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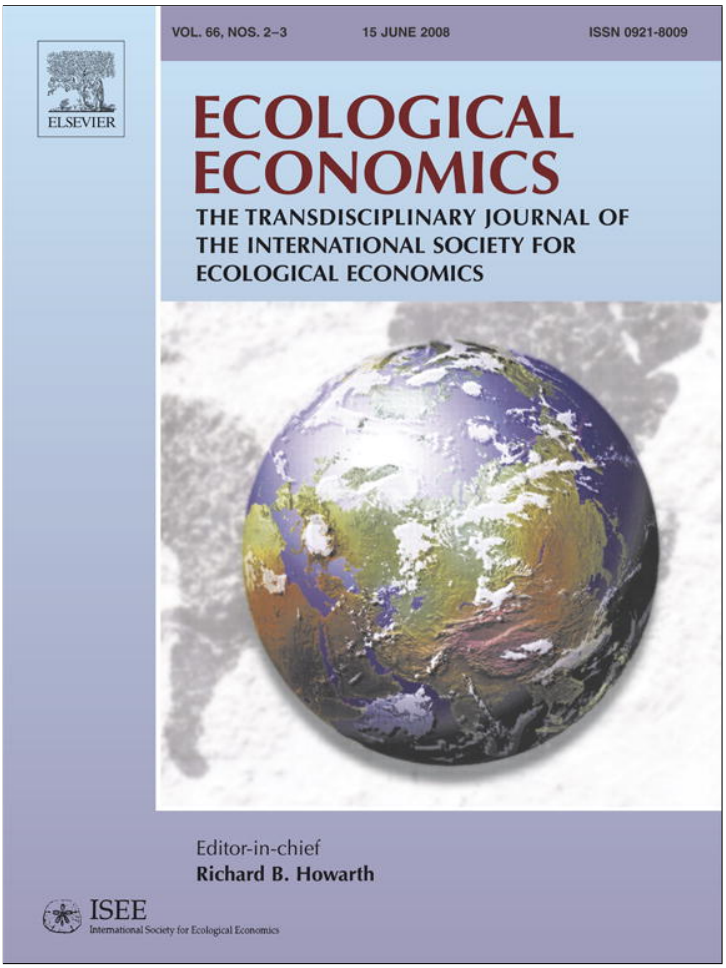

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ANALYSIS

The use of contingent valuation for evaluating protected areas in the developing world: Economic valuation of Morro do Diabo State Park, Atlantic Rainforest, São Paulo State (Brazil)

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ABSTRACT

The Brazilian Atlantic Rainforest is internationally recognised as one of the most biodiverse and threatened tropical forests in the world [Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., Kent, J., 2000. Biodiversity hotspots for conservation priorities. Nature 403, 853–858]. The Seasonal Semi-Deciduous Forest is among the most fragmented and threatened biomes of the Atlantic Rainforest Domain. The largest remnant of this biome (35,000 ha) is protected by the Morro do Diabo State Park (MDSP), situated in the area known as the Pontal do Paranapanema, in São Paulo State, Brazil. Despite its environmental importance, the park is under political, economic and demographic pressure. The main aim of our research was to estimate the population's willingness to pay (WTP) for the conservation of MDSP and for the Atlantic Rainforest's remnants in São Paulo State as a whole, by means of the contingent valuation method (CVM). The results featured a high incidence of null WTP and of protest votes. Nevertheless, the population is willing to pay US$ 2,113,548.00/year (R$ 7,080,385.00/year) for the conservation of the MDSP (use and existence values), or US$ 60.39 ha/year (R$ 202.30/ha/year). The results indicate that the preservation value is strongly associated to the population's ability to pay, increasing with income levels. Qualitative research questions showed that the population considers protected areas to be very important. Still, the valuation of MDSP revealed a gap between the government budget allotted to the park and the value assigned to the area by the public.

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1. Introduction

Despite being internationally recognised as one of the most important and threatened tropical forests in the world (Myers et al., 2000), there are very few studies on the economic valuation of the Atlantic Rainforest (Camphora and May, 2006; May et al., 2000). Before the European conquest, the Atlantic Rainforest covered the Brazilian coastline for 4000 km and had a total estimated extent of 1,200,000 km^2. It is now reduced to approximately 7.5% of its original distribution (Mittermeier et al., 2000; Myers et al., 2000). The Seasonal Semi-Deciduous Forest originally covered the inland plateau of São Paulo State (Brazil), but was nearly completely devastated in the last 130 years. Today, the Seasonal Semi-Deciduous Forest covers around 7.7% (349,574 ha) of its former area, mostly in small and isolated fragments within private properties (São Paulo, 2005). Nevertheless, these fragments still provide important ecosystem services, such as biodiversity preservation, watershed protection (Viana and Tabanez, 1996), landscape connectivity and soil seed bank conservation (Ditt, 2002), all fundamental to conservation strategies and the recuperation of natural vegetation.

The largest remnant of Seasonal Semi-Deciduous Forest (approximately 35,000 ha) is situated in Pontal do Paranapanema (22°27′–22°40′ S and 52°10′–52°22′ W), south-west of São Paulo State (Brazil) (see Fig. 1), protected by the Morro do Diabo State Park (MDSP). Located in the municipality of Teodoro Sampaio, MDSP was created in 1986 and is administered by the state Forest Institute (*Instituto Florestal*).

The park is the State's largest natural reserve of the *peroba-rosa* tree (*Aspidosperma polyneuron*), and the last haven for endemic and critically endangered species such as the black lion tamarin (*Leontopithecus chrysopygus*) (IUCN, 2006; MMA, 2006), and others listed as vulnerable or near threatened species by the Brazilian (MMA, 2006) or IUCN's red lists (IUCN, 2006) (the Brazilian tapir *Tapirus terrestris*, the jaguar *Panthera onca*, and the solitary tinamou, *Tinamus solitarius*) (IPE, 2000; IUCN, 2006; MMA, 2006). The park is bisected by the SP-613 highway, where roadkill is common (São Paulo, 1999). It is surrounded by small-scale farmers settled by federal government, larger agriculturalists and cattle ranchers, landless peasant camps and the urban population of the city of Teodoro Sampaio. In fact, MDSP is a forested island in a landscape matrix of pasture and agriculture land, and suffers from deleterious edge effects such as altered microclimate (drier, hotter and less shady) and invasive species (such as grasses). The park's boundaries are occasionally affected by the fire used by local farmers to clear pastures of weeds.

In the State of São Paulo, where there are approximately 900,000 ha of protected areas (Instituto Florestal, 2002), there has been an increasing reduction in the budget allotted to environmental agencies in the last few years (Dale, personal communication, 2002). The MDSP has also suffered cuts. Despite its importance, the park's annual budget has been decreasing since 1992, making it very difficult to manage the area satisfactorily (Faria, 2002; São Paulo, 1999).

The estimation of economic value associated to environmental services of protected natural areas is increasingly common in developed countries (Ortiz et al., 2001). However, despite the fact that developing countries encompass the largest share of natural resources in the planet, few economic valuation studies of any kind have been conducted in these regions, and willingness to pay methods have been very rarely applied (Dixon and Hufshmidt 1986; Dixon and Sherman 1990; Hadker et al., 1997).

Environmental valuation, based on microeconomic utility theory, seeks to reflect people's well being as a function of environmental goods and services. However, the measurement of monetary values associated with environmental benefits can be very difficult, especially in the case of little known resources, such as biodiversity. Besides the limitations in existing knowledge about the association between ecological functions and economic benefits, there are fundamental methodological limitations. For example, most of the economic studies associated with ecosystem service values only look for their contribution to human welfare (Brito, 2005). Nevertheless, the attribution of economic values to environmental resources is advantageous as it brings up social and economic issues that the ecological criterion by itself is not able to. By identifying the distribution of gains and losses within society, the public manager can find ways of reconciling alternative resource uses (Seroa da Motta, 1998).

The few examples of protected areas valuation in Brazil (Camphora and May, 2006), including those in the Atlantic Rainforest area, are listed in Table 1. The Jataí Ecological Station (JES), covering an area of about 4532 ha, and Iguaçú National Park (INP) are the only ones that, besides MDSP, also protect Seasonal Semi-Deciduous Forest remnants. Santos et al. (2001) analysed the environmental benefits resulting from structural and functional aspects of the ecosystems protected by JES by means of substitute goods, marginal productivity and contingent valuation methods. The contingent valuation method was applied to investigate sixteen environmental function values, divided into regulation, carrying capacity, production and information functions. One aspect of the information function was aesthetic value, estimated by travel cost. The authors tried to associate travel cost values to society's aesthetic or cultural values as an under-estimated proxy for the cultural, religious, ideological and aesthetic values of JES. The total socio-economic value of JES was estimated at US$ 708.83/ha/year (US$ 3,212,545.15/year), considered an underestimate by the authors, since many benefits could not be included due to lack of information or methodological limitations (Santos et al., 2001). Ortiz et al. (2001) used the travel costs method to estimate INP's total recreational value at US$ 155.31 ha/year.

2. Economic valuation of Morro do Diabo State Park: methodology

The central aim of this study was to value the existence of the MDSP by means of the contingent valuation method (CVM), as a way of evaluating its economic importance for the conservation of the Atlantic Seasonal Semi-Deciduous Forest. CVM was applied to capture the population's willingness to pay (WTP) for the conservation (existence value) of MDSP and for the rest of the Atlantic Rainforest's remnants in São Paulo State.

A survey was conducted by means of personal interviews at home from a questionnaire previously structured and

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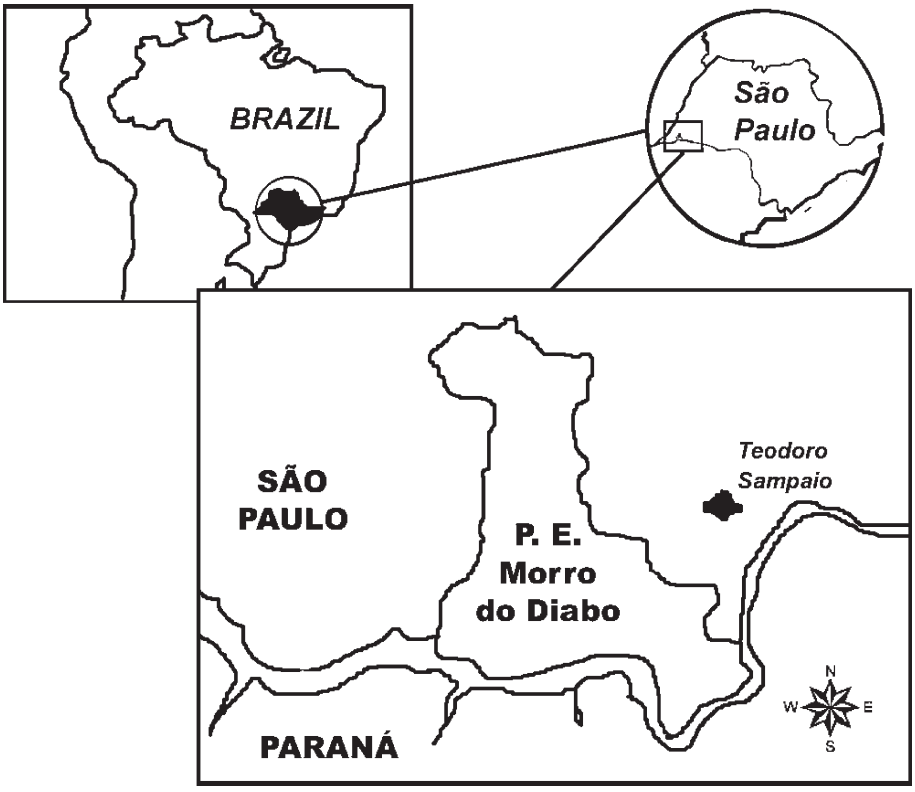

Fig. 1 – Location of Morro do Diabo State Park within the state of São Paulo and Brazil.

standardised, containing questions with alternative answers previously indicated to the interviewees (stimulated/closed), as well as exploratory questions (spontaneous/open).

A representative sample of the socio-economic profile of São Paulo state population was chosen from the municipality's population, estimated in 10,434,252 inhabitants (IBGE, 2000). The final sample was of 648 valid interviews of respondents over 16 years old, structured by quotas of socio-demographic variables (sex, age and region), established from the results of the municipality population's profile given by the year 2000 Census (IBGE, 2000): *Sex*: 47% men, 53% women/*Age*: 24% between 16 and 24 years of age, 24% between 25 and 34 years of age, 20% between 35 and 44 years of age, 19% between 45 and 59 years of age, and 13% over 60 years of age/*Education*: 25% up to 4th grades, 23% up to 8th forms, 39% up to 11th form, 13% at university level, Brazilian system/*Household income*: 28% up to

Table 1 – Comparison between the total aggregate/ha/year (US$) values for protected areas in Brazil

Author	Method	Site	Biome (Mantovani 2003)	Estimated value	US$/ha/year
Nogueira and Salgado (2001)	Travel cost, CVM	Brasilia N. P.	Cerrado (Savanah)	Total economic value (TEV) aggregate/year	531.92
Medeiros (2000)	Cost–benefit analysis	Superagui N. P.	Atlantic Rain Forest	Total socio-economic value	~60.00
Ortiz et al. (2001)	Travel cost	Iguaçu N. P.	Seasonal Semi-Deciduous Forest	Total recreational use value aggregate/year	155.31
Holmes et al. (1998)	WTP	Una B. R.	Atlantic Rain Forest	Use and protection values	9.08
Mikhailova and Barbosa (2002)	Travel cost, CVM	Rio Doce S. P.	Atlantic Rain Forest	Recreation services Regulation services Recreation services II	46.07 7.25 42.14
Azzoni and Isai (1994)	Production function	São Paulo State protected areas (total area 858,646 ha)	São Paulo State's natural forests	Present agricultural production net value	505.45–875.80
Santos et al. (2001)	CVM, substitute goods, marginal productivity	Jataí E. S.	Seasonal Semi-Deciduous Forest	Total use, option and existence values aggregate/year	708.83

National Park (N. P.)/Biological Reserve (B. R.)/State Park (S. P.)/Ecological Station (E. S.).

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Table 2 – Descriptive statistics of socio-economic variables

Variable	Average	Median	Mode	SD	Min	Max
WTPp (MDSP)	1.58	0.00	0.00	3.69	0.00	36.00
WTPm (Atlantic Rainforest)	1.31	0.00	0.00	3.79	0.00	50.00
Age (years)	38.6	36	20, 34 and 35	16.10	16	98
Sex (1/2)	1.53	2	2	0.50	1	2
Education (years)	5.34	6	7	2.18	1	9
Income (US$/month)	360.50	219.44	219.44	349.26	0.00	1567.40
Head (1/0)	0.44	0 (no)	0	0.68	0	1

1 US$=R$ 3.19 (15th August 2002).

twice the minimum wage (MW)[1], 33% between 2 and 5 times the MW, 22% between 5 and 10 times the MW, and 14% over 10 times the MW/*Economically Active Population*: 63% (26% in formal employment, 21% in the informal labour market, 15% unemployed)/*Non-Economically Active Population*: 37% (19% housewives, 10% retired, 8% exclusively students). The error margin was of ±4% for the final results, with a 95% confidence interval.

The interviews were carried out in the residence of the interviewee and captured the willingness to pay for the conservation of the MDSP (WTPp) and also for the whole São Paulo State Atlantic Rainforest remnants (WTPm). The value associated to the Atlantic Rainforest as a whole (WTPm) was asked as an *addition* to the WTP for the MDSP (WTPp) value. The payment instrument chosen was a monthly tax charged on the interviewee's water bill. This instrument was chosen because water is universally charged for in the municipality.

Before the questions regarding WTP, cards containing a brief description of MDSP and the Atlantic Rainforest were handed out to the interviewee and read by the interviewer. This procedure was established to give better information for the interviewer about the park and the Atlantic Rainforest. The questionnaire's was used with a focus group and subjected to two pilot tests before its final application. The results obtained reflect the opinion of the resident population of the municipality of São Paulo.

The inclusion of open questions sought to evaluate the interest of the population in environmental issues and the conservation of MDSP, independent of willingness to pay. The investigation of qualitative information has the advantage of aggregating social and cultural perspectives to the contingent valuation method (Clark et al., 2000). The analysis of such data considered the total valid sample of 648 interviews, since the large number of protest votes and/or null WTPs did not interfere in the results. An econometric analysis was conducted to explain the WTP as a result from the interviews. The model used was Censored Regression Model (Tobit model) (Greene, 1997; Halstead et al., 1991; Pindyck and Rubinfeld, 1991) due to the high number of zeros in the dependent variables.

[1] One minimum wage in Brazil corresponded, at the time, to US$ 62.7 or R$ 200.00 (1 US$=R$ 3.19, in 15th August 2002).

3. Econometric analysis

The socio-economic variables analysed were *Age* (age of the interviewee in years), *Sex*, *School* (code representing the interviewee's level of education) and *Income* (household income). The *School* variable used a proportional education scale, that is, the higher the code the more complete the education.

New variables were created to facilitate the WTP econometric estimation and the analysis of variables important for the explanation of the willingness to pay stated by the interviewees. The WTPp variable represented the willingness to pay for the preservation of the Morro do Diabo State Park. The same procedure was used in the creation of the WTPm variable (willingness to pay for the preservation of the Atlantic Rainforest).

The dummy variable *Head* was created, which featured positive value (1) if the interviewee was head of the household, and null (0) if the interviewee was not the head of the household. The aim was to test if this attribute of the interviewee was a factor of importance in the value established for the WTPs (the sample was formed by 44.5% of heads of household and 55.5% of people with some kind of relation with the head of the house). Of the latter, only 23 interviewees had no familial relation with the head of the house.

Other dummy variables were created with the aim of isolating the effect of each of the total economic value components informed by the interviewee, that is, to test if the existence values for the MDSP and the Atlantic Rainforest were captured or if they expressed use or option use value only. The variables dummyEV (existence value), dummyOV (option value), dummyUV (use value), dummyEVm (MDSP existence value), dummyOVm (MDSP option value) and dummyUVm (MDSP use value) were created from the answers to the variables questioning the respondent about the main motivation for the each WTP response.

Main descriptive statistics of the socio-economic and perception variables featured in the questionnaire are presented in Table 2. These statistics indicate the measures of central tendency and variability for each variable. The first important observation refers to the high incidence of zeroes for WTPp and WTPm. Of the total sample, 65.1% (442 records) WTP responses were zero. The same was true for WTPm variable — 68.7% (447 records) gave responses zero. This fact suggests a high incidence of protest votes.

The income of the interviewees was sought by means of value bands, a standard procedure in contingent valuation studies, used to facilitate the filling in by the interviewee and thus increase the number of valid answers. An average of each interval was used to obtain the descriptive statistics and also in the regressions. It should be highlighted that, in using the value bands for income, the central tendency measurements decrease in value, since the last interval (income above US$ 1,254.00 or R$ 4,000.00) is an open interval, and, therefore, does not feature a midpoint.

Table 3 features the frequency distribution of the interviewees' perception variables in relation to environmental issues and of the questionnaire comprehension control variable. The frequency distributions shown in Table 3 refer only to valid observations, that is, they do not consider the records with no answer (missing values).

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Table 3 – Frequency distribution of perception variables

Variable	Evaluation	Frequency
Interested in ecology	A lot of interest	342
	Little interest	234
	No interest	71
Importance of preservation	1 — less important	13
	2	11
	3	33
	4	60
	5 — very important	514
	6 — don't know	13
Is the government concerned?	Very concerned	17
	A little concerned	184
	Is not concerned	415
	Don't know	26
Personal concern	Very concerned	380
	A little concerned	216
	Is not concerned	42
	Don't know	7
In favour of ecological reservations	Totally in favour	613
	Partly in favour	29
	Indifferent	4
	Partly against	1
	Totally against	1
Questionnaire comprehension	Of easy comprehension	556
	Of difficult comprehension	69
	Don't know	5
Component of economic value WTPp		224
	Existence value	31
	Option value	143
	Use value	50
Component of economic value WTPm		203
	Existence value	28
	Option value	125
	Use value	50

As mentioned before, the high number of zeros in the dependent variables called for the use of a Censored Regression Model (Tobit model) (Greene, 1997; Halstead et al., 1991; Pindyck and Rubinfeld, 1991). This was the model used in the regressions and its use is called for by the fact that the zero WTPs could be in fact negative, but are limited to zero by the way in which the question was asked. In other words, there could be a willingness to receive and not to pay for preserving the forest.

3.1. *Regressions for WTPp estimation*

The analysis of the zero answers to the WTPp question resulted in the exclusion from the sample of those individuals who stated a willingness to pay of zero for reasons other than financial restrictions. In such cases, it is believed that the individuals acted in protest against government attitudes regarding environmental preservation or simply oppose any tax increase for any purpose. In this way, the variable Protest was created with the initial value of (0), becoming (1) when the interviewee mentioned some non-monetary motive for a willingness to pay equal to zero. In total, 249 protest votes were identified, and, thus, the final sample was reduced to 394 observations. Even with this exclusion, there were still 173 null WTPp values left, which reflected a real decision of attributing no gain in welfare (and, in some cases, a loss) from preservation of the MDSP.

As shown in Table 4, the incidence of protest votes by income class is very close to the distribution of the initial sample. In other words, the sample without the protest maintains the same distribution as the initial sample, and, therefore, is an acceptable reflection of the population.

As previously described, the Tobit model is appropriate for the estimation of equations where the dependent variable is limited (in this case the WTP had a lower limit equal to zero). Initially, a complete model using all the possible independent variables was estimated:

$$\mathrm{WTPp} = f(\mathrm{Age}, \mathrm{Sex}, \mathrm{School}, \mathrm{Income}, A, B, C, D, E, F, \mathrm{Head}, \mathrm{DummyEV}, \mathrm{DummyUV})$$

Where:

A Would you say that you are very interested, a little interested or not interested at all in issues related to the environment or ecology?

B From one (1) to five (5), five (5) meaning that the preservation of the environment in Brazil is very important and one (1) that it is not important, what importance do you attribute today to the preservation of the environment in the country?

C In your opinion, the Brazilian government is or is not concerned with the preservation of the environment in the country?

D What about you personally, would you say you are concerned or not concerned with the preservation of the environment in the country?

E And are you in favour or against the existence of these ecological reserves, which are areas of environmental preservation protected by law that no one can touch, not even to fell a tree?

F To conclude, we would like to know about difficulties understanding of the questionnaire that you have just answered. Would you say that it is a questionnaire of easy comprehension, of difficult comprehension, or you don't know?

Table 5 shows the results obtained in the initial econometric estimation. Although the adjustment coefficient R^2 is low, the results of statistical relevance for the explanatory variables were very good. These results suggest that the variables

Table 4 – Distribution of sample data by income class

Income		Sample with protest	Sample without protest, MDSP	Sample without protest, Atlantic Rainforest
R$/month	US$/month			
0–200	0–62.70	53 (8%)	42 (11%)	38 (10%)
201–400	63.00–125.40	128 (20%)	91 (23%)	86 (23%)
401–1000	125.71–313.48	211 (34%)	131 (33%)	121 (33%)
1001–2000	313.79–627.00	141 (23%)	81 (21%)	73 (20%)
2001–4000	627.27–1253.92	69 (11%)	39 (10%)	39 (11%)
>4000	>1253.92	22 (4%)	8 (2%)	7 (2%)
0	0	2 (0%)	2 (1%)	2 (1%)
Total		626 (100%)	394 (100%)	366 (100%)

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Table 5 – Complete WTPp model — protest excluded

Explanatory variable	WTPp		
	Coefficients	P>|t|	Statistics t
Age	−0.05770*	0.028	−2.207
Sex	0.25658	0.691	0.398
School	0.40627*	0.027	2.226
Income	0.00131***	0.000	3.848
Would you say you are very, a little or not interested in themes related to the environment or to ecology? (A)	−1.14505	0.063	−1.867
From one (1) to five (5), five (5) meaning that the preservation of the environment in Brazil is very important and one (1) that it is not important, what importance do you attribute today to the preservation of the environment? (B)	0.06026	0.893	0.134
In your opinion, the Brazilian government is or is not concerned with the preservation of the environment? (C)	0.08753	0.875	0.157
What about you personally, would you say you are concerned or not concerned with the preservation of the environment? (D)	−0. 64452	0.326	−0.983
And are you in favour or against the existence of these ecological reserves, which are areas of environment preservation protected by law that no one can touch, not even to fell a tree? (E)	0.64674	0.622	0.493
To conclude, we would like to know about difficulties understanding the questionnaire that you have just answered. Would you say that it is a questionnaire of easy comprehension, of difficult comprehension, or you don't know? (F)	−0.50889	0.546	−0.604
Head	−1.25868	0.104	−1.630
DummyEV	4.71482***	0.000	4.333
DummyUV	5.69674***	0.000	6.469
Constant	0.46602	0.904	0.121
Observations	373		
Pseudo R^2	0.0891		
Loglikelihood	−742.4362		

Dependent variable: WTPp; (*) Significant at 5% — (**) Significant at 1% — (***) Significant at 0.1%.

Age, *School*, *Income*, *A* and the EV and UV dummies are statically significant and with the expected arithmetic sign and, therefore, remained in the final model.

The result of the final model is presented in Table 6. Dummies EV and UV and the *Age* variable remain significant and the best result was obtained by omitting the *School* variable and the retaining the *Income* variable. Similarly, the *Head* variable was discarded in the final model due to its high degree of linear correlation with the variable *Age* (0.41), and the weak significance of its coefficient. The same took place with variables *A* and *D*, which were statistically correlated to each other. The latter featured better explanatory powers for the WTPp. Finally, the other socio-economic and evaluation variables were also excluded due to low WTPp explanatory powers. Among these, we highlight variables *E* and *F*, whose non-significant coefficients suggest that the interviewee's position in relation to the creation of ecological reserves, as well as his or her comprehension of the questionnaire, did not influence in the willingness to pay for the preservation of the MDSP. The coefficients' arithmetic signs are in accordance with the expected: younger, higher-income interviewees who are concerned with the preservation of the environment tend to state a higher WTPp.

Observing the dummies EV and UV coefficients, one notes that both are significant, but WTPp is increased when the respondent holds as the main motive UV rather than EV. That is, the interviewee could not dissociate the components of EV and UV and, thus, both were important in the decision. So, the results estimated here represent both EV and UV, and, in this way, will come close to a total economic value.

3.2. *Regressions for WTPm estimation*

As mentioned before, the value associated with the Atlantic Rainforest as a whole was also asked, as an addition to the WTPp value. As with the MDSP WTP question, protest responses to the Atlantic Forest question were also excluded from the sample. In total, combining both triages, we identified 277 protest votes, and, thus, the final sample was reduced to 366 observations. There were still 177 zero WTPm

Table 6 – WTPp final model — protest excluded

Explanatory variable	WTPp		
	Coefficients	P>|t|	Statistics t
Age	−0.11220***	0.000	−5.404
Income	0.001672***	0.000	5.667
And what about you personally, would you say that you are concerned or not concerned with the preservation of the environment in the country? (D)	−1.24377*	0.018	−2.383
DummyEV	4.58061***	0.000	4.362
DummyUV	5.59355***	0.000	6.476
Constant	3.58996**	0.003	3.032
Observations	391		
Pseudo R^2	0.0826		
Loglikelihood	−780.3129		

Dependent variable: WTPp; (*) Significant at 5% — (**)Significant at 1% — (***)Significant at 0.1%.

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Table 7 – WTPm complete model — protest excluded

Explanatory variable	WTPm		
	Coefficient	P>|t|	Statistics t
WTPp	0.63092***	0.000	12.624
Age	−0.05122**	0.007	−2.737
Sex	0.14590	0.741	0.330
School	0.28396*	0.026	2.242
Income	0.00057*	0.013	2.502
Would you say that you are very interested, a little interested or not interested at all in issues related to the environment or ecology? (A)	−0.20398	0.635	−0.476
From one (1) to five (5), five (5) meaning that the preservation of the environment in Brazil is very important, and one (1) meaning that it is not important, what importance do you attribute to the preservation of the environment? (B)	0.47692	0.147	1.452
In your opinion, is the Brazilian government concerned or not concerned with the preservation of the environment? (C)	0.10985	0.779	0.280
And you personally, would you say that you are concerned or not concerned with the preservation of the environment? (D)	−0.15987	0.733	−0.341
And are you in favour or against that these ecological reserves exist, these being areas of environmental preservation protected by law, which nobody can touch, not even to fell a tree? (E)	−0.56896	0.545	−0.606
To conclude, we would like to know the level of difficulty of the questionnaire you have just answered. Would you say that this is a questionnaire of easy comprehension/difficult comprehension/you don't know? (F)	−0.11643	0.837	−0.206
Head	−0.58975	0.261	−1.127
DummyEVm	2.33929***	0.001	3.272
DummyUVm	2.06422***	0.001	3.284
Constant	−3.21085	0.245	−1.163
Observations		349	
Pseudo R^2		0.1901	
Loglikelihood		−554.2763	

Dependent variable: WTPm; (*) Significant at 1% — (**)Significant at 10% — (***) Significant at 0.1%.

values left after this screening process, reflecting an economic decision of not attributing a well being gain to the preservation of all of the Atlantic Rainforest remnants in the State of São Paulo.

The same WTPp econometric models were used to estimate the coefficient of the WTPm explanatory variables. However, the value associated to the Atlantic Rainforest as a whole was elicited as an addition to the WTPp value. Therefore, in the WTPm estimation WTPp was included as an explanatory variable in order to test it as an "anchor," or starting point that influenced the WTPm value. The complete model was:

$$\mathrm{WTPm} = f(\mathrm{WTPp}, \mathrm{Age}, \mathrm{Sex}, \mathrm{School}, \mathrm{Income}, A, B, C, D, E, F, \mathrm{Head}, \mathrm{DummyEVm}, \mathrm{DummyUVm})$$

The final and complete models' results are presented, respectively, in Tables 7 and 8 below. It was not a surprise that the same independent variables that best explained the WTPp also featured statistically significant coefficients for the explanation of the WTPp (except variable *D*). The arithmetic signs of the coefficients are also equal. The high degree of significance in the WTPp explanatory variable characterises an anchoring in the value established by the interviewees for the WTPm. This means that people declared values for the preservation of the Atlantic Rainforest holding as reference point the value that they had declared as their willingness to pay for the preservation of the MDSP.

Another expected variation was in relation to the magnitude of dummies EV and UV. Note that for WTPm, the EVm coefficient (existence value for the Atlantic Rainforest) is higher than that of UVm (use value for the Atlantic Rainforest). Theoretically, this inversion makes sense, given that the forest as a whole would be more useful due to its existence rather than for its use. The same took place when UV was exchanged for OV. In other words, the respondent did not separate the part from the whole, and all value components induced their payment.

The individual monthly average WTP for the conservation of MDSP and the Atlantic Rainforest were calculated from the coefficients of the WTPp and WTPm final models (Tables 6

Table 8 – WTPm final model — protest excluded

Explanatory variable	WTPm		
	Coefficients	P>|t|	Statistics t
WTPp	0.63249***	0.000	12.953
Age	−0.07300***	0.000	−4.965
Income	0.00084***	0.000	4.173
DummyEVm	2.40890***	0.001	3.427
DummyUVm	1.96779***	0.001	3.236
Constant	0.02790	0.965	−0.044
Observations		365	
Pseudo R^2		0.1801	
Loglikelihood		−585.8919	

Dependant variable: WTPm; (*) Significant at 1% — (**) Significant at 10% — (***) Significant at 0.1%.

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and 8, respectively). Note that the final WTP for the whole forest would be the sum of the WTPp and WTPm, since WTPm is additional to WTPp. We also present central tendency estimates of both WTPp and WTPm variables (note that the median values would be zero, given the high incidence of null WTPs values). Given the existence of a high number of null WTPs, the estimates were also carried out for 5 income brackets.

All of these results are presented in Table 9. Note that in all cases the non-parametric estimates presented a standard deviation higher than the average, indicating that, statistically, those values, with a 95% confidence interval, could also be zero, or less. For example, a WTPp for all income brackets averages US$ 0.81 (R$ 2.58) with standard deviation equal to US$ 1.39 (R$ 4.43), and, therefore, the value of this WTP varies from US$ −0.58 to 2.20 (R$ −1.85 to 7.01). Observe that in Table 9 the estimate for the WTPp of the whole of the final sample is very low — US$ 0.06/month (R$ 0.19). By removing the lower income brackets in succession the values for WTPp grew. This confirms that the preservation value of the park is strongly associated with capacity to pay.

The WTPm of additional US$ 0.03 (R$ 0.08) for the Atlantic Rainforest, considering the whole of the sample, is half of the WTPp, which suggests a small gain in well being when preservation is widened to the whole of the forest. In total, the monthly individual WTP for the whole of the Atlantic Rainforest would be of US$ 0.09 (R$ 0.27). When the income brackets are considered, one observes that the WTPm values increase with income.

Lastly, it is noteworthy that the average non-parametric values of WTPp, except those related to all income levels, are, in general, 50% lower than those of the parametric estimates; those of the WTPm, on the contrary, are 50% higher. The total value for preservation of the whole of state's Atlantic Rainforest (WTPp+WTPm) ends up very close in the two models, considering the standard deviation of the non-parametric WTP values.

We must underscore that the exclusion of a large number of protest votes places the representativeness of the sample in question. At the same time, the aggregation of EV and UV is very difficult to avoid, and its mitigation depends on an efficient description of the object and motive for the research, including the formulation of the question that elicits the WTP. The only problem with the aggregation is that it does not guarantee that all types of UV are included, since the inclusion is influenced by the perception of each respondent. However, the questionnaire did not necessarily intend to capture this component. In this way, these WTP values should be underestimates of the total economic value of the ecosystems in question.

Based on the parametric WTP values for the MDSP and for the Atlantic Rainforest, the total aggregate value per month and per year was calculated, in Reais (R$) and in American dollars (US$) (Table 10). The number of households in the city of São Paulo was calculated according to information issued by IBGE (2000) (N=3,105,432). To obtain the value per hectare (US$ 60.39/ha/year) the total aggregate/year value was divided by the area of the MDSP (35,000 ha).

As previously indicated, the value attributed to the MDSP includes both the existence and use values. Despite coming close to the total economic value, the total value obtained for the park, of US$ 2,113,548/year (R$ 7,080,385/year), can be considered an underestimate.

Table 9 – Summary of the WTP estimates (US$ and R$/month)

Variable	Income level		WTP*	
	R$	US$	R$	US$
Non-parametric WTPp	All levels		2.58 (4.43)	0.81 (1.39)
	>200	>62.7	2.70 (4.50)	0.8 (1.4)
	>400	>125.4	3.04 (4.71)	1.0 (1.5)
	>1000	>313.5	4.14 (5.60)	1.3 (1.8)
	>2000	>627.0	5.84 (6.77)	1.8 (2.1)
	>4000	>1253.9	5.37 (8.33)	1.7 (2.6)
Non-parametric WTPm	All levels		1.98 (3.72)	0.6 (1.2)
	>200	>62.7	2.13 (3.88)	0.7 (1.2)
	>400	>125.4	2.51 (4.27)	0.8 (1.3)
	>1000	>313.5	3.29 (5.14)	1.0 (1.6)
	>2000	>627.0	4.94 (6.25)	1.5 (2.0)
	>4000	>1253.9	5.50 (8.68)	1.7 (2.7)
WTPp+WTPm — non-parametric	All levels		4.56	1.4
	>200	>62.7	4.83	1.5
	>400	>125.4	5.55	1.7
	>1000	>313.5	7.43	2.3
	>2000	>627.0	10.78	3.4
	>4000	>1253.9	10.87	3.4
WTPp — parametric	All levels		0.19	0.06
	>200	>62.7	0.48	0.2
	>400	>125.4	1.10	0.3
	>1000	>313.5	2.72	0.9
	>2000	>627.0	4.50	1.4
	>4000	>1253.9	6.30	2.0
WTPm — parametric	All levels		0.08	0.03
	>200	>62.7	0.34	0.1
	>400	>125.4	0.89	0.3
	>1000	>313.5	2.23	0.7
	>2000	>627.0	4.45	1.4
	>4000	>1253.9	5.63	1.8
WTPp+WTPm — parametric	All levels		0.27	0.09
	>200	>62.7	0.82	0.3
	>400	>125.4	1.98	0.6
	>1000	>313.5	4.95	1.6
	>2000	>627.0	8.94	2.8
	>4000	>1253.9	11.94	3.7

(*) Non-parametric estimates (standard deviation in parentheses).

This survey also indicated that most of the population of São Paulo municipality (79%) considers the preservation of the environment in Brazil to be very important, 89% showing a personal interest in environmental issues. However, the government's image in this area did not score well. When asked about the government's concern with environmental preservation, 64% considered it is not concerned and 28% that it is a little bit concerned. On the other hand, while 44% of the population believes that the government (federal, state and municipal) is the major responsible body for the environment's preservation in Brazil, a considerable portion (37%) thinks that this role should be played by civil society. In this way, when asked about the manner in which they would be willing to collaborate in the preservation of the country's environment, as part of civil society, the answers showed a high general willingness, and 60% of the population would be prepared to dedicate a few hours a month to engage in educational activities aimed at the preservation of the environment.

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Table 10 – WTP of the population São Paulo municipality for the conservation of the MDSP and the Atlantic Rainforest in the state, by month and by year (R$ and US$)

	WTP parametric		Total aggregate/month value		Total aggregate/year value	
	R$	US$	R$	US$	R$	US$
MDSP	0.19	0.06	590,032.00	176,129.00	7,080,385.00	2,113,548.00
Atlantic Rainforest	0.27	0.09	838,467.00	250,289.00	10,061,600.00	3,003,463.00

Despite the fact that 86% of the interviewees believed that the level of environmental degradation in Brazil is high, only 21% knew that the "conservation units" (*unidades de conservação* is the term used in Brazil) were natural reserves protected by law. Nevertheless, when asked if they agreed with the existence of strictly protected conservation units,[2] 99% were in favour, 94% being totally in favour, and 5% only partly. The figures signal, thus, a nearly total agreement with environmental protection policy in the form of conservation units, though there may be a bias, for the sample is entirely urban, with little access to green areas.

Of the total of people interviewed, 91% had never heard of the MDSP, but 96% stated that the park should be preserved. The main spontaneously declared reasons, both for the maintenance of the MDSP and for the Atlantic Rainforest as a whole, were the preservation of fauna and green areas, the improvement of air quality, their use as leisure areas, the guarantee of health and quality of life, the preservation of water, preservation for future generations, the maintenance of ecological balance, and making future research possible. This profile is consistent, even when limiting the sample to those individuals whose WTP is not zero.

Among those who were not willing to pay for the preservation of the MDSP, the reasons stated were unemployment, insufficient household income to cover basic needs, the belief that enough taxes are paid already and that it is responsibility of the government to guarantee the maintenance of the park, or because the respondent does not believe the government would give the money the right destination. Regarding the comprehension of the questionnaire, an absolute majority stated that the questionnaire was easy to understand.

4. Discussion

Public policies on biodiversity preservation based on the setting up of protected areas face a number of difficulties in Brazil and other developing countries (Bruner et al., 2001, 2004). Among these are society's insufficient support, conflicts with local populations and other government agencies, the lack of financial resources and their irregular delivery to managers (Nogueira and Salgado, 2001). One of the main obstacles to better management of protected areas is the relative fragility of the agencies responsible for them within the government structure, which makes them more vulnerable to political changes and budget cuts (Nogueira and Salgado, 2001). This has been the case with protected areas in the State of São Paulo (Dale, personal communication), such as MDSP (Faria, 2002).

MDSP's average yearly budget from 1997 to 2000 (R$ 271,341.75 or US$ 85,060.11, being 1 US$=R$ 3.19 in 15th August 2000) represents only 3.8% of the total aggregate value that the Municipality of São Paulo's population is willing to pay for its conservation (R$ 7,080,385.00 or US$ 2,219,556.43). These figures show a discrepancy between priorities of the state government and the general public, and mirrors a similar gap reported by Hadker et al. (1997) for Borivli National Park (BNP) in India (10,309 ha). There, the net value obtained for the park (1,033 million rupees or US$ 28,937,195)[3] is much higher than BNP's annual budget (17 million rupees per year or 1.65% of the total aggregate value). Bruner et al. (2001) report that the average protected-area management spending in developing countries ranges from US$ 0.05 to US$ 3.00 per ha, while actual needs would range from US$ 0.90 to US$ 9.00 per ha. MDSP's figures (US$ 2.4/ha/year) are at the high end of the range of actual expenditures and the low end of needed spending.

When compared with the total aggregate/year/ha values obtained by monetary valuation methods for other protected areas in Brazil (Table 1), MDSP (60.39 US$/ha/year) is close to Superagui National Park's total socio-economic value (60.00 US$/ha/year) and Rio Doce State Park's recreational values (42.14–46.07 US$/ha/year), but is low in comparison to the other studied areas. It is much lower, for example, than the other two areas that protect remnants of the Seasonal Semi-Deciduous Forest. Jataí Ecological Station's TEV was estimated at 762.40 US$/year/ha. While in MDSP only use and existence values were calculated, Jataí's use values were associated with ecosystems functions and calculated by other methods (substitute goods/avoided costs and marginal productivity) (Santos et al., 2001). Iguaçú National Park, on the other hand, is a world-famous tourist destination due to its spectacular waterfalls and, receives almost 800,000 tourists/year, half of them from abroad. Its total recreational value (155.31 US$/year/ha), calculated by the travel costs methods, reflects unique features (Ortiz et al., 2001).

[2] Integral protection conservation units, in which parks are included, are those serving "the maintenance of ecosystems free of changes caused by human interference, admitting only the indirect use of its natural attributes" (Brasil, 2000).

[3] Hadker et al. (1997) presented values only in local currency. The conversion to American dollars was based on the exchange rates of August 1997, year of publication of that article, which was of Rs 35.6980/1 US$ (obtained from www.xe.com/ict/).

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Another aspect of this study that should be highlighted is the lack of proportionality between the total aggregated value for Atlantic Rainforest in the State of São Paulo (US$ 0.09/household or US$ 3,003,463.00/year) and MDSP (US$ 0.06/household or US$ 2,113,548.00). These figures can be explained, first of all, by the fact that when WTPm was asked (as an addition to WTPp) the respondent had already mentally "spent" most of his altruistic budget with the park. This attitude could also be explained by the expectation of diminishing marginal utility of consumption: one may be willing to pay a certain amount for preserving an extra hectare of rainforest, but it's unlikely that he or she would be willing to pay the same amount per hectare for the whole forest. Alternatively, one could consider that if existence value is correlated to stock, the respondent may want to guarantee a minimum stock to ensure the existence of the Semi-Deciduous Forest. The marginal willingness to pay for a larger stock would be proportionally lower than the stock variation until it reached almost zero at the sustainable stock level. This means that at that sustainable level the population's total WTP would be equal to the value of the total stock. Although the area of the whole forest is much bigger than the park, marginal WTP is not. For example, when Horton et al. (2002) changed the size of a conservation area in the Amazon in 300%, resulting WTP estimate changed of only 38% (for a theoretical discussion on this argument, see also Hanemann, 1995).

According to Attfield (1998, pp. 165) existence value (EV) is the value "of the continued existence of various things" that can be related to the intrinsic value of the minimum critical stock ("good continued existence" — Aldred, 1994 *apud* Attfield, 1998, pp. 163). This value is not related to the flow of environmental goods and services that determine use values. It follows that EV would decrease with the size of the preserved area or would grow less than proportionally to that area. Note that the WTPm values are always inferior to those of WTPp, even knowing that the area of the Atlantic Rainforest is fifty times bigger than that of the park. This would be expected since we have demonstrated that EV more forcefully commands the WTPm valuation than WTPp's, and, therefore, the increase in the WTPm is proportionally lower than that of the preserved area.

As described before, our results also showed a large number of questionnaires with null WTP both for MDSP (65.1% of the total) and for the Atlantic Rainforest (68.7%), pointing to two factors: (1) lack of credibility of the government in the use of public resources and, therefore, lack of trust in charging for public services (water, electricity) as payment vehicles for WTP estimation; (2) the bias induced by the population's budget restrictions, which can seriously influence the size of the final sample.

These results are similar to those obtained by Hadker et al. (1997) for Mumbai residents' WTP for the preservation of BNP. Willingness to pay was estimated by means of dichotomous bids, followed by an open question about the maximum WTP. The authors also investigated the willingness to participate in voluntary park maintenance, as a way to include those who could not contribute financially but would be interested in preserving the park. Of the total population interviewed by the authors, 35.9% responded with protest votes (in the case of the MDSP 38.5%), and 24.9% thought that the government should be responsible for the maintenance of the park. Besides, 26.9% said that household budget restrictions limited payment capacity (26.8% in the case of MDSP). When asked about the availability for voluntary work, 28% of the population responded positively (Hadker et al., 1997), while in São Paulo 60% of the population would be willing to dedicate a few hours a month for environmental education activities, and 37% believes that the major responsible player for environmental preservation in Brazil was civil society and not the government.

The issues discussed above highlight some of the problems faced by the monetary valuation of natural resources, especially through stated WTP methods. These difficulties can be added to those discussed by Brito (2005) concerning biodiversity valuation, such as the kind of inputs (knowledge about all components of biodiversity, in terms of genes, species or ecosystems) required to form current individual preferences and the fact that national and international goals of biodiversity conservation and economic growth are usually conflicting (Ehrenfeld, 1988; Czech et al., 2000). Other ecologists and conservation biologists think that it is either impossible or unwise to place a value on such intangible things as biodiversity, environmental aesthetics or long-term ecological benefits (Pimm, 1997). Besides, Balmford et al. (2002) have demonstrated that the loss of nonmarketed services outweighs the marketed marginal benefits of ecosystem conversion often by a considerable amount.

On the other side, most economists think that some of the problems faced by protected areas arise because ecosystem services normally do not have market values, and for this reason are undervalued in policy decisions (Costanza et al., 1997). The establishment of economic value as a criterion complementary to environmental criteria could help to increase the efficiency of environmental management (Seroa da Motta, 1998; Tomam, 1998), highlighting the importance of protected areas to society. Nevertheless, some economists admit that there are moral issues involved in ecosystem valuation, but, instead of abandoning it altogether, we should choose to make them more explicit (Costanza et al., 1997).

Despite all the problems faced by protected areas in the tropics, Bruner et al. (2001, 2004) have shown that they have been effective in protecting the ecosystems and biodiversity within their borders, suggesting they should remain a central part of conservation strategies. We believe that beside the possible contributions of this study to public policy decisions (including the importance of establishing new conservation strategies), the economic valuation of MDSP can bring benefits for the resolution of social problems and land conflicts in Pontal do Paranapanema. Most farmers in Pontal do Paranapanema occupy public areas without legal title, making bad environmental use of the land, and the park is the only significant example of the benefits that native ecosystem conservation can bring to the region. The economic valuation of MDSP could orient the State government in the negotiations concerning land conflict resolution and in the development of more sustainable land use alternatives. Besides, our results could serve as a reference value for compensation of losses caused by environmental damage.

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5. Conclusion

The aim of this study was to carry out the economic valuation of the existence value of Morro do Diabo State Park (MDSP) and the Atlantic Rainforest's remnants in São Paulo State by means of the contingent valuation method (CVM). Our questionnaire captured both the use and existence values in both cases. The WTP values can be considered as underestimates of the total economic value. The high incidence of zero values was due to: (i) protest votes and (ii) the population's low payment capacity. The effect of the ability to pay was dominant, for, even when the protest votes were left out of the sample, the WTP average estimates featured values close to zero (or even negative). However, these WTP estimates increased with income level. The coefficients' arithmetic signs were as expected: younger, higher-income interviewees who were concerned with the preservation of the environment tended to state a higher WTP for MDSP.

The results showed consistency with all the correlations between the WTP values and the socio-economic and perception variables investigated. Monetary and non-monetary interests point to the potential for more effective action by the State and environmental NGOs in the conservation of the last remnants of the Seasonal Semi-Deciduous Forest in the State of São Paulo, including the organisation of voluntary work.

Although the CVM has limitations in the valuation of protected areas in developing countries, we believe that it can serve as a useful tool for the formulation of public policies, as it highlights the environmental values quantitatively in a way few methods can. This study has shown that the inclusion of qualitative research, in which a non-monetary contribution option is offered to the interviewee, can sketch a more trustworthy picture of people's real interest in the preservation of a protected area, avoiding one of the main criticisms to CVM: that the economic valuation of natural resources depends on the interviewees' income (Jacobs, 1991, pp. 212).

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