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USING DIRECT QUESTIONING TO VALUE THE EXISTENCE BENEFITS OF PRESERVED NATURAL AREAS

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A major limitation to the effectiveness of benefit-cost analyses of proposals involving natural ecosystems is the assertion of existence demand. Not only has confusion arisen regarding its exact definition but little has been done to establish its magnitude. Existence benefits are defined and an empirical study of the value a sample of Canberra residents places on the continued provision of the existence benefits of a particular ecosystem, Nadgee Nature Reserve, is outlined. It is concluded that while the measurement technique employed, the direct questioning of respondents, may be subject to a problem of response bias, it is capable of providing a reasonable estimate of these existence benefits. The average existence value per Canberra adult is at least $20, that is $2 per annum in perpetuity given a 10 per cent real interest rate.

To present a comprehensive analysis of any land allocation decision which involves a choice between the preservation or development of a natural ecosystem, the benefit-cost practitioner must be able to measure, in monetary terms, the benefits which arise from both options. While the measurement of the majority of developmental benefits is relatively straightforward, given that markets for these benefits exist, the difficulties involved in obtaining accurate valuations for the often non-marketed preservation benefits have frequently caused the abandonment of the benefit-cost technique.

Over the past decade, numerous advances have been achieved in the development and use of methods specifically designed to measure non-market benefits. The benefit-cost analyst can now approach the task of evaluating projects which involve natural ecosystem preservation as an alternative land-use with a considerably improved and expanded array of measurement tools. In particular, those benefits which are enjoyed by visitors to preserved natural areas—the participatory benefits—can now be measured with a greater degree of accuracy through both 'related market' techniques, specifically the travel cost method (see Ulph and Reynolds 1979), and 'revealed preferences' techniques such as the iterative bidding method (see Randall, Ives and Eastman 1974) and direct questioning (see Hammack and Brown 1974). The revealed preferences techniques also appear to offer the potential for measuring the non-participatory benefits of natural ecosystem preservation. These benefits may be enjoyed by people who do not visit preserved areas. They include educational benefits derived through the reading or viewing of material which relates to preserved areas, scientific benefits gained through researchers working in such places, gene-pool maintenance benefits en-

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joyed when people in the future are able to draw from the reservoir of genetic material stored in preserved areas and existence benefits gained through the knowledge that the ecosystems, and individual species which make up the ecosystems, survive in a natural state.

Even though the potential for the measurement of non-participatory benefits of preservation appears to exist, there is a dearth of actual case studies. Whilst this may be explained in many cases by the insignificance of non-participatory benefits relative to the other benefits and costs involved, it is likely that in some cases, notably where development proposals involving reductions in the extent of low visitation wilderness areas are being considered, criticism will be attracted by benefit-cost appraisals which do not incorporate non-participatory benefit measurements.

The non-participatory benefit type which appears to be least understood and to offer the highest order of measurement difficulty is the existence benefit. Not only has confusion arisen over the definition of existence value but little has been done to establish whether it accrues and, if so, its magnitude. In this paper, the magnitude of the existence values enjoyed by a specific group of individuals (a sample of Canberra, ACT residents) for the continued preservation of a particular natural area, Nadgee Nature Reserve, NSW, is established. A clarification of the existence value concept is provided and some broader conclusions as to the relevance of existence values to preservation/development decisions are drawn.

Existence Benefits Defined

Existence values have been defined by Bishop (1978, p. 15) as '. . . the utility that people receive from simply knowing that something exists'. This utility was recognised by Krutilla (1967, p. 781) who noticed the satisfaction that people enjoyed from the knowledge that parts of North America remain as wilderness areas '. . . even though they would be appalled by the prospect of being exposed to it'. He also drew attention to subscriptions to the World Wildlife Fund as evidence of existence demand. Barkley and Seckler (1972, p.131) mention existence demand in reference to the blue whale: '. . . countless millions of people derive pleasure from simply knowing that the whale exists'. Despite this, albeit non-empirical, recognition of the concept of existence value, there appears to be some confusion regarding the exact nature of the benefit. Clearly, such confusion must be eliminated before any measurement process can be implemented. Bishop's narrow definition is adopted for the purposes of this study. In so doing it is recognised that subscriptions to the World Wildlife Fund and donations to 'Save the Whale' campaigns are manifestations not only of the value people enjoy from the pure knowledge of a species' (or ecosystems') continued existence but also a combination of present and future non-participatory values and expected participatory values.

Importantly, the definition adopted here is anthropocentrically and utilitarian based. Often it is argued (see Elliott 1978) that animals and plants have a right to exist beyond that to which they are entitled as a result of any benefits they may yield to people. This so-called 'moral argument' is not part of existence demand because it presents individuals with the moral imperative that we ought to preserve plants and animals.

Existence demand merely asserts that individuals would willingly choose to spend resources to preserve plants and animals.

The characteristics of Nadgee Nature Reserve, an area of land on the far south coast of NSW which is managed by the NSW National Parks and Wildlife Service suggest that its continued preservation is likely to offer certain existence benefits. First, the area is known to, or is thought to, support populations of three species of birds which are listed by the Parks Service as endangered (see Robertson 1977): the Ground Parrot, the Eastern Bristle Bird and the Glossy Black Cockatoo. The enjoyment resulting from the knowledge that these birds continue to survive would be classified as an existence benefit resulting from Nadgee's preservation. Secondly, the Reserve is the only coastal area which remains in a relatively natural state in south-eastern Australia and contains one of the most diverse mosaics of habitats to be found anywhere in Australia in such a compact area (see Newsome, McIlroy and Catling 1978). The relative scarcity of the Nadgee ecosystem, considered as an entity, may thus provide a reason for individuals to enjoy existence benefits.

Because the physical features found in Nadgee suggest that it is likely to provide existence benefits, it was regarded as being a suitable area on which to focus this measurement study. Nadgee was also attractive as a site for the study of existence values in isolation from the other benefits which may be provided by an area of preserved natural ecosystem, because of the management regime employed by the Parks Service in the Reserve. Specifically, Nadgee is managed with a strong emphasis on the provision of non-participatory benefits, with restrictions being placed on visitation and encouragement being given to the pursuit of scientific research. The array of preservation benefits being provided by Nadgee is thus considerably narrowed, making the task of isolating existence values for measurement purposes a simpler process. The mechanics of how the existence benefits enjoyed by Canberra residents as a result of the continued preservation of Nadgee Nature Reserve were isolated for measurement, are detailed in the following section.

The Questionnaire and the Survey

On the basis of its theoretical adequacy and its cost-effectiveness, traded off against the possibility of response bias, direct questioning by personal interview was chosen to be the technique most appropriate to the task of measuring the existence benefits provided by Nadgee. The questionnaire designed to provide the vehicle for the measurement technique, was centred on the hypothetical concept of a campaign to prevent an area of preserved natural ecosystem from being developed. Essentially, respondents were asked, given the circumstances described, if they would be willing to pay anything as a once-only lump sum to ensure the continued supply of existence benefits from the area under threat. Those who indicated a preparedness to pay were asked the amount they would be willing to pay. No payments were collected and respondents were informed at the outset that the interviewers were not collecting money. A number of key features were embodied in the questionnaire.[1]

[1] The questionnaire is contained in Bennett (1981) or is available from the author on request.

(a) The existence benefits provided by Nadgee were isolated from the other benefits of the Reserve through the hypothetical campaign concept. The ecosystem which was at the centre of the preservation campaign, although based on the features of Nadgee, remained anonymous and was embellished with a number of restrictions on visitation additional to those applied at Nadgee which were included in an attempt to eliminate from a respondent's consideration all but the non-participatory benefits. Additionally, the campaign incorporated a funding arrangement under which respondents were excluded from any commitment to pay for scientific or gene-pool maintenance benefits. Obviously, this setting falls short of a total isolation of existence benefits, but this ideal isolation could never embody the realism considered by Randall and Brookshire (1978) to be important in securing accurate revelations of preferences.

(b) Context reality was provided by the use of the physical features of Nadgee as the basis of the hypothetical reserve. Photographs of key features were used to highlight the reality of the described setting. In addition, questions were based on a format of willingness to pay to prevent the loss of existence benefits rather than the less well known format of willingness to accept compensation if existence benefits were lost. Theoretically, the differences between responses to the two formats should be slight (see Randall and Stoll 1980). However, Meyer's (1979) summary of the results of studies which asked both types of questions suggests that differences are in fact quite substantial. Both Randall and Brookshire (1978) and Rowe, d'Arge and Brookshire (1980) have concluded that the problems associated with a shift in property rights away from the status quo, as is implicit in the adoption of a 'willingness-to-pay' format, are less substantial than those which arise from the unfamilarity most respondents experience when asked 'willingness-to-accept-compensation' questions.

(c) The questionnaire, through its provision of information about the Reserve's existence benefits at low cost to the respondent, was designed to reduce 'hypothetical' bias in individual's responses. This type of bias 'is not a true bias, being the result not of systematic influences but rather of noise resulting from a failure to invest as much effort in the contingent decision as would be invested in an actual decision, presumably because the penalties from a wrong decision in a hypothetical market are not so tangible' (Randall and Brookshire 1978, p. 15). By lowering the costs of assembling information on which to base an assessment of preferences, the questionnaire aimed to induce a larger proportion of the sample to avoid the inclusion of hypothetical bias in their responses.

(d) The questionnaire was also designed to reduce the incidence of payment-mode bias. The direct questioning method involves respondents being asked their willingness to pay through a specific mode of payment. If a respondent has a particular dislike, or like, for the payment mode provided, a payment-mode bias in revealed preferences may result. To alleviate this problem, alternative payment modes from which respondents who wished to support the

preservation option could choose, were provided by the questionnaire. The alternatives were an increase in tax paid to government and a donation made to a conservation organisation.[2]

(e) A section of the questionnaire was devoted to questions which sought information on socio-economic characteristics, stated preferences and patterns of actual behaviour. In part, this information was gathered to enable the cross-checking of respondents' willingness-to-pay bids for evidence of strategic bias. There are many variants of the basic notion of strategic bias, arising primarily from the differing techniques of questioning and varying assumptions made regarding the behaviour of respondents: three are prominent. First, if it is thought that respondents believe their individual responses to the hypothetical questions will have no policy implications, and that they will be forced to pay the amount they bid, then the incentive is to *understate* their true preferences—the classic 'free-rider' response. Secondly, if it is assumed that respondents believe their responses are relevant to policy and that they also believe that they will never have to pay anything for the provision of the good in question (regardless of whether their beliefs are justified), then *overstatement* of true preferences is the appropriate strategic behaviour. Finally, if respondents are informed that they will be required to pay the mean bid, calculated over all respondents, and it is assumed that respondents believe that this collection will eventually take place (and this involves an assumption that respondents believe their responses have policy implications) then if individuals possess willingness to pay which exceeds their expectations of the mean bid, then the strategic response is to *overstate* their preference. However, if individuals possess willingness to pay which is less than their expectations of the mean bid, then they would be expected to *understate* their preferences under a strategic behaviour hypothesis.

(f) The effects on willingness to pay for existence benefits of varying levels of information supplied to respondents and the degree of rarity displayed by species described to respondents as inhabiting the reserve were further areas into which the questionnaire probed. The questionnaire enabled an examination of these effects through its provision of four varying sets of information, each set being targeted on a specific sub-sample group of respondents.

Five hundred and ninety-three residents of Canberra, over the age of 18 were selected to respond to the questionnaire. Selection was based on the systematic random sampling of households listed in the ACT rates file. Forty-nine of the selected individuals either refused to answer, could not be contacted or were unable to participate because of language difficulties, leaving a total sample size of 544. Sample selection and interviewing was undertaken by the Australian National University Survey Research Centre in 1979. The sample was found to consist of a large pro-

[2] It is possible that distortions to willingness-to-pay bids could arise because of the provision of alternative payment modes. Specifically, if respondents assumed that a donation to a conservation organisation was tax deductible, their bids could be inflated relative to what they would have been willing to pay as an additional tax.

portion of 20-44 year olds with high household incomes, but this characteristic was found to be consistent with the overall Canberra population. However, the significant socio-economic differences which were found to exist between the Canberra and Australian populations suggest that any results derived from the questionnaire data could be extrapolated to a national context only after adjustment to take account of those differences. Extrapolation would also require the careful assessment of any locational features specific to Canberra. For instance, the respondents' familiarity with the type of coastal ecosystem displayed in the questionnaire may be a factor influencing their existence values.

The Results

In this section the data on respondents' willingness-to-pay bids are considered in two stages: first, the distribution of bids is examined in an attempt to establish the extent of existence benefits; and second, an explanation of the distribution, in terms of respondents' characteristics, is provided. To enable such analyses, the bids are assumed to be accurate indications of individuals' equivalent surpluses arising from the continued provision of Nadgee's existence benefits. The validity of this assumption is addressed in the next section.

Bid magnitudes

The distribution of willingness-to-pay bids is displayed in Table 1.[3] The 25 per cent of respondents who bid the modal score of zero were questioned as to their reason for this response. Of these 26 per cent indicated a belief that the government should accept the responsibility for the preservation project using consolidated revenue and 22 per cent suggested that they bid zero because they believed that public access to the Reserve should be permitted. Neither of these responses implies that the individual has bid zero as a valuation of existence benefits. Rather, those in favour of public visitation appear to be registering a protest against the proposed preservation strategy while those desiring government action, without extra taxes, seem to be displaying a preference for a distribution of the burden of payment and a dissatisfaction with the current allocation of budget funds. The preponderance of zero bidders who called for government action does not necessarily suggest a failure of these respondents to appreciate the alternative payment modes provided: they may neither want to give a donation nor pay an additional tax but would rather a reshuffling of government priorities. Other well-supported reasons for a zero bid included 'Too poor' (12 per cent), 'Against taxes' (12 per cent) and 'Don't know' (11 per cent).

Those respondents who refused to make a bid were also questioned as to the reason for their response. The majority (82 per cent) offered the 'Don't know' reason whilst others required more information before being prepared to make a bid.

[3] The willingness-to-pay bids were originally divided into four sub-groups depending on the level of information provided by the interviewer. Amalgamation of these groups into the distribution displayed in Table 1 was possible only because no significant differences could be established between the means of the four sub-group distributions. Testing for differences between means was accomplished using t-tests between mean pairs and an F test across all means. These tests were based on the parametric distributions which resulted following a grouping (around the principal bids \$1, \$2, \$5, \$10, \$20, \$50 and \$100) and logging transformation of the original non-parametric distributions.

TABLE 1

The Distribution of Willingness-to-Pay Bids

Willingness to pay	Absolute frequency	Relative frequency	Adjusted frequency	Cumulative frequency
$		per cent	per cent	per cent
0	137	25.2	29.3	29.3
1	21	3.9	4.5	33.8
2	31	5.7	6.6	40.5
3	7	1.3	1.5	42.0
4	2	0.4	0.4	42.4
5	50	9.2	10.7	53.1
6	1	0.2	0.2	53.3
10	73	13.4	15.6	69.0
15	2	0.4	0.4	69.4
20	39	7.2	8.4	77.7
24	2	0.4	0.4	78.2
25	4	0.7	0.9	79.0
26	2	0.4	0.4	79.4
30	9	1.7	1.9	81.4
35	1	0.2	0.2	81.6
40	3	0.6	0.6	82.2
50	31	5.7	6.6	88.9
52	5	0.9	1.1	89.9
75	1	0.2	0.2	90.1
80	1	0.2	0.2	90.4
100	26	4.8	5.6	95.9
150	3	0.6	0.6	96.6
200	9	1.7	1.9	98.5
250	1	0.2	0.2	98.7
300	1	0.2	0.2	98.9
500	4	0.7	0.9	99.8
750	1	0.2	0.2	100.0
Refusal	77	14.1	–	–
Total	544	100.0	100.0	–

Mean: $27.08 Median: $5.21
Mode: $0.00 Standard Deviation: $68.82

Explanation of existence benefits

Given the heavy concentration of zero bids and the somewhat lumpy character of the bid distribution, the task of explaining the relationships in respondents' existence values was approached using a dual process. First, the choice between a zero or a positive bid, denoted as a respondent's preparedness to pay, was considered in terms of respondents' characteristics using both cross-tabulation and discriminant analysis. Second, if a positive bid was chosen, the choice of how much to pay, denoted as a respondent's willingness to pay, was examined for evidence of explanatory features using cross-tabulation and multiple regression analysis.

A selection of the features of the cross-tabulation analysis between preparedness to pay and respondent characteristics is displayed in Table 2. Subsequent three way cross-tabulations showed that the relationship between preparedness to pay and respondents' propensity to watch nature study programs on television was spurious to the life-cycle stage, age and marital status variables. Whilst it was also suspected that the

TABLE 2

Relationship Between Preparedness to Pay and Respondents' Characteristics

Characteristic	χ^2	Degrees of freedom	Level of significance	Characteristic features favouring	
				Yes	No
Age group	4.8	2	0.09	18-30 years	–
Sex	1.3	1	0.26	Females	Males
Life-cycle stage	12.3	5	0.02	Age <30, with no children; Has grown family	Age >30, single; Has young family
Household income group (gross, per annum)	9.2	4	0.06	$15 600-20 799; >$26 000	$0-9 879
Age of leaving school	5.4	6	0.5	–	–
Place of birth	0.4	1	0.5	–	–
Occupation	5.1	3	0.16	Lower white collar	Blue collar
Watch nature television?	15.9	1	0.0	Yes	No
Read nature books?	10.4	1	0.0	Yes	No
How important is conservation?	19.9	1	0.0	Very important	Not very important
Days spent in parks	4.0	2	0.14	<7	Zero

respondents' attitudes to conservation (How important is conservation?) and their preference for reading nature study books and magazines were also spurious, it could only be concluded that information on the combination of variables to which they were spurious had not been collected. On the basis of the information gathered from the cross-tabulation analysis, a discriminant analysis was performed to determine the relative strengths of the relationship between preparedness to pay and respondent characteristics. A summary of the discriminating variables is provided in Table 3.

The discrimination function, the weighted linear combination of the five characteristic variables, which forces the preparedness-to-pay groups to be as statistically distinct as possible was estimated as:

$$D = -0.38\,AGE + 0.73\,Q1 + 0.28\,HHINC + 0.46\,Q18 \tag{1}$$

where *AGE* is the standardised score of respondent's age;
Q1 is the standardised score of respondent's attitude to the importance of conservation;
HHINC is the standardised score of respondent's gross fortnightly household income; and
Q18 is the standardised score of respondent's preference for reading nature study books.

The life-cycle stage variable (the presence or not of a family) was found to be insignificant, using a minimum tolerance value of the F ratio of 0.001, possibly because of its correlation with the age variable. The remaining variables demonstrate a positive relationship between preparedness to pay, and attitude to conservation, income and preference for reading nature study books and a negative relationship between preparedness to pay and age. The attitude-to-conservation variable is the strongest discriminating variable. However, only 11 per cent of the variance associated with preparedness to pay was explained by the discriminant function.

For the purposes of the cross-tabulation phase of the analysis of the willingness-to-pay bids, the distribution was grouped in recognition of the discrete intervals evident. Some of the features of the cross-tabulations between the bids and respondent characteristics are presented in Table 4. Except for the obviously collinear relationship between individuals' willingness to pay and their attitudes to the preservation function of national parks, other variables were not shown by subsequent three way cross-tabulation to be spurious.

To provide a more rigorous analysis of the relationship between the willingness to pay and respondent characteristics, a multiple regression analysis was employed. The variables considered as independent variables, selected on the basis of the cross-tabulation and other analyses are listed in Table 5. Before being entered as an independent variable in any regression function, each variable was checked for evidence of collinearity with other independent variables. Given this initial variable selection process, and the subsequent elimination of variables on the basis of their coefficients' t-values, the regression results are shown in Table 6.

The superiority of equation (5), which involves a per household,

TABLE 3

The Discriminating Variables[a]

Prepared to pay?	Number of respondents	Means of discriminating variables				
		Age	Life-cycle stage[b]	Conservation importance[c]	Read nature books?[d]	Gross household income
		years				$/fortnight
Yes	396	36.1 (12.8)	0.57 (0.50)	0.65 (0.48)	0.53 (0.50)	825.7 (376.5)
No	121	38.9 (14.0)	0.61 (0.49)	0.40 (0.49)	0.34 (0.47)	745.9 (389.5)

[a] The numbers in parentheses are standard deviations.
[b] 1 = family; 0 = no family.
[c] 1 = very important; 0 = other.
[d] 1 = yes; 0 = no.

TABLE 4

Relationship between Willingness to Pay and Respondents' Characteristics

Characteristic	χ^2	Degrees of freedom	Level of significance	Comments
Age group	11.3	12	0.5	–
Sex	5.2	6	0.52	–
Life-cycle stage	29.3	30	0.5	–
Has post-school qualifications?	8.3	6	0.22	Qualified respondents bid higher
Place of birth	5.3	6	0.5	Australian born respondents bid higher
Household income group (gross, per annum)	43.6	24	0.008	Higher income earners bid higher
Read nature books?	19.27	6	0.004	Readers bid higher
Days spent in parks	15.5	12	0.22	Higher users are higher bidders
How important is conservation?	4.8	6	0.56	–
How important are parks for preservation?	16.7	6	0.01	'Very important' respondents bid higher
Payment mode	19.1	6	0.004	Government mode dominates extreme bids

TABLE 5

Variable List

Variable	Abbreviation	Units	Coding
Willingness to pay	*WTP*	$	Continuous
Age	*AGE*	Years	Continuous
Sex	*SEX*	Dummy	1 = male; 0 = female
Life-cycle stage	*LCS*	Dummy	1 = family; 0 = no family
Marital status	*MSTAT*	Dummy	1 = married; 0 = not married
Has qualifications?	*Q52C*	Dummy	1 = yes; 0 = no
Qualification type	*Q52CYES*	Dummy	1 = graduate; 0 = non-graduate
Place of schooling	*Q52B*	Dummy	1 = city; 0 = non-city
Place of birth	*BORN*	Dummy	1 = Australia, U.K., Ireland; 0 = other
Activity	*ACT*	Dummy	1 = working; 0 = not working
Occupation	*GPOCC*	Dummy	1 = white collar; 0 = blue collar
Television viewing of nature programs	*Q17*	Dummy	1 = yes; 0 = no
Reading of nature books	*Q18*	Dummy	1 = yes; 0 = no
Household gross income	*HHINC*	$	Continuous
Importance of conservation	*Q1*	Dummy	1 = very important; 0 = other
Payment mode	*Q12*	Dummy	1 = government; 0 = conservation organisation
Used natural areas?	*Q3*	Dummy	1 = yes; 0 = no
Total use of natural areas	*TOTUSE*	Days	Continuous
Number in household	*N*	–	Continuous

TABLE 6

Regression Results[a]

Equation number	Equation	R^2	F	Degrees of freedom
(2)	$WTP = -0.03 + \underset{(3.34)}{16.4Q12} + \underset{(2.23)}{10.9Q18} + \underset{(1.92)}{16.6BORN} + \underset{(1.67)}{0.01HHINC}$	0.07	5.6	4278
(3)	$\ln WTP = 1.0 + \underset{(4.0)}{0.0008HHINC} + \underset{(2.5)}{0.4Q12} + \underset{(2.5)}{0.37Q18} + \underset{(2.2)}{0.01AGE}$	0.10	7.39	4278
(4)	$\ln WTP = -4.0 + \underset{(4.38)}{0.57 \ln HHINC} + \underset{(2.47)}{0.37Q12} + \underset{(2.73)}{0.41Q18} + \underset{(2.54)}{0.61 \ln AGE} + \underset{(1.99)}{0.35BORN}$	0.12	7.8	5277
(5)	$\ln(WTP/N) = \underset{(4.66)}{3.55} + \underset{(6.07)}{0.83} \ln (HHINC/N) + \underset{(2.44)}{0.41Q12} + \underset{(2.43)}{0.0002AGE^2}$	0.17	16.7	3239

[a] The numbers in parentheses are t-values.

logarithmic transformation, is not only evidenced by better levels of significance amongst t-statistics and F statistics and a higher R^2 but also by a lack of heteroscedasticity. The plots of residuals against the predicted dependent variables for equations (2), (3) and (4) displayed a distinct pattern whereby strong bands of points were evident. These bands were the result of the bunching of bids around the predominant bid magnitudes of \$1, \$2, \$5, \$10, \$20, \$50 and \$100. By transforming the *WTP* dependent variable using the number of people in the household as a divisor and then taking the log of the fraction, the heteroscedasticity problem was overcome and a significant improvement in explanatory power was made. Furthermore, from the residual plot for equation (5) it would appear that no variable which has a significant impact on the dependent variable has been omitted from the regression equation. Hence, while the equation can only explain 17 per cent of the variation exhibited by the dependent variable, it can be regarded as a useful tool for explanatory purposes over cross-sectional data.

All equations indicate a positive relationship between willingness to pay and gross household income. An income elasticity of willingness to pay of 0.57 was derived from the double-log form equation (4). Existence benefits can thus be classified as a normal good. This result is consistent with the outcome of the discriminant analysis which showed that respondents with higher incomes were more likely to be prepared to pay.

From equations (4) and (5) it can be concluded that age and willingness to pay are positively related. However, some contradiction exists between the preparedness-to-pay and willingness-to-pay analyses. It would appear that, while older respondents are less likely to be prepared to pay anything, those who decide to pay something are more likely to bid amounts larger than younger contributors.

Respondents' preference for reading nature-based material (*Q18*) is a significant independent variable in equations (2), (3) and (4) but was omitted from equation (5) as an insignificant factor. The increased level of significance associated with the income-based variable in equation (5) may indicate some collinearity between ln (*HHINC/N*) and *Q18*, possibly via the educational status of the respondent. Certainly the positive relationship between *Q18* and preparedness to pay established in the discriminant analysis is substantiated in the regression analysis.

Finally, *Q12* appears as a significant independent variable in each equation and always has a positive coefficient indicating that higher bidders favoured the increase in tax-payment mode. This consistent result may merely show that the tax-option respondents value existence benefits more than those who would prefer to donate to a conservation organisation. But this conclusion contradicts the evidence of the cross-tabulation analysis shown in Table 4. Those choosing the tax mode tended to bid not only high but also low, with the donors dominating the intermediate bid ranges. Apparently, because the regression analysis involves the forcing of the payment-mode/willingness-to-pay relationship into a linear form, the high bid/tax link appears dominant.

Bid Accuracy

The usefulness of the results outlined depends crucially on the assumption that respondents' bids are accurate reflections of their existence benefits. If respondents:

(a) were unable to isolate existence benefits from other preservation benefits when they bid;
(b) biased their bids because the willingness-to-pay questions asked were hypothetical;
(c) biased their bids according to the mode of payment chosen; or
(d) behaved strategically,

the assumption would be invalid. The questionnaire was designed to address specifically the first three of these four possible behaviour patterns of respondents. Considerable attention was paid to the description of the hypothetical reserve to ensure that respondents understood clearly that their attention should be focused on the existence value only.[4] The problem of hypothetical bias was tackled in the questionnaire through the provision of information using photographs and a setting which was convincing.[5] The dual-payment mode system incorporated in the questionnaire was used specifically to minimise the possibility of payment-mode bias.

The fourth behaviour possibility, strategic behaviour, is not directly addressed by the questionnaire. Furthermore, the nature and extent of any possible bias which would result from strategic behaviour is difficult to predict. For instance, it is possible that respondents act under the specific delusion that no payment of any sort will be made by them either now or in the future as a result of their bidding. If this were the case, as could well be, given that respondents knew their answers were confidential and that the interviewers stated at the onset that they were not collecting money, a uniformity upward bias may emerge. Alternatively, respondents choosing the taxation-payment mode might consider that their bids have an impact on the chances of the program being implemented and would thus overstate or understate their preferences according to their individual perceptions of value versus expected tax increases. Respondents choosing the donation mode may behave in a myopic fashion by overstating but may perceive that the conservation organisation would eventually abandon the land purchase if overstatement were prevalent. This uncertainty makes it necessary to assess carefully the likelihood of the presence of strategic bias in the bids. This assessment was carried out by the examination of responses to the questionnaire for any contradictions which may indicate the presence of strategic behaviour.

Prima facie evidence of strategic behaviour by respondents can be gained by an examination of the distribution of willingness-to-pay bids. The size of the standard deviation, $68.82, relative to the mean bid of $27.08 and the fact that the high value 'tail' of the distribution extends to

[4] The relatively large percentage of respondents who gave a zero bid as a protest against the area being closed to public use indicates that the exclusion of participatory benefits from the respondents' analysis was effective. This evidence together with information gathered at the pre-test and interviewer de-briefing stages shows that the majority of respondents appreciated the separation process.

[5] The results of the tests undertaken to detect significant differences between the distributions of bids generated by sub-samples which were given different information described in footnote 2 may be indicative of hypothetical bias. However, because the tests were not specifically centred on the possibility of hypothetical bias, such as strong conclusion cannot be drawn. For instance, the lack of a significant difference could have been caused by the small changes in information involved.

$750 may be indicative of strategic bias.[6] However, this result must be considered with caution, primarily because it is not possible to assert categorically that because a respondent bids a large amount, he is acting strategically. Further information on the validity of such an assertion can be obtained through a detailed analysis of the characteristics of respondents who bid very high relative to the mean. A number of contradictions were evident between the magnitude of the bids of the seven respondents who bid $250 and over, and their socio-economic characteristics. For instance, contrary to the expectations established by the cross-tabulation analyses in the previous section, none of these seven were graduates and, even though five of the high bidders had household incomes in excess of $15 000 per annum, two of these were the dependent children of high income families. Contradictions were also evident between these respondents' stated attitudes toward conservation, their level of usage of national parks and the magnitude of their bids. However, again it must be stressed that, while such contradictions provide prima facie evidence for strategic bias, the proof is not definite; a personal bid, need not reflect the overall trend of the sample, particularly given the low level of explanation provided by the trend analysis detailed in the previous section.

A further indication of the presence of strategic behaviour was gained by a series of comparisons between the stated attitudes and preferences of respondents and their actual behaviour. For instance, 115 respondents indicated a positive preference for the existence benefits of Nadgee but were not prepared to pay anything under the scenario presented by the questionnaire. This can be argued to be an indication of understating strategic behaviour. Why respondents should choose to understate when no payment is required is open to some debate. However, possible explanations include a belief that some payment, based on their bid, would eventually be required (contrary to the information provided by the interviewer) or even an inability to overcome the habit of understatement in the circumstance of being asked what they would be willing to pay (given that normally, say in a haggling situation, payment would be required).

The importance of understating strategic behaviour was placed in perspective by a further comparison of attitudes and actions. Comparing the distribution of willingness-to-pay bids, with the distribution of subscriptions to any conservation organisation for any purpose made in the 12 months prior to the survey, capitalised as an annuity so as to be comparable to the once only willingness-to-pay bid, it was found that the subscriptions distribution had a significantly lower mean. This somewhat tentative analysis can be used to conclude that understating strategic behaviour is unlikely to be as severe in the questionnaire responses as it is in the actual payment required situation where such free-riding behaviour would be expected.

[6] Brookshire, Ives and Schulze (1976, p. 340) hypothesised that if strategic bias were present, the distribution would have a large variance with 'a large number of zero and extremely high bids'. However, it must be recognised that their study involved the payment rule that the mean bid would eventually be collected, thus causing bias both up and down according to valuation relative to mean expectation. In the current study, the no-payment-ever payment rule could be expected to yield a consistent upward bias. However, the fact that zero is the modal bid may be indicative of a somewhat contrary result.

The analysis of strategic bias using the responses to the main questionnaire is clearly not sufficiently rigorous to enable definite conclusions to be drawn. This situation arises largely because it is not possible, using the questionnaire format, to estimate conclusively respondents' true valuations.[7] However, it would appear that there is some evidence to suggest that both overstatement and understatement are present in respondents' willingness-to-pay bids resulting in some self-cancelling of strategic bias. This finding is supported by the results of the experimental studies carried out by Smith (1979) in the context of payment-required questioning of willingness to pay and Bennett (1982) in the no-payment-required context.

Conclusions

The ability of the direct questioning method to provide useful measurements of the Canberra population's valuation of the existence benefits supplied by Nadgee Nature Reserve depends crucially on the validity of the assumption that respondents' willingness-to-pay bids were accurate representations of their equivalent surpluses. While the problems associated with validating this assumption clearly indicate that the direct questioning method, applied in this particular case and in general, is far from perfect, they are not sufficiently severe to render the information supplied by the technique useless. Rather, the measurement technique appears to be capable of providing a reasonable estimate of the bands within which the value of the non-marketed benefit, in this case, the existence value of Nadgee, is likely to fall.

Given this qualified affirmative to the question of technique quality, some conclusions can be drawn regarding the extent of existence benefits. The benefits derived by Canberra residents from the continued preservation of Nadgee Nature Reserve for existence benefits are clearly non-zero: it would seem likely that the average existence value per adult is at least $20, that is, $2 per annum in perpetuity, given a 10 per cent real interest rate. However, up to 25 per cent of Canberra adults do not gain any value from the knowledge of Nadgee's existence. Even so, it can be concluded that the existence benefits provided by Nadgee are substantial and form a significant proportion of the area's total contribution to the welfare of society.

The limitations involved in extrapolating these results to a wider population than Canberra and to the existence benefits generated by other preserved natural areas have been noted, but in general it can be stated that existence benefits must be recognised by decision makers as valid contributions to individuals' well-being. Even if the questionnaire did not ensure the effective isolation of existence values, it can be concluded that non-participatory benefits, other than the scientific research and gene-pool maintenance benefits play an important role. This is particularly true, in a relative sense, when the provision of wilderness areas is under scrutiny. Because such areas are defined in terms of limited, or zero, public visitation, their prime rationale for preservation lies in the

[7] Blomquist (1979) attempted to incorporate a Clarke tax, demand revealing mechanism into a direct questioning format in order to ensure truthful revelation of preferences, but concluded that the mechanism was not suitable, at its present stage of development, to the particular format used.

magnitude of their non-participatory benefits. Any neglect to incorporate such benefits into the decision maker's analysis could well result in sub-optimal levels of provision.

The results detailed here have important implications for the managers of already preserved natural ecosystems who are seeking to design systems of land-use zoning within their areas of control. In recognition of the non-participatory benefits of preservation and in particular, existence benefits, these managers may wish to zone sub-regions as being unavailable for public visitation if it is true that provision of existence benefits and public access are mutually exclusive.

Finally, in a more general context, it can be concluded that the direct questioning method for establishing the value of non-market goods has the potential for increased use. However, any future use of the technique must be tentative because of the possibility of strategic behaviour amongst respondents. It may be that if direct questioning were employed to value a wilderness area which was subject to a controversial and highly publicised development project, for instance the Franklin River case, and respondents knew very clearly that their bids would have a direct impact on policy, then the incentive to overstate amongst those who had positive valuations of the preservation benefits may be much stronger. In addition, if the technique was used repeatedly as a policy-making tool, and feedback as to the impact of the surveys on policy was freely available, then the overstating incentive may again prove to be a prime obstacle.

References

Barkley, P. W. and Seckler, D. W. (1972), *Economic Growth and Environmental Decay: the Solution Becomes the Problem*, Harcourt Brace Jovanovich, New York.

Bennett, J. W. (1981), Evaluation of the benefits of natural ecosystem preservation with special reference to existence values, Ph.D. thesis, Australian National University, Canberra.

—— (1982), 'Validating Revealed Preferences for Public Goods'. Paper presented to the 11th Conference of Economists, Flinders University.

Bishop, R. C. (1978), 'Endangered species and uncertainty: the economics of a safe minimum stand', *American Journal of Agricultural Economics* 60(1), 10-18.

Blomquist, G. (1979), Measuring the Recreational and Aesthetic Benefits of Cleaner Water, Illinois State University, mimeo.

Brookshire, D. S., Ives, B. C. and Schulze, W. D. (1976), 'The valuation of aesthetic preferences', *Journal Environmental Economics and Management* 3(4), 325-46.

Elliot, R. (1978), 'Ethics and conservation', *Habitat* 6(2), 9-13.

Hammack, J. and Brown, G. M. (1974), *Waterfalls and Wetlands: Toward Bioeconomic Analysis*, Johns Hopkins University Press, Baltimore.

Krutilla, J. B. (1967), 'Conservation reconsidered', *American Economic Review* 57(4), 777-86.

Meyer, P. A. (1979), 'Publicly vested values for fish and wildlife: criteria for economic welfare and interface with the law', *Land Economics* 55(2), 223-35.

Newsome, A. E., McIlroy, J. and Catling, P. (1978), 'The effects of extensive wildfire on populations of twenty ground vertebrates in South-East Australia', in J. Kikkawa and H. A. Nix (eds), *Managing Terrestrial Ecosystems: Proceedings of the Ecological Society of Australia*, Watson Ferguson, Brisbane.

Randall, A. and Brookshire, D. S. (1978), *Public Policy, Public Goods and Contingent Valuation Mechanisms*, Staff Paper 68, Department of Agricultural Economics, University of Kentucky.

——, Ives, B. and Eastman, C. (1974), 'Bidding games for valuation of aesthetic environmental improvements', *Journal of Environmental Economics and Management* 1(2), 132-49.

—— and Stoll, I. R. (1980), 'Consumers' surplus in commodity space', *American Economic Review* 70(3), 449-55.

Rowe, R. D., D'Arge, R. C. and Brookshire, D. S. (1980), 'An experiment in the economic value of visibility', *Journal Environmental Economics and Management* 7(1), 1-19.

Robertson, G. (1977), 'Endangered fauna', *Parks and Wildlife* 1(5), 150-9.

Smith, V. L. (1979), 'An experimental comparison of three public good mechanisms', *Scandinavian Journal of Economics* 81(2), 198-215.

Ulph, A. M. and Reynolds, I. K. (1979), 'An activities model of consumer behaviour with special reference to outdoor recreation', *Scottish Journal of Political Economy* 26(1), 33-60.