Environment and Development Economics 10: 159–178
DOI: 10.1017/S1355770X0400186X Printed in the United Kingdom

Biodiversity and nature-based tourism at forest reserves in Uganda

ROBIN NAIDOO
Department of Biological Sciences, University of Alberta, Edmonton, Alberta, Canada T6G 2E9.

WIKTOR L. ADAMOWICZ
Department of Rural Economy, 515 General Services Building, University of Alberta, Edmonton, Alberta, Canada T6G 2H1.
E-mail: vic.adamowicz@ualberta.ca

ABSTRACT. The benefits of nature-based tourism to biodiversity conservation are often presumed but rarely quantified. The relative value placed on attributes of nature parks is unknown, as is the contribution of biodiversity to tourists' willingness to visit a particular protected area. We surveyed tourists and foreign residents in Uganda to determine how preferences for particular protected areas are formed. We evaluated tourists' demand for elevated biodiversity levels (increased numbers of bird species seen), relative to other protected areas attributes. As the number of bird species increased, tourists demonstrated increased willingness to visit a protected area, independently of all other factors. We used these results to evaluate a revenue-maximizing park management strategy, and consider how revenues from nature-based tourism compare with those from local agricultural land-uses.

1. Introduction

Integrated conservation and development projects (ICDP), which combine local environmentally based industries with the maintenance of biodiversity as dual conservation/development goals, are a standard sustainable development approach in many developing countries (Salafsky and Margoluis, 1999; Salafsky *et al*., 2001). It is often assumed that ICDPs will result in the conservation of the natural resource(s) in question, while at the same time leading to increased benefits for local communities who may have forgone less environmentally friendly development strategies (Infield and Adams, 1999; Salafsky and Wollenberg, 2000). Nature-based tourism[1] is often a key component of ICDPs in developing countries (Bookbinder *et al*.,

[1] We use this term rather than the more restrictive 'ecotourism' for several reasons. Nature-based tourism can be more flexibly defined as any type of tourism that has as its primary purpose the viewing and/or enjoyment of nature, including hiking, birdwatching, safaris, etc. While the term ecotourism implies ecologically friendly tourism, such is not always the case (Obua, 1997; Isaacs, 2000), and confusion exists as to its exact meaning.

1998; Isaacs, 2000; Salafsky *et al.*, 2001). Because nature-based tourism is a non-consumptive activity that should rely on intact natural resources to generate revenue, it is regularly viewed as a 'win–win' situation for conservation and sustainable development.

Quantitative assessments of ICDPs are rare, and have shown mixed results in terms of both environmental and economic goals (Balmford *et al.*, 2002; Salafsky *et al.*, 2001; Barnes *et al.*, 2002). More particularly, assumptions regarding nature-based tourism, the conservation of biodiversity, and community welfare are not supported by empirical research. There is little evidence to suggest that tourists are interested in biodiversity *per se*, rather than spectacular landscapes, attractive lodging facilities, or a few charismatic species, when visiting a protected area. Tourists may have many different motivations for visiting tropical protected areas, and hence relying on nature-based tourism to conserve biodiversity may be a risky venture if tourists are not particularly concerned about biodiversity.

To predict whether nature-based tourism can lead to protection of biodiversity and increased welfare of local residents, we must investigate the relative preferences of tourists in the context of protected area visitation. Such an investigation should also include a means of quantifying the values tourists hold for various levels/states of biodiversity. If nature-based tourism is to be an effective means of conserving biodiversity, tourists' behaviour must lead to elevated revenues for areas rich in biodiversity. Assuming appropriate transfer mechanisms to those who control the fate of an area's natural resources, this would then provide an incentive to maintain natural ecosystems with high levels of biodiversity in protected areas.

Measuring values for biodiversity is a difficult proposition. The majority of attempts have involved willingness-to-pay approaches, because of the non-market nature of biodiversity conservation (Moran, 1994; Adger *et al.*, 1995; Kosz, 1996; Loomis and White, 1996; but see Montgomery *et al.*, 1999). But these passive-use values are seldom ones that can be captured by local communities. Passive-use values often refer to circumstances that are global or regional in nature (Adger *et al.*, 1995), and in many instances are values for phenomena that have no obvious and direct connections to real-world tradeoffs or economies (Gowdy, 1997). Therefore, while passive-use values can provide a rough indication of magnitude of preference for certain situations, they may not be useful for policy-making at local levels unless international mechanisms to capture them can be developed (Pearce, 1996).

In the case of nature-based tourism, a market for biodiversity may exist among nature tourists, and hence this is a direct-use value that in theory may be useful in assessing sustainable development options. Two issues surrounding its application are: (i) how can one accurately measure the value tourists may have for biodiversity?; and (ii) what mechanisms can be used to ensure that local communities capture this value? Here we deal primarily with the first issue. As several papers have pointed out, many ICDPs are failing because revenue flows from 'local' industries are not reaching the community members originally targeted (Bookbinder *et al.*, 1998; Murombedzi, 1999; Infield and Adams, 1999; Salafsky *et al.*, 2001).

People living near the conservation area therefore prefer to have guaranteed but unsustainable access to the resource, rather than foregoing resource exploitation for compensation that may never arrive. Although this is obviously a critical issue for ICDPs, it is beyond the scope of our study.

We focus here on the demand for nature-based tourism, as a function of biodiversity, that could benefit communities through the collection of entrance fees. The existence of a potential market for biodiversity among tourists means that a revealed preference approach to measuring the value tourists hold for biodiversity could be suitable. However, the logistics of such an approach would be extremely challenging, due to the large number of associated factors that would need to be accounted for, the large number of protected areas from which data would need to be collected, and the difficulty in deciding on which aspect of biodiversity would be quantified. For these reasons, a stated choice approach to the valuation of biodiversity is preferable.

Stated preference techniques involve asking respondents about their economic behaviour, given a well-described artificial market scenario. Stated preference techniques avoid some of the difficulties associated with revealed preference studies: they can assess demand for products which have no well-developed markets, they avoid issues of collinearity and low variability in explanatory variables, they are less demanding of research resources, and they can be experimentally designed to provide clear and easily interpretable results (Louviere *et al.*, 2000). Stated preference techniques have been used in a wide variety of applications (e.g., Revelt and Train, 1998; Bhat, 2000), and are particularly useful in environmental economics (Adamowicz *et al.*, 1994; Adamowicz *et al.*, 1998), where markets for ecological goods and services typically are non-existent, although these may nonetheless be highly valued by consumers.

This study employs a choice experiment approach to assess the potential for biodiversity to contribute to local community welfare via increased revenue from elevated visitation rates by nature tourists. A choice experiment is a technique that combines elements of experimental design, survey questionnaires, and discrete choice modelling to produce estimates of demand as a function of attributes of the goods and alternatives. Choice experiments are enjoying increased use in the field of environmental economics (Blamey *et al.*, 1999; Rolfe *et al.*, 2000; Boxall and Macnab, 2000), and have been used in a tourism–tropical country context (Hearne and Salinas, 2002). A comparison of the performance of choice experiments with actual consumer behaviour concluded that they provide accurate results (Carlsson and Martinsson, 2001). Calibration of choice models with actual data can minimize hypothetical bias problems (Louviere *et al.*, 2000).

The study was conducted in Uganda, an east African country high in biodiversity, politically stable enough to support a small but growing nature-based tourism industry, and in urgent need of sustainable development options for its impoverished population. We focussed on a forest reserve in the south of the country, and presented tourists and foreign residents with a choice experiment designed to elucidate their preferences for biodiversity relative to other attributes that may be important to them. We asked respondents to choose either the forest reserve of interest, or two possible substitutes, to visit on their next trip. The choice was based on entrance fee, travel time, lodging facilities, tour packages, landscape features, and biodiversity of each destination. We quantified preferences for all of these attributes, and assessed whether elevated levels of biodiversity may have the potential to contribute to the welfare of communities living near the forest reserve.

2. Methods

2.1. Choice experiment modelling

Random utility theory, in which consumers make discrete choices from a set of alternatives, underpins the choice experiment approach. In random utility theory, the consumer is said to obtain utility U (conditional on their choice) from an alternative i by the following

$$U_i = \nu_i + \varepsilon_i \tag{1}$$

This conditional indirect utility function is composed of the systematic indirect utility component (ν_i), and a random error component (ε_i). An alternative i will be chosen if it has a greater utility than alternative j. The probability of choosing i over j is thus

$$p(i) = \text{probability } (\nu_i + \varepsilon_i >= \nu_j + \varepsilon_j) \tag{2}$$

where i and j are elements of the choice set.

By assuming that the errors are type-I extreme value distributed, the probability of choosing i becomes

$$p(i) = e^{\nu_i} \Big/ \sum\nolimits_j e^{\nu_j} \tag{3}$$

The standard multinomial choice model applies to choice experiments when ν_i is defined as

$$\nu_i = \sum\nolimits_j \beta_k X_i^k \tag{4}$$

where B_k is the coefficient on attribute X^k.

This model can be estimated by maximum likelihood techniques, and is a useful first cut at modelling choice behaviour. However, several well-known limitations apply. The most severe of these is the independence of irrelevant alternatives (IIA) property, which states that a change in the attributes of one alternative changes the probabilities of the other alternatives in proportion. This substitution pattern may not be realistic in all settings. Secondly, the coefficients of all attributes are assumed to be the same for all respondents in a choice experiment, whereas in reality there may be substantial variability in how people respond to attributes. Finally, the standard multinomial choice model assumes that unobserved factors are independent over choices, whereas one might actually expect such factors to be correlated within decision-makers (Train, 2003).

To overcome such limitations, we estimated a random parameters logit model (RPL) using panel data (Revelt and Train, 1998). This specification assumes that an individual's utility i for an alternative k is described by

$$U_{ik} = X_{ik}\bar{\beta} + X_{ik}\tilde{\beta} + \varepsilon_{ik} \tag{5}$$

that is, that each person's utility deviates from the population mean $\bar{\beta}$ by the vector $\tilde{\beta}$. The jointness of the probability of observing a given sequence of choices is thus obtained within individuals, which is realistic in a choice experiment setting, as long as there are no learning or fatigue effects while completing the survey, and if completing the survey itself leads to no changes in tastes. Unlike the standard MNL model, estimating the coefficients on X now requires estimating the distribution (form specified by the analyst) from which these Bs arise. Readers interested in an overview of RPL models should consult Train (2003).

Although this RPL model allows the analyst to assess the effects of unobserved heterogeneity, heterogeneity that might be explained by observable socioeconomic variables is not accounted for. Previous studies have interacted individual-invariant variables with choice experiment attributes to address this issue (e.g., Revelt and Train, 1998). Another way to address this within the RPL framework is to introduce heterogeneity among respondents in the mean of the parameter variable through individual variables such as age and income.[2] In other words, the specified parameter distributions are "shifted" by individual-level variables, and the significance of these shifts can be tested in a manner analogous to tests for typical attribute coefficients (Hensher and Greene, 2002).

2.2. Design of the choice experiment

The description of each choice in terms of attributes, and the selection of choice alternatives (the 'choice set') are critical to the design of a successful choice experiment (Louviere *et al.*, 2000). Attributes must describe each alternative in realistic and thorough terms, such that the respondent can clearly differentiate between alternatives based on them. However, the number of attributes should not be so high as to ask the respondent to assimilate more information than s/he is capable of. The alternatives presented in the choice set must also be a realistic set of close substitutes that the respondent would consider if s/he were actually making a choice.

In this study, respondents were asked to choose from three protected forest areas that they could visit, assuming a trip origin at Kampala, the capital city of Uganda.[3] Mabira Forest Reserve is a 300 km^2 patch of

[2] Another way to account for respondent heterogeneity is through a market segmentation approach (Louviere *et al.*, 2000). In our preliminary analyses we tested many different such approaches, including segments based on country of residence (expatriate residents of Uganda vs tourists), purpose of trip visit (business, holiday, or visiting friends and relatives), and gender (male vs female). While some slight differences in attribute coefficients were found, the overall similarity between models was great enough to warrant using aggregate models for analysis and policy simulations, and hence we present only these aggregate models in the paper.

[3] We assume separability of trips to protected areas from trips to other types of protected areas (e.g., savannahs), and also from other types of recreational activities.

protected forest in the south of the country. Budongo Forest Reserve is a 825 km^2 protected forest in central Uganda, and Kibale National Park is a forest of 528 km^2 in western Uganda. All three protected areas are composed mostly of tropical lowland forest, and are well-known for their diversity of forest birds. In addition to the choice of these three protected forests, respondents were also allowed a choice of not visiting any of these forests.

We focus on Mabira Forest Reserve, and the preferences of nature tourists for attributes at this forest, because of related work on avian (bird) biodiversity that one of us has conducted there (Naidoo, 2004). Birds are an appropriate taxonomic group to use in the context of tourist preferences for biodiversity. Birds are conspicuous, many different species can be easily identified by amateur naturalists or birdwatchers, and international birdwatching tours are increasing in popularity (Blondel, 2000. In addition, birds are a good surrogate for overall biodiversity levels in Ugandan forests (Howard *et al*., 1998), hence high levels of avian biodiversity are indicative of biodiversity-rich areas across many taxonomic groups.

Because of its proximity to the capital Kampala, and to the country's second city Jinja, Mabira Forest Reserve exists in a zone of high human population density. The local residents are mostly smallholder farmers, with farms containing a mix of cash and subsistence crops, such as coffee, bananas, maize, cassava, ground nuts, and sweet potatoes, as well as scattered trees (Oduol and Aluma, 1990). Living standards in the region are low, with a life expectancy of 47 years and annual household incomes of around US$200 (National Environment Management Authority, 1997; Mrema *et al*., 2001).[4] Although it is officially prohibited to reside, graze livestock, or cultivate land in the Reserve, funding for monitoring and enforcement is lacking, and violations are widespread (Howard *et al*., 2000, personal observation). Locals use the forest as a source of fuelwood, poles, construction material, wild fruit and vegetables, honey, fodder, and wild game (Mupada, 1997), and agricultural encroachment within the Reserve boundaries is an issue of prime management concern. Determining whether economic incentives to halt forest degradation result from optimal management of the Reserve is thus a key question for managers of the forest.

The attributes that defined each choice were the following: travel time from trip origin (hours), entrance fee (US$), number of bird species likely to be seen, whether the visit was part of an organized tour, what type of lodging facilities were available on site, what type of landscape features the forest contained, and the likelihood of seeing large game animals. The attributes and their levels in the choice experiment are shown in table 1. Because of experimental design constraints, we fixed the attributes of Kibale Forest National Park at their current levels,[5] and

[4] All monetary values are expressed in 2001 US dollars, unless otherwise noted.

[5] In some cases these entailed best guesses or approximations. For example, we set number of bird species likely to be seen at Kibale at 40, as this seems to be a reasonable estimate for a tourist to expect on a day outing with no special effort made to detect bird species. Kibale also does not possess a luxury lodge, but does

Table 1. *Attributes and levels of the choice experiment*

Attributes	*Levels*	*Abbreviation*
No. bird species seen	4 (20,40,60,80)	BIRDS
Entrance fee (US$)	4 (5,15,25,40)	FEE
Travel time (hours)	3 (1,5,6)**	TIME
Visit part of tour?	2 (yes, no*)	TOUR
Lodging facilities	4 (None*,	
	Tents,	TENTS
	Cabin,	CABIN
	Luxury lodge)	LODGE
Landscape features	4 (Primary forest, secondary forest, agriculture*,	
	Primary forest,	PRIMFOR
	Secondary forest,	SECFOR
	Primary and secondary forest)	BOTHFOR
Chance of seeing large wildlife	2 (Very slim chance*, Very good chance)	WILDLIFE

Notes: *Base case for effects coding.
**Alternative-fixed attribute.

varied only those of Mabira Forest Reserve and Budongo Forest Reserve. Attributes and their levels were based on reviews of the literature, personal observations, communications with relevant authorities, and potential policy implications of the results.

Because of space and complexity constraints, estimating a choice model necessitates the selection of only a very few of the many possible attributes that could define alternatives. We recognize that two attributes that were not included in the choice experiment could potentially be important omissions: site congestion and security.[6] Regarding site congestion, none of the sites could be considered prime East African tourist destinations (unlike, say, Serengeti National Park or Mt. Kilimanjaro, where congestion issues are a real concern); average daily visitation rates were less than five visitors for each park (see footnote 8). Security concerns are relevant to park visits by travellers, and while we did not include this attribute, effects of unobserved attributes such as security can be captured under the park labels of the alternatives.

Given that there are two alternatives with six attributes each (four of which have four levels and two of which have two levels) a total of $(4^4 \times 2^2) \times (4^4 \times 2^2)$ combinations of attribute levels are possible in a fully factorial design. We reduced the number of combinations by using a fractional factorial design (Louviere *et al.*, 2000) that considers only main effects and ignores potential interactions among attributes. The minimum number of profiles (attribute level combinations) necessary to estimate

have a luxury tented camp, a much more comfortable level of accommodation than the other two parks in the choice set.

[6] We thank two anonymous reviewers who mentioned these attributes.

Assuming the following nature parks were the **ONLY THREE** choices available when you were making your decision for where to visit on your next trip out of Kampala, which one of them would you have picked?

Features of nature parks	Mabira Forest Reserve	Budongo Forest Reserve	Kibale National Park	
Travel time from Kampala	1 hour	5 hours	6 hours	I WOULD NOT VISIT ANY OF THESE PROTECTED AREAS ON MY NEXT TRIP
Entrance fee (U.S. $)	10	10	15	
Destination part of package or tour?	No	No	Yes	
Lodging facilities	Cabin	Tent	Luxury lodge	
Landscape features	Forest and smallholder agriculture	Primary and secondary forest	Primary and secondary forest	
Bird species you may see	60	40	60	
Chance of seeing large wildlife	Very slim chance	Very slim chance	Very good chance	
	☐	☑	☐	☐

Please Tick ONE Box Only

Figure 1. *An example of one of the 16 choice scenarios presented to each respondent in the choice experiment portion of the survey*

orthogonal main effects was 32. We divided these 32 profiles into two blocks of 16, and presented one block of 16 scenarios to respondents by means of a survey.

The survey consisted of an explanation of why the research was being conducted, the choice experiment section (figure 1), a section on demographics, and an appendix which included a glossary of terms and photographs of landscape levels described in the choice experiment. Each respondent was required to complete the choice experiment section by selecting one of the four available options (visiting either Mabira, Budongo, Kibale, or none of them) in each of the 16 scenarios, based on the values of the attributes described above that varied for each scenario. Prior to the start of surveying, we pretested surveys to ensure that the instrument was clear and unconfusing to respondents. Questioning of park and tourism officials in Uganda regarding choice sets and attributes lent further confidence to our belief that the choice experiment was a realistic, artificial market setting.

The survey was administered in the departure lounge at the country's international airport in Entebbe by two Ugandan assistants, during July and August, 2001. Close to 1,000 surveys were handed out to travellers waiting in the departure lounge. Of these, 132 were not filled in, representing a 13 per cent refusal rate. In all, 861 surveys were collected with usable responses, representing a large sample of the potential tourists for Mabira

Forest Reserve. Of all surveys 96.6 per cent were either from tourists (80.1 per cent) or from foreign residents of Uganda (16.5 per cent). Since these two groups are the most relevant for policy purposes, we restricted our analysis to them.

2.3. Model estimation

The distribution of taste parameters (travel time, entrance fee, and bird species) were estimated by the mean and standard deviation of a normal distribution. We allowed for nonlinearity in our specification by using the natural logarithm of birds and travel time.[7] For categorical attributes, effects-coded variables were used (Louviere *et al.*, 2000). This method is similar to dummy variables, except that a categorical variable with n levels is replaced by $n - 1$ effects-coded variables. The omitted level is referred to as the base case, and the significance of coefficients on the other levels are relative to the base case (i.e., a significant positive coefficient indicates that this attribute level confers significantly greater utility than the base level). Selection of the base cases was arbitrary; these are indicated in table 1.

2.4. Policy assessments

We were interested in determining whether elevated levels of biodiversity lead to increased tourist visitation, and hence whether they have the potential to increase community welfare. Other studies have shown that tourists are often willing to pay higher entrance fees than they currently do (e.g., Schultz *et al.*, 1998; Scarpa *et al.*, 2000), but these studies have not asked whether biodiversity may be directly implicated as a cause. Considering entrance fee and bird species seen, we asked what an optimal management scheme for Mabira Forest Reserve would entail, with optimality defined as the maximization of revenue accruing to the park ecotourism centre. To construct such a scheme, we first calibrated our models to actual tourist data for the three reserves in the choice set.[8] Using the parameters estimated for the normal distributions of the random variables, we made 5,000 draws and calculated the average coefficients from these runs. These were then used to calculate alternative-specific constants that equalized model-predicted and actual proportions of visitors to each site, using attribute values that reflected current conditions at each site.

Once these alternative-specific constants were estimated, the entrance fee at Mabira Forest Reserve was varied from \$0 to \$65 in increments of \$0.5, and the proportion of visitors predicted to visit Mabira Forest was recorded. To incorporate stochasticity arising from the random variables, we made 1,000 draws from the parameterized normal distributions and found the entrance fee at which revenue was maximized. We repeated this procedure 100 times. This protocol was followed for each of 20, 40, 60, and 80 bird

[7] This specification seems logical, as using the natural logarithm of both birds and travel time assumes positive but diminishing utility to travellers as these variables increase towards some asymptote.

[8] Data on visitors to Mabira Forest Reserve and Budongo Forest Reserve were supplied by the Uganda Forest Department, and data on visitors to Kibale National Park were supplied by the Uganda Wildlife Authority.

species likely to be seen at Mabira Forest. Finally, the proportion of visitors was converted to revenue in US$ by multiplying the average number of visitors per year to these three parks by the proportion of visitors predicted to visit Mabira Forest Reserve, multiplied again by the value of the entrance fee paid, for each of the above scenarios.[9]

3. Results

Column one of table 2 shows results from the standard multinomial model of tourist visitation. All coefficients are significantly different from zero, except for those on PRIMFOR and TOUR. Respondents received negative utility from FEE, TIME, SECFOR (as compared with both forest types and agricultural areas), and TENTS (as compared with no lodging at all). Positive utility was conferred by increased numbers of bird species seen (BIRDS), CABIN, and LODGE (as compared with no lodging at all), BOTHFOR (as compared with both forest types and agricultural areas), and WILDLIFE. This model correctly classified 47.6 per cent of choice experiment responses, and had a pseudo R-squared[10] of 0.125.

Results from the RPL model (using 50 Halton draws to estimate distributions) are shown in column two of table 2. For the effects-coded variables, the direction and significance of coefficients are the same as in the standard multinomial model, except that TOUR now confers significant negative utility on average respondents, and the coefficient on TENTS is no longer significant. Coefficients on BIRDS and FEE continue to be highly significant, while the coefficient on TIME is no longer significant. In addition, standard deviations of the coefficients on continuous variables were all significantly positive. This indicates that there is considerable heterogeneity among respondents, in terms of their responses to these variables, that the standard multinomial model did not capture. Most notably, the RPL model provides a much better fit to the data, as reflected in the higher pseudo R-squared value (0.380).

Heterogeneity among respondents may be due to variation in tastes or other unobservable variables, or to variation in socioeconomic condition, which is observable to some extent. The RPL model of column two, table 2 addresses the first of these heterogeneity types, but not the second. To tease these two sources apart, AGE (in years) and annual INCOME (in

[9] The number of tourist and foreign resident visitors was summed over each park from 1996–2001, and averaged over the five-year time period to produce an annual value. This worked out to an annual average of 3,765 tourist and foreign resident visitors to the three parks. Actual number of visitors from 1996 to 2001 were: Mabira, 6224; Budongo: 4257; Kibale: 8343. Note that our policy simulations assume no growth in the overall tourist market of these three parks, whereas in reality the World Tourism Organization expects the tourism industry in Africa to quadruple by 2020.

[10] Pseudo R-squares are the likelihood ratio index subtracted from unity, where the likelihood ratio index is the maximized log-likelihood function divided by the log-likelihood function when attribute coefficients are zero. They are a measure of goodness of model fit, with ratios of between 0.2 and 0.4 equivalent in magnitude to least-squares regression R^2s of 0.7–0.9 (Louviere *et al.*, 2000).

Table 2. *Tourist visitation models derived from the choice experiment data (coefficients, with t-values in brackets)*

Attribute	*MNL*	*RPL*	*MNL w age/income*	*RPL w age/income*
Attribute means				
ln (BIRDS)	0.1892	0.6626	0.4140	0.7857
	(16.2)	(24.4)	(11.3)	(11.1)
St. Dev. ln (BIRDS)	–	0.7680	–	0.7163
		(26.7)		(34.9)
FEE	−0.0212	−0.0252	−0.0360	−0.0452
	(−17.0)	(−12.5)	(−9.3)	(−9.0)
St. Dev. FEE	–	0.0397	–	0.0404
		(19.9)		(20.9)
ln (TIME)	−0.1862	−0.0466	−0.2916	0.4263
	(−7.6)	(−0.6)	(−4.6)	(2.6)
St. Dev. ln (TIME)	–	2.3570	–	2.3898
		(24.1)		(38.9)
TOUR	−0.0081	−0.073	−0.0101	−0.0747
	(−0.5)	(−4.1)	(−0.6)	(−4.3)
TENTS	−0.0791	−0.0239	−0.0723	−0.0098
	(−2.8)	(−0.7)	(−2.3)	(−0.3)
CABIN	0.2522	0.3661	0.2605	0.3625
	(9.4)	(11.4)	(9.0)	(10.6)
LODGE	0.2369	0.1512	0.2470	0.1625
	(10.0)	(5.3)	(9.7)	(7.2)
PRIMFOR	−0.0338	−0.0178	−0.0237	−0.0031
	(−1.2)	(−0.6)	(−0.8)	(−0.1)
SECFOR	−0.1623	−0.1510	−0.1693	−0.1626
	(−5.7)	(−4.5)	(−5.4)	(−4.4)
BOTHFOR	0.183	0.0767	0.1921	0.0894
	(7.9)	(2.8)	(7.6)	(3.3)
WILDLIFE	0.5591	0.6778	0.5593	0.679
	(33.8)	(35.0)	(31.2)	(52.3)
Interactions with age/income				
ln (BIRDS) – AGE	–	–	−0.0821	−0.0645
			(−8.3)	(−3.5)
ln (BIRDS) – INCOME	–	–	0.0116	0.0171
			(2.9)	(2.3)
FEE – AGE	–	–	0.0030	0.0047
			(2.9)	3.1
FEE – INCOME	–	–	0.0008	0.0007
			(1.9)	(1.1)
ln (TIME) – AGE	–	–	−0.0171	−0.1948
			(−1.0)	(−4.3)
ln (TIME) – INCOME	–	–	0.0230	0.0231
			(3.5)	(1.3)
Log-likelihood	−16,516.0*	−11,707.3**	−13,849.4	−9,983.0
Pseudo R^2	0.125	0.380	0.141	0.381
Number of observations	13,623	13,623	11,632	11,632

* Log–likelihood at 11,632 observations = −14,013.9.
** Log–likelihood at 11,632 observations = −10,021.3.

US$, aggregated into seven classes) of respondents were entered into the MNL model by interactions with the three continuous variables, and into the RPL model by constraining the distribution means of the continuous variables.[11] The results from these models are shown in columns three (MNL with AGE/INCOME) and four (RPL with AGE/INCOME) of table 2. No practical differences in the coefficients on BIRDS and FEE were noted, and the results for all effects-coded variables were also similar. The coefficient on TIME in the RPL with AGE/INCOME was now positive, however, indicating that the mean response to increased travelling time is to increase utility, a finding at odds with most recreational choice studies. The standard deviation on TIME is much larger than those on BIRDS and FEE, indicating enormous variability in how travellers respond to this variable. Just over half (57.1 per cent) of the area under the normal curve that is generated from the estimated mean and standard deviation of TIME is greater than 0, indicating that about equal proportions of respondents favour increased travelling time versus reduced travelling time. In contrast, 86.8 per cent of respondents' response surface for birds was indicative of preference for increased numbers of species, while 86.4 per cent was indicative of preference for lower entrance fees.

Results from both models that included AGE and INCOME effects indicated that these two variables had statistically significant effects on tourist visitation: five of the six interactions were significant for the model in column 3, and 4 of the 6 were significant for the model in column 4. The addition of AGE and INCOME to models greatly improved performance in the MNL models, with an increase in log-likelihood of 164.5, and the pseudo R-squared increasing from 0.125 to 0.141. In contrast, addition of AGE and INCOME to the RPL model produced more modest gains: an improvement in the log-likelihood of 38.3, and virtually identical pseudo R-squares (0.381 vs 0.380).[12] In addition, the RPL model with AGE and INCOME in column four of table 2 shows that the significance of unobserved heterogeneity (as measured by t-coefficients on the standard deviations of the continuous parameters) was much greater than that of observed heterogeneity (as measured by AGE and INCOME interactions). For these reasons, it appears that the majority of heterogeneity in responses was unobserved; i.e., little of the respondent's heterogeneity could be captured by socioeconomic variables such as AGE and INCOME.[13]

[11] Income is a standard variable used to explain individual-level variation in choice experiment studies (e.g., Revelt and Train, 1998). We included a respondent's age because we hypothesized that younger travellers ('backpackers') and older adults may differ in terms of their eagerness to make long trips, their willingness to pay higher entrance fees, and their interest in birdwatching.

[12] We also conducted likelihood-ratio tests that supported this point more formally.

[13] We tried many econometric specifications for the choice model that we do not present here. These included nested logit models, RPL models with lognormal distributions for the taste parameters, parameter interactions with socioeconomic variables such as family size, sex, and marital status, and market segmentation studies on these variables and others. Very few qualitative differences among models were noted, and where differences were noted, the models we do not

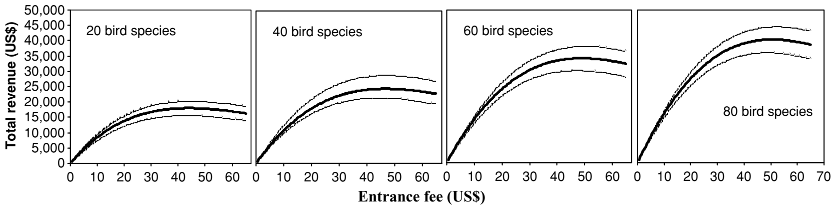

Figure 2. *Revenue flows to the Mabira Forest ecotourism centre. Each curve (heavy lines) represents the change in revenue as entrance fee increases for a given level of bird species seen. Standard deviations above and below each curve are also shown (weak lines)*

Because interacting AGE and INCOME with the continuous variables did not greatly improve model fit, and because including these two socioeconomic variables would complicate model calibration and simulation, we used the RPL model of column two in table 2 for all policy simulations. The share of visitors predicted to visit Mabira Forest (as compared with either Budongo or Kibale) was very close to the actual share (36 per cent vs 33 per cent); this is another indication of the reliability of the model. Predicted shares for Budongo (29 per cent vs 23 per cent) and Kibale (35 per cent vs 44 per cent) were slightly less accurate but nevertheless quite close to the true values. To calibrate the model predictions to these actual values, we added alternative specific constants to each site to equalize actual and predicted visitation shares (constants added were Mabira: −0.09; Budongo: −0.235; Kibale: 0.22).

Revenue flows from these calibrated models for various levels of entrance fee and birds species seen are shown in figure 2. Revenue accruing to the park ecotourism centre was maximized at an average entrance fee of $47.53 (SD = 2.28; range 37.5–62); a fee of this size resulted in average revenue flows of $29,919 (SD = 3,386; range 12,198–52,158). The number of bird species seen was a strong determinant of revenue flows. When tourists expected to see 20 bird species, revenue flows at the maximum entrance fee were $18,032 (SD = 2,346; range 12,198–25,196). When the number of bird species likely to be seen was 80, maximum revenue flows were $40,423 (SD = 4,287; range 27,662–52,158), for an average difference of $22,391, or 7.4 cents per bird species per tourist. Note that these figures assume no additional collection costs for elevated entrance fees.

4. Discussion

4.1. General results

The choice behaviour of tourists and expatriate residents of Uganda was assessed in the context of visitations to protected areas using a choice

present usually performed poorly compared with the ones in this paper. A list of alternative specifications and their results are available from the authors upon request.

experiment approach. Four different models were used to predict respondents' choices: the standard multinomial model (MNL), the random parameters logit model (RPL), the MNL model with demographic variables, and the RPL model with demographic variables. Almost all of the attributes in the study contributed significantly to tourists' choices of which park to visit. Respondents therefore appeared to be trading off parks by their attribute bundles, and not simply by one dominant attribute or by park name. Strong effects of bird species (positive), chance of seeing large wildlife (positive), entrance fee (negative), cabin (positive), luxury lodge (positive), secondary forest (negative), and both forest types (positive) were noted in all three models. Travel time, tour, tents, and primary forest were less consistent determinants of tourist choice.

The RPL models greatly outperformed the MNL models, indicating significant unobserved heterogeneity in responses to numbers of bird species seen, travel time, and entrance fee. Comparisons among MNL and RPL models with and without demographic variables, along with strong significant effects of taste variability in RPL models that also included demographic variables, suggest that unobserved heterogeneity effects were stronger than heterogeneity associated with respondents' demographic characteristics. Conventional techniques that attempt to account for heterogeneity by interacting demographic variables with model attributes (e.g., Boxall and Macnab, 2000) may therefore still be leaving a great deal of heterogeneity unaccounted for. The use of RPL models in consumer choice studies is increasing (Revelt and Train, 1998; Train, 1998; Bhat, 2000; Layton and Brown, 2000; Hensher and Greene, 2002; Train, 2003), and the results presented here argue strongly for its superiority over the conventional MNL.

As in many previous studies, 'price' (in this case, entrance fee) entered negatively into respondents' utility functions. Given that we sampled travellers who were already in Uganda, and hence whose trip expenditures would already have been orders of magnitude higher than the range of entrance fees in our experiment,[14] this result is reassuring in that respondents viewed park entrance fees as an important attribute. It has been suggested that park entrance fees are a very minor component of foreign tourists' expenses in developing countries, and hence that large increases in entrance fees may do little to dissuade tourists from visiting protected areas (Maille and Mendelsohn, 1993; Menkhaus and Lober, 1996). Our results indicate that tourists are acting as price-sensitive consumers in the context of park visitation in Uganda, but that they are not very responsive to price changes.[15] The results from this study indicate that revenue could be maximized by increasing entrance fees at Mabira Forest Reserve, from their current \$2.75/3.50 (foreign residents/tourists) to 47\$.

[14] This would not necessarily be true for expatriate residents of Uganda, however as mentioned previously, market segmentation models for tourists vs expats showed no significant differences in responses to this attribute (or others).

[15] The price elasticity of choice for Mabira Forest Reserve was a relatively low –0.303, indicating an inelastic demand (per cent change in visitation probability less than the per cent change in price).

This greater than tenfold increase in fees is in line with empirical studies of nature-based tourism that estimate large consumer surpluses or WTP on the order of 8–30 times greater than park entrance fees (Maille and Mendelsohn, 1993; Moran, 1994; Menkhaus and Lober, 1996; Schultz *et al.*, 1998; Barnes *et al.*, 1999). Interestingly, one study that found actual entrance fees and tourists' WTP to be similar was that of Chase *et al.* (1998), which was conducted shortly after Costa Rica raised entrance fees in its parks tenfold. It seems clear that, in general, entrance fees for foreign tourists in developing countries could be raised significantly in order to generate increased park revenues. It is equally clear, however, that a host of political factors may make such large increases in entrance fees difficult or undesirable to implement (Chase *et al.*, 1998).

4.2. Biodiversity – ecotourism

The number of bird species likely to be seen was a strong positive predictor of choosing a particular park to visit. Because we specified the natural logarithm of birds seen, diminishing returns were imposed as the number of species increased. These results provide evidence that biodiversity *per se*, i.e. the number of different species in a given situation, contributes to nature-based tourism by enhancing the attractiveness of a protected area to tourists. This study therefore upholds one of the most cited (yet poorly quantified) benefits of ecotourism: that biodiversity is a main reason why tourists visit protected areas, and hence the maintenance of critical biodiversity habitat can provide economic returns. These results are also at odds with a number of recent studies which describe the relationship between ecotourism and conservation of biodiversity as ambiguous at best, or inimical at worst (Bookbinder *et al.*, 1998; Isaacs, 2000).

At least for forested parks in Uganda, the positive relationship between probability of visitation and bird biodiversity is a compelling reason for management scenarios that maintain or enhance the possibility of large numbers of bird species being seen during a tourist's visit. The most obvious way to achieve this goal is to maintain sufficient habitat for large numbers of forest species to persist in protected areas. Bird species in forested areas in Uganda show a typical species area relationship, with greater numbers of species found in larger areas.[16] Maintaining or increasing the area of forest reserves will thus increase the number of bird species found in these reserves. More specifically, remaining tracts of old-growth forest should be conserved, as old forest stands in Mabira Forest Reserve contain as many or more species per unit area than the more common secondary forest, and bird communities are also quite different in old growth stands as compared with secondary forest (Naidoo, 2004).

It should be noted that strictly speaking, the number of bird species likely to be seen on a trip to a protected area need not be positively correlated with bird biodiversity in that park. All three parks in the choice set of our experiment contain far greater numbers of bird species than the upper limit of the bird species attribute (the upper limit was 80 bird

[16] Log(bird species) = 0.48 *log(area) + 1.03; data from Howard *et al.* (2000).

species seen, as compared with species lists of 287 for Mabira, 359 for Budongo, and 325 for Kibale). Factors such as the park's trail network, bird guiding services, specialized infrastructure (blinds, canopy tower, etc.), and vegetation density will therefore be very important factors influencing how many of these bird species are seen. The number of bird species seen on a trip will be uniquely correlated with bird biodiversity only when other factors such as those above are constant among parks. The magnitude of these impacts on bird species seen is an empirical question however, and does not detract from the theoretical significance of bird species per unit area as a positive influence on the number of bird species seen.

4.3. Sustainable development

Forests are at the forefront of conservation efforts because of the seemingly large discrepancy between their standing economic value, and their value as a supply of timber and/or agricultural land. Because many valuable environmental services of standing forests are not traded in the market, a large number of valuation studies have attempted to quantify both market and non-market benefits of forests in both states (standing vs logged). While some studies have shown that certain non-market environmental services from standing forests have rather large economic values (Mendelsohn and Balick, 1995; Adger *et al.*, 1995; Kremen *et al.*, 2000), these values were generally regional or global in nature, and hence institutions to capture this value were either weak or non-existent. In general, for a forest with no official or *de facto* protected status to remain standing, its economic value as a standing forest must not only be higher than its value as timber or agricultural land, but this value must be capturable by the relevant decision-making agents (Kremen *et al.*, 2000).

Valuation of a forest in terms of its recreation value for nature-based tourism is practical because this is a market-based value that can in theory be captured by those agents involved in managing the forest: government and local residents. The standing-forest value we estimate for Mabira Forest is interesting because one attribute of the forest that was valued was biodiversity, a non-market commodity typically very difficult to measure. At current average tourism levels, we estimate that nature-based tourism in Mabira Forest Reserve generates approximately US$7,000 in revenue per year, or US$0.23/ha/yr.[17] Our optimal pricing analysis suggests this is a serious undervaluation: raising the entrance fee to $47 for tourists and foreign residents would result in revenues from $18,032 (assuming 20 bird species seen) to $40,423 (80 bird species seen) from entrance fees alone.[18] Average annual values per hectare of forest would thus rise to $0.60–1.35.

[17] The exact figure is $6,983.34, assuming the average exchange rate (Interbank, April–September 2001) of 1,800 Ugandan Shillings for one US dollar. Revenue data are from the Uganda Forest Department, and include revenue generated from entrance fees for Ugandan citizens (1,000 Ush for one-day entrance fee), foreign residents of Uganda (5,000 Ush), and foreign tourists (6,000 Ush), as well as camping and cabin fees.

[18] Ecotourism revenue at Mabira Forest from visits by Ugandan citizens is currently ∼$1,200/yr; assuming prices and visitation rates for Ugandan citizens remain

While comparisons of per-unit area measures of value can be misleading because of the importance of local economic and physical conditions, it is nonetheless interesting to compare our results with other such estimates from developing countries. Gossling (1999) reviewed per-hectare estimates for forest value based on entrance fees; values ranged from \$0.15 to \$3.6/ha/yr for forest reserves in Costa Rica and Ecuador. Kremen *et al.* (2000) assessed the economic costs and benefits of an ICDP for a forest reserve in Madagascar; they found that the net present value (NPV) of the park managed for ecotourism was \$19.1/ha (US 1996), whereas, at the same discount rate and time horizon, we estimate NPVs of \$11.98–26.95 for Mabira Forest. More generally, our estimate of the standing value of Mabira Forest is similar to other recent estimates of tropical forests based on non-consumptive or sustainable management (Godoy *et al.*, 2000; Kremen *et al.*, 2000). These estimates of the standing value of tropical forests are significantly lower than extractive management schemes, and are also lower than earlier, more optimistic estimates (Peters *et al.*, 1989). In part, this is because these later studies have calculated values that are capturable by those agents whose decision it is to conserve or convert the forest. While other indirect or passive values may hold extremely large values at the global level (e.g., Adger *et al.*, 1995), such values remain in the theoretical realm only, unless institutional mechanisms for capture by the relevant agents exist.

We have demonstrated that regardless of entrance fee levels, it appears that increased amounts of revenue can be generated by allowing tourists the possibility of seeing greater numbers of bird species at Mabira Forest. Bearing in mind the caveats referred to earlier, the conservation of forest within the reserve will generally increase this possibility. Hence, maintaining bird biodiversity is economically beneficial to the Forest Department, which runs the ecotourism centre. In theory, the communities surrounding the forest reserve may also benefit, as an agreement between community leaders and the Forest Department entitles them to some of the receipts from the ecotourism centre (Mupada, 1997). However, mechanisms to implement revenue-sharing at Mabira Forest are weak, with revenue transfer operating in an *ad hoc* and confusing manner. Experience in other areas of Uganda with such community revenue-sharing schemes have met with mixed results, with unsteady institutional implementation a key weakness to programs which nevertheless have improved local attitudes towards adjacent protected areas (Infield and Adams, 1999; Archabald and Naughton-Treves, 2001). Assuming appropriate revenue-sharing mechanisms can be developed, a thorough economic analysis of villagers' incentives to degrade or conserve the forest would assess the economic value of using the forest in a destructive or non-sustainable way, and compare this with its value as a nature-based tourism site. Nevertheless, the analyses presented here show that biodiversity conservation does have modest potential to contribute economically to sustainable development.

at current levels, adding this sum to the revenue figures above results in total revenues of \$17,609–31,661. Corresponding per-hectare values are \$0.59–1.06.

References

Adamowicz, W., P. Boxall, M. Williams, and J. Louviere (1998), 'Stated preference approaches for measuring passive use values: choice experiments and contingent valuation', *American Journal of Agricultural Economics* **80**: 64–75.

Adamowicz, W., J. Louviere, and M. Williams (1994), 'Combining revealed and stated preference methods for valuing environmental amenities', *Journal of Environmental Economics and Management* **26**: 271–292.

Adger, W.N., K. Brown, R. Cervigni, and D. Moran (1995), 'Total economic value of forests in Mexico', *Ambio* **24**: 286–296.

Archabald, K. and L. Naughton-Treves (2001), 'Tourism revenue-sharing around nationals parks in Western Uganda: early efforts to identify and reward local communities', *Environmental Conservation* **28**: 135–149.

Balmford, A., A. Bruner, P. Cooper, R. Costanza, S. Farber, R.E. Green, M. Jenkins, P. Jefferies, V. Jessamy, J. Madden, K. Munro, N. Myers, S. Naeem, J. Paavola, M. Rayment, S. Rosendo, J. Roughgarden, K. Trumper, and R.K. Turner (2002), 'Economic reasons for conserving wild nature', *Science* **297**: 950–953.

Barnes, J.I., J. MacGregor, and L.C. Weaver (2002), 'Economic efficiency and incentives for change within Namibia's community wildlife use initiatives', *World Development* **30**: 667–681.

Barnes, J.I., C. Schier, and G. van Rooy (1999), 'Tourists' willingness to pay wildlife viewing and wildlife conservation in Namibia', *South African Journal of Wildlife Research* **39**: 101–111.

Bhat, C.R. (2000), 'Incorporating observed and unobserved heterogeneity in urban work travel mode choice modeling', *Transportation Science* **34**: 228–238.

Blamey, R., J. Gordon, and R. Chapman (1999), 'Choice modelling: assessing the environmental values of water supply options', *Australian Journal of Agricultural and Resource Economics* **43**: 337–357.

Blondel, J. (2000), 'Birding in the sky: only fun, chance for ecodevelopment, or both?', Tourism and Biodiversity: Environment in a Global Information Society, 20–23 September, Port-Cros, France, Scientific Committee on Problems of the Environment.

Bookbinder, M.P. *et al.* (1998), 'Ecotourism's support of biodiversity conservation', *Conservation Biology* **12**: 1399–1404.

Boxall, P.C. and B. Macnab (2000), 'Exploring the preferences of wildlife recreationists for features of boreal forest management: a choice experiment approach', *Canadian Journal of Forest Research* **30**: 1931–1941.

Carlsson, F. and P. Martinsson (2001), 'Do hypothetical and actual marginal willingness to pay differ in choice experiments? Application to the valuation of the environment', *Journal of Environmental Economics and Management* **41**: 179–192.

Chase, L.C., D.R. Lee, W.D. Schulze, and D.J. Anderson (1998), 'Ecotourism demand and differential pricing of national park access in Costa Rica', *Land Economics* **74**: 466–482.

Godoy, R. *et al.* (2000), 'Valuation of consumption and sale of forest goods from a Central American rain forest', *Nature* **406**: 62–63.

Gossling, S. (1999), 'Ecotourism: a means to safeguard biodiversity and ecosystem function?', *Ecological Economics* **29**: 303–320.

Gowdy, J.M. (1997), 'The value of biodiversity: markets, society, and ecosystems', *Land Economics* **73**: 25–41.

Hearne, R.R. and Z.M. Salinas (2002), 'The use of choice experiments in the analysis of tourist preferences for ecotourism development in Costa Rica', *Journal of Environmental Management* **65**: 153–163.

Hensher, D.A. and W.H. Greene (2002), 'The mixed logit model: the state of practice', University of Sydney Working Paper ITS-WP-02–01.

Howard, P.C. *et al*. (1998), 'Complementarity and the use of indicator groups for reserve selection', *Nature* **394**: 472–475.
Howard, P.C. *et al*. (2000), 'Protected area planning in the tropics: Uganda's national system of forest nature reserves', *Conservation Biology* **14**: 858–875.
Infield, M. and W.M. Adams (1999), 'Institutional sustainability and community conservation: a case study from Uganda', *Journal of International Development* **11**: 305–315.
Isaacs, J.C. (2000), 'The limited potential of ecotourism to contribute to wildlife conservation', *Wildlife Society Bulletin* **28**: 61–69.
Kosz, M. (1996), 'Valuing riverside wetlands: the case of the "Donau-Auen" national park', *Ecological Economics* **16**: 109–127.
Kremen, C. *et al*. (2000), 'Economic incentives for rain forest conservation across scales', *Science* **288**: 1828–1832.
Layton, D.F. and G. Brown (2000), 'Heterogeneous preferences regarding global climate change', *The Review of Economics and Statistics* **82**: 616–624.
Loomis, J.B. and D.S. White (1996), 'Economic benefits of rare and endangered species: summary and meta-analysis', *Ecological Economics* **18**: 197–206.
Louviere, J.J., D.A. Hensher, and J.D. Swait (2000), *Stated choice methods: analysis and application*, Cambridge: Cambridge University Press.
Maille, P. and R. Mendelsohn (1993), 'Valuing ecotourism in Madagascar', *Journal of Environmental Management* **38**: 213–218.
Mendelsohn, R. and M.J. Balick (1995), 'The value of undiscovered pharmaceuticals in tropical forests', *Economic Botany* **49**: 223–228.
Menkhaus, S. and D.J. Lober (1996), 'International ecotourism and the valuation of tropical rainforests in Costa Rica', *Journal of Environmental Management* **47**: 1–10.
Montgomery, C.A., R.A. Pollak, K. Freemark, and D. White (1999), 'Pricing biodiversity', *Journal of Environmental Economics and Management* **38**: 1–19.
Moran, D. (1994), 'Contingent valuation and biodiversity: measuring the user surplus of Kenyan protected areas', *Biodiversity and Conservation* **3**: 663–684.
Mrema, M., D. Wafula, and H. Agaba (2001), 'Livelihood strategies and the use of tree and forest products in the Mabira forest buffer zone', International Centre for Research in Agroforestry, Kampala, Uganda.
Mupada, E. (1997), 'Towards collaborative forest management in the conservation of Uganda's rain forests', Kampala, Forest Department, Uganda.
Murombedzi, J.C. (1999), 'Devolution and stewardship in Zimbabwe's CAMPFIRE program', *Journal of International Development* **11**: 287–293.
Naidoo, R. (2004), 'Species richness and community composition of songbirds in a tropical forest – agricultural landscape', *Animal Conservation* **7**: 93–105.
National Environment Management Authority (1997), 'District State of the Environment Report, Mukono ', National Environment Management Authority, Kampala, Uganda.
Obua, J. (1997), 'The potential development and ecological impact of ecotourism in Kibale National Park, Uganda', *Journal of Environmental Management* **50**: 27–38.
Oduol, P.A. and J.R.W. Aluma (1990), 'The banana (Musa spp.) – Coffee robusta traditional agroforestry system of Uganda', *Agroforestry Systems* **11**: 213–226.
Pearce, D. (1996), 'Global environmental value and the tropical forests: demonstration and capture', in W.L. Adamowicz, P.C. Boxall, M.K. Luckert, W.E. Phillips, and W.A. White (eds), *Forestry, Economics and the Environment*, Wallingford, UK: CAB International, pp. 11–48.
Peters, C.M., A.H. Gentry, and R.O. Mendelsohn (1989), 'Valuation of an Amazonian rainforest', *Nature* **339**: 655–656.
Revelt, D. and K. Train (1998), 'Mixed logit with repeated choices: households' choices of appliance efficiency level', *Review of Economics and Statistics* **80**: 647–657.

Rolfe, J., J. Bennett, and J. Louviere (2000), 'Choice modelling and its potential application to tropical rainforest preservation', *Ecological Economics* **35**: 289–302.
Salafsky, N., H. Cauley, G. Balachander, B. Cordes, J. Parks, C. Margoulis, S. Bhatt, C. Encarnacion, D. Russell, and R. Margoulis (2001), 'A systematic test of an enterprise strategy for community-based biodiversity conservation', *Conservation Biology* **15**: 1585–1595.
Salafsky, N. and R. Margoluis (1999), 'Threat reduction assessment: a practical and cost-effective approach to evaluating conservation and development projects', *Conservation Biology* **13**: 830–841.
Salafsky, N. and L. Wollenberg (2000), 'Linking livelihoods and conservation: a conceptual framework for assessing the integration of human needs and biodiversity', *World Development* **28**: 1421–1438.
Scarpa, R., S.M. Chilton, W.G. Hutchinson, and J. Buongiorno (2000), 'Valuing the recreational benefits from the creation of nature reserves in Irish forests', *Ecological Economics* **33**: 237–250.
Schultz, S., J. Pinazzo, and M. Cifuentes (1998), 'Opportunities and limitations of contingent valuation surveys to determine national park entrance fees: evidence from Costa Rica', *Environment and Development Economics* **3**: 131–149.
Train, K.E. (1998), 'Recreation demand models with taste differences over people', *Land Economics* **74**: 230–239.
Train, K.E. (2003), *Discrete Choice Methods with Simulation*, Cambridge: Cambridge University Press.