red-tides and algae blooms?*
> ***Q22.*** *Have you heard or read something in the news about incidents related to the presence of toxic algae in the seawater? (If yes, do you recall any, anywhere in the world).*

If the respondent does not understand the question, the interviewer is instructed to inform:

> *Red tides refer to a higher concentration of microorganisms that float on the surface of the water. Most of the times this layer does not allow to pass the sunlight, and thus is responsible for important marine ecological damages. Algal-blooms, as the name suggests, refer to the flower of microscopic algae. They are visible to the naked eye in the form of foams, often associated with a repellent odor.*

The questionnaire continues with the description of the main causes for the current conditions with respect to the seawater quality:

> *The main source of microscopic toxic algae in the seawater along this coast is Rotterdam harbor. The cause is the ballast water discharged by ships. Water discharges are done to compensate for differences in a ship's cargo and thus guarantee the balance of the ship during its journey. However, this process causes seawater containing local micro-organisms, including algae, being transferred from other parts of the world to the North Sea.*

In addition, the respondents are informed about the possibility to change the current situation and describe an alternative policy option that is characterized by the introduction of a prevention scheme:

> *To stop the discharge of ship ballast water, the ship companies, together with the Rotterdam harbor authority and the Dutch government, may propose introduce a prevention scheme. This is characterized by two actions:*
> *The 1st action consists is the construction of a ballast water disposal treatment complex. This will be located in the Rotterdam harbor and will be at work from the year 2006 on. Ballast water will be transferred to an internal circuit and submitted to an appropriated physical-chemical treatment before being discharged to the sea.*
> *The 2nd action is the implementation of algae monitoring program, where surveillance ships and specialized personal will be responsible for the monitoring of the water quality in the open sea along the North-Holland beaches.*

Furthermore, respondents are informed that in a scenario where the proposed prevention scheme were to be approved:

> *Ship companies would be responsible for the financing of the ballast water disposal treatment complex in Rotterdam and partially for the financing of the algae monitoring program. As a result, the risk of a biological pollution incident along the North-Holland coast and beaches will decrease with 90%.*

And that in the scenario without the implementation of both actions:

> *The present risk of a biological pollution incident in along the Dutch coast and beaches is expected to double in the next five years. Some beaches may then even be closed to visitors.*

Finally, the respondent is asked whether

> ***Q23.*** *Do you have you any questions about the described biological pollution prevention scheme?*

And if she says "yes" the interviewer is instructed to repeat the description so as to ensure the comprehension of the survey narrative.

At this stage, respondents face the contingent valuation questions, but before they are informed about the nature of the payment vehicle, about the layout of the survey-market conditions as well as the number of agents involved in the transaction:

> *The proposed prevention scheme is characterized by an investment in sophisticated monitoring techniques so that "imported" ballast water is immediately identified and locally chemically treated, thus avoiding any risks for marine wildlife and public health and security.*
> *In order to guarantee to you, and all beach recreationists, that it is possible to continue the beach in the same way you have done so far, without the risk of a biological pollution incident, it important to know how much this prevention scheme is worth to you.*
> *Therefore I would like to know how would you vote on the introduction of a biological pollution annual tax on seawater, given that the tax revenue will be exclusively applied to the water treatment complex and to the water monitoring program, keeping North-Holland coast line free from toxic algae and North-Holland beaches free from algae foams. The tax will be collected over a period of 2 years. If the majority of the people vote in favor, all Dutch households would have to pay such annual tax.*

Like before, if there is any remark about the comprehension of text, the interviewer is instructed to introduce the following disclaimer:

> *Given international agreements, the government cannot legally oblige the ship companies to contribute for the general costs of this monitoring program. It can instead oblige the companies to pay a monetary compensation when accidents happen or when they violate the law. This can cover the cleaning costs of an accident. However, under the present monitoring regulations it is very difficult to identify the responsible vessel, and take legal actions against it.*

Before the monetary value elicitation question, and following the NOAA Panel guidelines, the interviewer calls the respondent's attention to her budget constraint and the existence of other natural areas and recreation opportunities.

To better simulate price taking in market behavior, the respondents are asked how would they vote the present protection program bearing in mind that its approval would imply the payment of a tax annual tax amount[22] for the next two fiscal years:

> ***Q24.*** *If the total tax amount to be paid for the water treatment complex and for the water monitoring program was 15 NLG per year for the next 2 years, and thus keeping North-Holland coast free from toxic algae and North-Holland beaches free from algae foams, how would you vote on the introduction this tax?*

If the respondent votes in favor, she will asked:

> ***Q25.*** *And how would you vote if the total tax amount to be paid were 45 NLG, per year for the next 2 years?*

On the contrary, if the respondent votes against Q24, she will be asked:

> ***Q26.*** *And how would you vote if the total tax amount to be paid were 5 NLG, per year for the next 2 years?*

After having answered both referendum questions, respondents who voted twice "in favor" (or "against") are asked to state through an open ended, her maximum willingness to pay, respectively:

> ***Q27.*** *What is the most that you are willing to pay, per year for the next 2 years?*
> ***Q28.*** *Are you willing to pay anything at all, per year for the next 2 years?*

Section E: demographic and socio-economic questions

This section consists of a set of questions that allow us to describe the respondent socio-economic profile and thus help us to better understand, and predict, the stated willingness to pay answers. They include:

> ***Q29.*** *When were you born (year)?*
> ***Q30.*** *What is the highest form of education that you have received?*
> ***Q31.*** *What is the primary focus of your education?*
> ***Q32.*** *Do you have a partner with whom you live together?*
> ***Q33.*** *How many of your children are living at home?*

As before, questions Q30 and Q31 show an answering card. The last socio-economic question measures the respondent's household income. Since from the theoretical point of view this information reveals to be particularly relevant for the analysis of the stated willingness to pay answers and the empirical evidence shows that there is a high rate of non-responses for this type of question, we present a two stage income elicitation scheme. In the

[22] This is an example of a used bid. The full bid card design used in the questionnaire is reproduced in Table 3.

first question we present three wide ranges of income ranges. A letter randomly labels each income range. The respondent receives a card and she is asked:

> ***Q34.*** *I'll present you different income categories. Can you tell me in which category the common monthly take-home pay of your household can be placed? You need to take into account the net income of you. The data will only be used for statistical analysis. You will be anonymous.*

The card shows that “P” denotes a household situation with less than situation 3.000 NLG/month, “H” corresponds to 3.000 to 6.000 NLG/month and finally “D” describes a household with more than 6.000 NLG/month. If, for example, the letter “P” is selected then the respondent is faced with a second income range card:

> ***Q35p.*** *Ask again the LETTERS that best describe the situation*
> *PP. < 1.000 NLG*
> *PH. > 1. 000 and < 2.000*
> *PD. > 2. 000 and < 3.000*

Alternatively, if “H” is selected then we will have:

> ***Q35h.*** *Ask again the LETTERS that best describe the situation*
> *HP. > 3. 000 and < 4.000*
> *HH. > 4. 000 and < 5.000*
> *HD. > 5. 000 and < 6.000*

Finally, if “D” is selected the final question will be:

> ***Q35d.*** *Ask again the LETTERS that best describe the situation*
> *HP. > 6. 000 and < 7.000*
> *HH. > 7. 000 and < 8.000*
> *HD. > 8. 000 and < 12.000*

The combination of the two income elicitation questions is two fold: first allows us to check whether the individual is being coherent with her income statements, secondly it allows to have a rather fine-tuned household income information without facing a relatively high risk of non-response.

Section F: follow-up questions

Unlike the remaining sections, the questions are here addressed to the interviewer. The objective is to assess the interviewer opinion with respect to the degree of comprehension of the interview by the respondent. For this reason this section is known in the literature as “follow-up”, “control” or “evaluations” questions. All are answered just after the interviewer leaves the presence of the respondent and before engaging in another interview. They include:

Q36. *According to you, did the interview pass well?(yes, no)*

Q37. *Why did the interview not pass well?(see card)*

Q38. *Please rank how (well) understood did the respondent understand each section of the survey? (ranging from "not well understood", "understood" to "well understood")*

1. *Recreational questions;*
2. *Travel Cost & Expenditure questions ;*
3. *Beach Management options;*
4. *Marine Protection Scheme;*
5. *Contingent Valuation Questions*

Appendix III: Questionnnaire (verbatim)

Questionnaire

A. Initial contact

To be filled in before meeting the respondent.

A.1	Questionnaire Nr: ____
A.2	Interviewer: _______________
A.3	Day : ____________________
A.4	Date : ____________
A.5	Hour: ____h_____
A.6	Specific location:____________ __________________
A.7.	Weather: ________________
A.8	Circumstances on beach:_______

Good-morning/good-afternoon. My name is**[say your name]** and I am working with the *Vrije Universiteit* in Amsterdam. This short questionnaire is part of a research project that has the goal to study the recreational behavior of visitors at North-Holland beaches.

A.8 May I kindly ask you some questions about your attitudes and opinions? **[please circle respondent's answer]**

0. No

1. Yes

If **no**: May I ask you the most important reason why you do not want to participate?

_______________ [open ended]

CODE 1: 5/15/45

Please think careful about each question and give your best answer. There are no right or wrong answers, only personal answers.

B. Recreational and Expenditure Data

B.1 How many persons are in your group (including yourself):
____ Persons, of who ____ Adults and ____ children (<15 years)

B.2 During one full year, how often do you visit this beach?
[circle respondent's answer]

1. Less than once a month → Show Card 1 → Nr: _______ (nota: 1 to 4)

2. At least once a month → Show Card 2 → Nr: _______ (nota: 5 to 9)

B.3 Why did you come to the beach today (the main reason)? Show Card 3
[circle respondent's answer]
1. Sunbathing
2. Swimming
3. Biking
4. Walking along the waterfront (you can see the sea)
5. Walking along the dunes (you cannot see the sea)
6. Other: ____________ [open ended]

B.31 If multiple reasc

B.4 How long do you plan to stay at the beach?
1. A couple of hours
2. At least half a day (either morning or afternoon)
3. The whole day
4. Other: ____________ [open ended]

B.5 Do you also come to this beach during the Winter period?
0. No
1. Yes
If **yes**, what recreation activities do you usually undertake?
______________________________[open ended]

C. Travel Cost and Expenditures Data

C.1 Where do you live? Zip Code:

				–			________
(e.g.	2	0	1	2	–	C	A HAARLEM)

C.2 How did you come to the beach? **[circle respondent's answer]**

1. by car

1.1. What is the type of car:

1 Brand: ________ **2.** Model: ________ **3.** Motor size: ____cc

1.2. Fuel type **[circle respondent's answer]**

1. Gasoline **2.** Diesel **3.** LPG

1.3. How much are you spending on parking today: _______

2. by bike

3. by public bus

4. on foot

5. other: ____________ [open ended]

C.3 Do you have a perception of how much did it cost to you to travel today to the beach (all the family)?

0. No

1. Yes

If **yes**, how much?

[circle respondent's answer]

3.1. less than 15 NLG

3.2. between 15 and 25 NLG

3.3. between 25 and 50 NLG

3.4. more than 50 NLG

Show Card 4

For: **[circle respondent's answer]**

a. Single way trip

b. 2 way trip

C.4 Did you hire or buy anything at the beach (sun-umbrella.

0. No

1. Yes

If **yes**, how much did you spend on this? ________________ [open ended]

C.5 Did you buy anything at the beach (drinks or eaten)?

0. No

1. Yes

If **yes**, how much did you spend on this? ________________ [open ended]

D. Opinion on beach management

In a preliminary study we verify that beach recreationists have expressed different opinions with respect to the degree of importance regarding the priority of alternative beach management aspects. For each aspect, I would like you to tell me whether you think it is **very important**, **important**, **little important**, or **not importance.**

Show Card 5

(ROTATE CARD 5; READ EACH ITEM ON THE LIST; CIRCLE RESPONDENT ANSWER BEFORE PROCEEDING TO THE NEXT ITEM)

		Not Important	⟵⟶		Very Important
D.1	Ensure that the quality of the seawater is such that it does not provoke skin allergies.	0	1	2	3
D.2	Ensure that the sand along the waterfront of the beach is clean from algae and foams.	0	1	2	3
D.3	Ensure that the dunes continue to be recreational areas and not for housing.	0	1	2	3
D.4	Ensure that some dunes are protected as areas for nature and closed to the public.	0	1	2	3
D.5	Ensure that the marine ecosystem is not threatened by water pollution.	0	1	2	3
D.6	Ensure that parking lots, bars, restaurants and ice-cream stands are sufficient for the number of beach visitors.	0	1	2	3
D.7	Ensure beach recreation zoning where volleyball fields, bike paths, windsurfing and boating is allowed to visitors.	0	1	2	3
D.8	Ensure that the beach is clean from rubbish such as cans and cigarette bull.	0	1	2	3
D.9	Ensure beach zoning where nudity is allowed to visitors.	0	1	2	3
D.10.	Ensure beach zoning where dogs are allowed to get in together with their owner.	0	1	2	3

As you can see there are several potentially relevant issues. The reminder of this questionnaire, however, focuses attention on the protection of seawater and beach against biological pollution.

E. Biological pollution

Recent scientific measurements show the presence of microscopic toxic algae in the seawater along this coast. With the increase of the water temperature registered during the summer, these toxic algae can reproduce rapidly, potentially creating the so-called ‘red-tides’ on open sea and ‘algae blooms’ on the beaches.**[PAUSE]**

If there is any remark about the text, tick here ❐ and explain again:

> **Red-tides** refer to a higher concentration of microorganisms that float on the surface of the water. Most of the times this layer does not allow to pass the sunlight, and thus is responsible for important ecological damages in the marine ecosystem.
>
> **Algae-blooms,** as the name suggests, refer to the flower of microscopic algae. They are visible to the naked eye in the form of foams, often associated with a repellent odor.

These toxic algae constitute an important source of biological pollution causing important risks to marine ecosystems (mass mortalities of commercial fish) as well as risks to humans (ranging from skin allergies to fish poisoning). At this moment this beach is highly exposed to the risk of a biological pollution event.

E.1 Were you informed about the risk of water pollution in this beach related to biological pollution incidents such as red-tides and algae blooms? **[circle respondent’s answer]**

0. No
1. Yes
99. No answer

E.2 Have you heard or read something in the news about incidents related to the presence of toxic algae in the sea water? **[circle respondent’s answer]**

0. No
1. Yes
99. No answer
If **yes**, do you recall any (anywhere in the world)?
_________________________ [open ended]

The main source of microscopic toxic algae in the seawater along this coast is Rotterdam harbor. The cause is the ballast water discharged by ships. Water discharges are done to compensate for differences in a ship’s cargo and thus guarantee the balance of the ship during its journey. However, this process causes seawater containing local microorganisms, including algae, being transferred from other parts of the world to the North sea.

[PAUSE]

To stop the discharge of ship ballast water, the ship companies, together with the Rotterdam harbor authority and the Dutch government, may propose introduce a prevention scheme. This is characterized by two actions.

1. The 1st action consists is the construction of a ballast water disposal treatment complex. This will be located in the Rotterdam harbor and will be at work from the year 2006 on. Ballast water will be transferred to an internal circuit and submitted to an appropriated physical-chemical treatment before being discharged to the sea.
2. The 2nd action is the implementation of algae monitoring program, where surveillance ships and specialized personal will be responsible for the monitoring of the water quality in the open sea along the North-Holland beaches.
   [PAUSE]

If the proposed prevention scheme were to be approved, ship companies would be responsible for the financing of the ballast water disposal treatment complex in Rotterdam and partially for the financing of the algae monitoring program. As a result, the risk of a biological pollution incident along the North-Holland coast and beaches will decrease with 90%.

[PAUSE]

As opposed to this, without the implementation of both actions, the present risk of a biological pollution incident in along the Dutch coast and beaches is expected to double in the next five years. Some beaches may then even be closed to visitors.

[PAUSE]

E.3	Do you have you any questions about the described biological pollution prevention scheme? **[circle respondent's answer]**

0. No

1. Yes

If yes**,** which?

____

____

____

F. Hypothetical valuation question

In order to guarantee to you, and all beach recreationists, that it is possible to continue the beach in the same way you have done so far, without the risk of a biological pollution incident, it important to know how much this prevention scheme is worth to you.

Therefore I would like to know how would you vote on theintroduction of a biological pollution annual tax on seawater, given that the tax revenue will be exclusively applied to the water treatment complex and to the water monitoring program, keeping North-Holland coast line free from toxic algae and North-Holland beaches free from algae foams. The tax will be collected over a period of 2 years. If the majority of the people vote in favor, all Dutch households would have to pay such annual tax. **[PAUSE]**

If there is any remark about the text, tick here ❒ and explain again:

> Given international agreements, the government cannot legally oblige the ship companies to contribute for the general costs of this monitoring program. It can instead oblige the companies to pay a monetary compensation when accidents happen or when they violate the law. This can cover the cleaning costs of an accident. However, under the present monitoring regulations it is very difficult to identify the responsible vessel, and take legal actions against it.
>
> The proposed prevention scheme is characterized by an investment in sophisticated monitoring techniques so that "imported" ballast water is immediately identified and locally chemically treated, thus avoiding any risks for marine wildlife and public health and security.

So please think about:

- Your current household income and expenditures
- The existence of other natural areas and recreation opportunities

F.1 Keeping these factors in mind, if the total tax amount to be paid for the water treatment complex and for the water monitoring program was 15 NLG per year **[SMALL PAUSE]** for the next 2 years, and thus keeping North-Holland coast free from toxic algae and North-Holland beaches free from algae foams, how would you vote on the introduction this tax?

1. VOTE IN FAVOR **-» F2**
2. VOTE AGAINST **-» F3**

99. No answer DO NOT READ **-» F3**

F.2 And how would you vote if the total tax amount to be paid was 45 NLG per year **[SMALL PAUSE]** for the next 2 years?

1. VOTE IN FAVOR **-» F4**
2. VOTE AGAINST

99. No answer DO NOT READ

F.3 And how would you vote if the total tax amount to be paid was 5 NLG per year **[SMALL PAUSE]** for the next 2 years?

1. VOTE IN FAVOR
2. VOTE AGAINST **-» F5**

99. No answer DO NOT READ **-» F5**

F.4 What is the most that you are willing to pay, per year **[SMALL PAUSE]** for the next 2 years?

__________________NLG/Year

F.5 Are you willing to pay anything at all?

0. No **-» F6**

1. Yes
99. No answer

If yes, how much per year? _________NLG/Year

F.6 Can you give the most important reason why your household is not prepared to pay? **[circle respondent's answer]**

1. I don't believe in the proposed project
2. The proposed project is not worth that much
3. The ship companies have to pay all the costs
4. I don't want to pay something extra; the government has to pay everything out of the regular budget
5. My income doesn't allow me to pay this anything
6. Other, specify:

____
____
____

G. Hypothetical valuation question

To finish, I would like to ask you some personal questions. Your answers will be handled confidentially. We do not need to know the name of your family. You will remain anonymous.

G.1 Year of birth: _____

G.2 What is the highest form of education that you have received? Show card 6

1. Lager onderwijs or basisonderwijs
2. LBO, MAVO
3. MBO, HAVO
4. HBO, Universiteit
5. Other: Specify: _______
99. No answer

G.3 What is the primary focus of your education? Show card 7

1. Technology or natural science
2. Economy, trade or business
3. Medical or social care
4. Culture, art or communication
5. Other: ___________[specify]

99. No answer

G.4 Do you have a partner with whom you live together?

1. Yes **2.** No **99.** No answer

G.5 How many of your children are living at home? _________

If **G4** is **yes**

G.6 I'll present you different income categories. Can you tell me in which category the common monthly take-home pay of your HOUSEHOLD (you and **[your partner]**) can be placed? You need to take into account the NET income of you. The data will only be used for statistical analysis. You will be anonymous Show card 8
Please indicate the LETTER that best describes your situation (NLG/month).

P. < 3.000 NLG **H.** > 3. 000 and < 6.000 **D.** > 6.000
99. No answer

If **P** is selected letter then
Show card **8P** and ask again the LETTERS that best describe the situation
PP. < 1.000 NLG **PH.** > 1. 000 and < 2.000 **PD.** > 2. 000 and < 3.000

If **H** is selected then
Show card **8H** and ask again the LETTERS that best describe the situation:
HP. > 3. 000 and < 4.000 **HH.** > 4. 000 and < 5.000 **HD.** > 5. 000 and < 6.000

If **D** is selected then
Show card **8D** and ask again the LETTERS that best describes the situation:
DP. > 6. 000 and < 7.000 **DH.** > 7. 000 and > 8.000 **DD.** > 8.000 and < 12.000

This is the end of the questionnaire.
THANK YOU VERY MUCH for your collaboration.
(give an ice-cream, lotto ticket)

INTERVIEWER please GO to SECTION H before start a new questionnaire

H. Control questions (to be answered by the interviewers)

H.1 According to you, did the interview pass well?

0. No

1. Yes

H.2 Why did the interview NOT pass well?

1. Because the respondent did not understand the questionnaire well

2. Because the respondent wanted to know too much details

3. Because the respondent clearly did not have any interest

4. Because the respondent frequently interrupted the questions

5. Others: [specify]

____

____

H.3 Which parts are not (well) understood by the respondent?

Survey Section		Not well understood	Understood	Well understood
B.	RECREATIONAL DATA	1	2	3
C.	TRAVEL COST & EXPENDITURE DATA	1	2	3
D.	OPINION ON BEACH MANAGEMENT	1	2	3
E.	BIOLOGICAL POLLUTION	1	2	3
F.	HYPOTHETICAL VALUATION QUESTION	1	2	3

Appendix IV: Sampling mechanism

Figure 3 maps the province of North-Holland and Figure 4 the zoning of the Zandvoort coastal area, where the survey was executed. Table 20 provides the sampling structure that was followed to extract different beach visitors within the Zandvoort coastal area.

Figure 3. Province of North-Holland

Figure 4. Zandvoort coastal area

Table 20. Sampling structure

Geographical zone	Beach houses	Number visitor groups
Zandvoort South: Adam and Eva - Havana	Adam and Eva	8
	America	8
	Langevelderslag	8
	Strictly	5
	La Terrasse	7
	Tyn Akersloot	6
Zandvoort city center: Havana – Venice	Boulevard	2
	Havana	11
	Gammon Club	7
	Venice	9
Zandvoort city center: Venice – Casino	n. 1A	4
	n. 1B	2
	n. 1C	2
	Calypso	2
	Bad-Zuid	6
	Take Five	8
	Jantje	4
	Far out	5
	Trefpubt Annet	4
	Club Maritime	10
	Boom	8
	De Zoon	3
Zandvoort city center: Casino – Jeroen Paviljoen	Skyline	5
	Sunset	4
	Bonbini	4
	Route 16	6
	No name	4
	Thalassa	2
	Strandpaviljoen	5
	Paviljoen Jeroen	9
Zandvoort North: Jeroen Paviljoen – Summertime	Paviljoen Willy	8
	Paviljoen Driehuizen	7
	n. 22	1
	n. 23	2
	Nautique	4
	n. 24	5
	Kerkman	7
	25	7
	Sandy Hill	5
	Summertime	2
Bloemendaal	Beach of Bloemendaal (no beachouses)	26

Appendix V: Socio-demographic-economic information

Survey data:

Age (%)

17-25 years	26-33 years	34-41 years	42-49 years	50-57 years	+58 years
9.5	25.2	25.3	14.4	14.5	13.2

Household size (%)

One	Two	Three	Four	Five	Six and seven
33.4	23.7	14.6	21.7	5.4	1.2

Highest education level (%)

LBO	MAVO	MBO	HAVO	VWO	HBO	UNIVERSITY
7.1	10.4	18.8	13.8	5.9	27.2	16.7

Monthly household net income (%)

<1 000 NLG	>1 000 <2 000	>2 000 <3 000	>3 000 <4 000	>4 000 <5 000	>5 000 <6 000	>6 000 <7 000	>7 000 <8 000	>8 000 NLG
3.0	8.3	8.7	13.9	16.1	13.0	10.0	7.4	14.3

Dutch national data:

Age (%)

20-39 years	40-64 years	65-79 years	+ 80 years
39.3	43.0	13.5	4.2

2000-2001 education participants (%)

Secondary				Vocational	University
Junior General	Senior General	Senior vocational	Pre-university	colleges	
7.0	7.0	18.9	2.9	41.2	23.0

Source: www.statline.cbs.nl

Appendix VI: Demand function estimation results

Demand function estimation results - MODEL II [(a), (b)]

	Transport cost approach					
	Fuel-cost approach			User-cost approach		
	Estimate	Std. Error	p-val.	Estimate	Std. Error	p-val.
Intercept	1.452*	0.197	0.00	1.330*	0.194	0.00
Travel costs						
Transport	– 0.0041*	0.003	0.01	– 0.0002	0.001	0.72
Travel time	– 0.0029	0.006	0.29	– 0.0081*	0.007	0.03
Parking	– 0.0004	0.008	0.90	– 0.0034	0.006	0.34
Site characteristics						
Bloemendaal Beach	0.2586**	0.142	0.07	0.2682**	0.143	0.06
Sunny weather	– 0.0214	0.106	0.83	– 0.0347	0.106	0.74
Week-end	0.1437	0.111	0.19	0.1211	0.111	0.28
Respondent's characteristics						
Gender	– 0.0946	0.095	0.32	– 0.0772	0.096	0.42
Age	– 0.0035	0.003	0.37	– 0.0033	0.003	0.40
Net Income (by the hundreds of €)	0.0024*	0.024	0.03	0.0032*	0.024	0.03
Field of studies: Economics	– 0.1146	0.095	0.23	– 0.1259	0.096	0.19
Living with a partner	– 0.1658	0.116	0.15	– 0.1751	0.116	0.13
Stay at the beach all day	0.2099*	0.107	0.05	0.2184*	0.107	0.04
Log-likelihood	-280.65			-283.89		

Notes:

[(a)] Calculations are performed using count data models in *LIMDEP*®.

[(b)] In order to correct for the possible presence of heteroskedasticity we have also tried a Binominal Negative model specification. This gave similar estimation results. Moreover, the estimate of the additional over dispersion parameter revealed not to be statistically significant from zero, i.e. the heteroskedasticity is rejected.

[* (**)] Statistically significant at 5% (10%)

Appendix VII: Demand curve estimation results

Table 21 and Table 22 the estimation results of the demand curve for yearly visits to the Zandvoort beach area, respectively for Model I and Model II econometric specifications.

Table 21. Demand curve - MODEL I

	Fuel-cost approach			User-cost approach		
	Estimate	Std. Error	p-val.	Estimate	Std. Error	p-val.
Intercept	3.8752**	0.634	0.00	3.3841**	0.639	0.00
Travel costs[1] (per adult)	– 0.0013**	0.005	0.00	– 0.0091**	0.002	0.00
Site characteristics						
Bloemendaal beach	1.0416**	0.524	0.04	1.2342**	0.540	0.02
Sunny weather	0.1436	0.345	0.67	0.3302	0.353	0.34
Week-end	0.3983	0.369	0.28	0.6242**	0.376	0.09
Respondent's characteristics						
Gender	– 0.4048	0.310	0.19	– 0.2277	0.327	0.48
Age	– 0.0057	0.013	0.65	– 0.0047	0.013	0.72
Net income (by hundreds of €)	0.0101**	0.007	0.03	0.0095**	0.008	0.09
Field of studies: Economics	– 0.2760	0.314	0.38	– 0.1784	0.324	0.58
Living with a partner	– 0.7540**	0.377	0.04	– 0.7393**	0.391	0.05
Stay at the beach all day	0.6416**	0.356	0.07	0.6568**	0.370	0.07
Adjusted R^2		0.215			0.157	
A.I.C.		4.075			4.147	
F test (p-value)		0.000			0.000	

Table 22. Demand curve – MODEL II

	Fuel-cost approach			User-cost approach		
	Estimate	Std. Error	p-val.	Estimate	Std. Error	p-val.
Intercept	1.3550**	0.195	0.00	1.2001**	0.192	0.00
Travel costs[1] (per adult)	– 0.0049**	0.002	0.00	– 0.0017**	0.001	0.00
Site characteristics						
Bloemendaal beach	0.2438**	0.142	0.08	0.3047**	0.142	0.03
Sunny weather	0.0651	0.105	0.53	0.1209	0.104	0.25
Week-end	0.1238	0.110	0.26	0.1911**	0.110	0.08
Respondent's characteristics						
Gender	– 0.0992	0.095	0.29	– 0.0684	0.095	0.47
Age	– 0.0026	0.003	0.50	– 0.0020	0.003	0.59
Net income (by hundreds of €)	0.0028**	0.002	0.00	0.0026**	0.002	0.01
Field of studies: Economics	– 0.0930	0.095	0.32	– 0.0586	0.094	0.53
Living with a partner	– 0.1937**	0.112	0.08	– 0.1831	0.113	0.11
Stay at the beach all day	0.2025**	0.105	0.05	0.2053**	0.106	0.05
Log-likelihood		– 287.301			– 293.627	

Notes: [1] Travel costs equals to the sum of transport, travel time and parking costs.

[**] Significant at 10%

Table 23 lists the sample mean values for all the explanatory variables used in the estimation of the demand curve.

Table 23. Explanatory variables evaluated at their sample mean for Model I and Model II

Fuel costs*	User costs*	Beach of Bloemendaal	Sunny weather	Week end	Gender	Age	Economics study	Income	Living partner	All day
10.8 €	20.3 €	0.099	0.368	0.289	0.507	39.711	0.375	2368 €	0.625	0.23

Note: * per adult

Bearing in mind the estimation results provided in Table 21, and the mean values showed in Table 23, we are able to derive the demand curve (in its reduced form) for yearly visits as

$$\begin{aligned} log\,N &= 3.8752 - 0.0013 \times P^{Model\,I}_{fuel-\cos t} + 1.0416 \times 0.099 + 0 \times 0.368 + 0 \times 0.289 + 0 \times 0.507 - \\ &\quad - 0 \times 39.711 + 0.0101 \times 23.68 - 0 \times 0.375 - 0.7540 \times 0.625 + 0.6416 \times 0.230 \\ &= 3.7704 - 0.0616 \times P^{Model\,I}_{fuel-\cos t} \end{aligned} \tag{B.1}$$

Bearing in mind Equation (B.1) we are able to derive the fuel-cost inverse demand curve, i.e.

$$P^{Model\,I}_{fuel-\cos t} = 61.2086 - 16.2338 \times log\,N \tag{B.2}$$

And the user-cost inverse demand function,

$$P^{Model\,I}_{user-\cos t} = 160.4740 - 46.0532 \times log\,N \tag{B.3}$$

References:

Akaike, H. 1973. "Information Theory and an Extension of the Maximum Likelihood Principle", in B. Petrov and B. Csake (eds), *Second International Symposium on Information Theory*, Akademai Kiado, Budapest.

Anderson, D.M. 1994. "Red tides", *Sci Am.*, vol. 271, pags. 52-58.

Billard, C. 1992. "Fibrocapsa japonica (raphidophyceae), algue planqtonique nouvelle pour les côtes de France", *Crypt. Algol.*, vol. 13, pags. 225-231.

Boalch, G.T. 1987. "Changes in the phytoplankton of the western English Channel in recent years", *Br. Phycol. J.*, vol. 22, pags. 225-235.

Boman, M. and G. Bostedt 1995. "Valuing the Wolf in Sweden", *Report No. 110, Swedish University of Agricultural Sciences*, Department of Forest Economics, Umeä, Sweden.

van den Bergh, J.C.J.M., Nunes, P.A.L.D, Dotinga, H.M., Kooistra, W.H.C.F., Vrieling, E.G. and L. Peperzak 2002. "Exotic harmful algae in marine ecosystems: an integrated biological-economic-legal analysis of impacts and policies", *Marine Policy*, vol. 26, pags. 59-74.

CBS – Centraal Bureau voor de Statistiek (2000) *Statistical Year Book*, Voorburg/Heerlen, The Netherlands.

Cameron, T. A. and M. D. James 1987. "Efficient estimation methods for closed-ended contingent valuation surveys", *American Journal of Agricultural Economics*, pags. 269-276.

Cameron, T. A. 1988. "A new paradigm for valuing Non-Market goods Using Referenda Data: Maximum Likelihood Estimation by Censored Logistic Regression", *Journal of Environmental Economics and Management*, vol. 15, pags. 355`-379.

Cameron, T. A. 1991. "Interval estimates of Non-Market Resource Values from Referendum Contingent Valuation Surveys", *Land Economics*, vol. 67(4), pags. 413-21.

Cameron, T. A. and J. Quiggin 1994. "Estimation using Contingent Valuation Data from a Dichotomous Choice with Follow-up questionnaire", *Journal of Environmental Economics and Management*, vol. 27, pags.218-234.

Carson, R. T., R. C. Mitchell, W. M. Hanemann, R. J. Kopp, S. Presser and P. A. Ruud 1992. "A Contingent Valuation Study of Lost Passive Use Values Resulting from the Exxon Valdez Oil Spill", *Report prepared for the Attorney General of the State of Alaska*, Washington, US.

Davis, D. and D.F. Gartside 2001. "Challenges for economic policy in sustainable management of marine natural resources", *Ecological Economics*, vol. 36, pags. 223-236.

Greene, W.H. 2000. *Econometric Analysis,* chapter 20 "Limited Dependent Variable and Duration Models", New Jersey, US.

Gunn, H.F., Tuinenga, J.G., Cheung, Y.H.F. and H.J. Kleijn (1998) "Value of Dutch travel time savings in 1997", *8th WCTR Proceedings,* vol.3. pags. 513-526. Hallegraeff, G.M. 1998. "Transport of toxic dinoflagellates via ships' ballast water; bioeconomic risk assessment and efficacy of possible ballast water management strategies", *Mar. Ecol. Prog. Ser.*, vol. 168, pags. 297-309.

Hallegraeff, G.M. and S. Fraga 1998. "Bloom dynamics of the toxic dinoflagellate Gymnodinium catenatum, with emphasis on Tasmanian and Spanish coastal waters", in *Physiological Ecology of Harmful Algae Blooms*, Anderson, D.M., Cembella, A.D. and G.M. Hallegraeff (eds), Springer-Verlag, Berlin, pags. 59-80.

Hanemann, M. W., J. Loomis and B. Kanninen (1991) "Statistical Efficiency of Double-bounded Dichotomous Choice Contingent Valuation", *American Journal of Agricultural Economics*, vol. 73(4), pags. 1255-1263.

Hicks, J. R. (1943) “The Four Consumer Surpluses”, *Review of Economic Studies,* vol. 11(1), pags. 31-41.

Holmes, T. P. and R. A. Kramer (1995) “An Independent Sample Test of Yea-Saying and Starting Point Bias in Dichotomous-Choice Contingent Valuation” *Journal of Environmental Economics and Management*, vol. 29(1), pags. 121-32.

Johnson, N.L and Kotz S. 1970. *Continuous Univariate Distributions*, Vol. 2. Willey, New York, US.

Loomis, J.B and R.G. Walsh 1997. *Recreation Economic Decisions: Comparing Benefits and Costs,* Pennsylvania, US.

Lüthy, J. 1979. “Epidemic paralytic shellfish poisoning in western Europe, 1976”, In *Toxic Dinoflagellate Blooms*, Taylor D.L. and H.H. Seliger (eds.), Elsevier, New York, pags. 15-22.

McMinn, A., Hallegraeff, G.M., Thomson, P., Jenkinsn, A.V. and H. Heijnis 1997. “Cyst and radionucleotide evidence for the recent introduction of the toxic dinoflagellate *Gymnodinium catenatum* into Tasmanian waters”, *Mar. Ecol. Prog. Ser.*, vol. 161, pags. 165-172.

Nehring, S. 1995. “*Gymnodinium catenatum* Graham (Dinophyceae) in Europe: a growing problem?”, *J. Plankton Res*. Vol. 17, pags. 85-102.

Nehring, S. 1998. “Establishment of thermophilic phytoplankton species in the North Sea: biological indicators of climatic changes?”, *ICES J. Mar. Sci.*, vol. 55, pags. 818-823.

NOAA - National Oceanic and Atmospheric Administration 1993. “Report of the NOAA Panel on Contingent Valuation”, *Federal Register*, US, vol. 58(10), pags. 4601-4614.

Nunes, P.A.L.D. and J.C.J.M. van den Bergh 2001. “Economic Valuation of Biodiversity: Sense or Nonsense”, *Ecological Economics*, vol. 39, pags. 203-222.

Nunes, P.A.L.D. 2002. *The Contingent Valuation of Natural Parks: Assessing the Warm Glow Propensity Factor*, Edward Elgar Publishing (UK), New Horizons in Environmental Economics Series, (in press).

Ostenfeld, C.H. 1908. “On the immigration of Biddulphia sinensis and its occurrence in the North Sea during 1903-1907”, series *Plankton*, vol. I, pags. 1-48.

Perrings, C., Williamson and S. Dalmazzone 2000. *The Economics of Biological Invasions*, Edward Elgar, UK.

Scholin, C., Gulland, F., Doucette, G.J., Benson, S., Busman, M., Chavez, F.P., Cordaro, J., DeLong, R., De Vogelaere, A., Harvey, J., Haulena, M., Lefebvre, A., Lipscomb, T., Loscutoff, S., Lowenstine, L.J., Marin III, R., Miller, P.E., McLellan, W.A., Moeller, P.D.R., Powell, C.R., Rowles, T., Silvagni, P., Silver, M., Spraker, T., Trainer, V. and F.M. Van Dolah (2000). “Mortality of sea lions along the central California coast linked to a toxic diatom bloom”, *Nature*, vol. 403, pags. 80-84.

Wyatt, T. 1995 “Global spreading, time series, models and monitoring”, in *Harmful Marine Algae Blooms*, Lassus, P., Arzul, G., Erard, E., Gentien P. and C. Marcaillou (eds) Lavoisier, Paris, pags. 755-764.