The WTP for Property Rights for the Giant Panda:

Can a Charismatic Species be an Instrument for Conservation of Natural Habitat?

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Paper prepared for the BIOECON workshop on:

"Property-related mechanisms for biodiversity conservation"

Rome, Italy, 30-31 May 2002

Abstract

The paper presents the results from a stated preference study to address issues concerning the potential for using flag-ship species, such as the Giant Panda, to purchase the property rights for the conservation of natural habitat. The study finds, first, that there is clear WTP for acquiring the property rights for panda habitat. The nature of this demand is found both convincing and logically coherent in that it is an increasing function of land (at a diminishing rate). Secondly, the study decomposed the elicited values into genetic stock, animal welfare and implicit biodiversity values. The results show that the latter type of value consist of almost half of total value implying that the Panda is in fact a potential instrument for greater biodiversity conservation. Thirdly, the study shows that these implicit biodiversity values are dependent on the preservation of the flagship species itself, implying that the panda is not only a potential instrument for habitat conservation, but a necessary one. Finally, the extent to which the flagship approach can be capable of contributing to wider biodiversity conservation is discussed.

Key-Words: flag-ship species, existence value, contingent valuation, Giant Panda.

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[1] The authors would like to acknowledge the financial assistance from the China Council for International Co-operation on Environment & Development (CCICED) and from European Commission's Framework V Programme.
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1. Introduction.

There are quite a few examples of species that have dramatically greater appeal to humans than do others. These are those species that are immediately identifiable by name (e.g. elephant, lion, tiger, panda) and often have some charismatic or symbolic attributes. They are commonly associated with a particular geographic location or habitat (e.g. African savannahs, Indian forests, Chinese mountains). Because of this association between the species and their habitats, these charismatic species are also sometimes referred to as "flagship" species. They are the leading representatives to human society of the habitats from which they derive.

One measure of society's interest in the flagship species is its valuation of those species, Surveys on the willingness to pay (WTP) for the preservation of wildlife indicate that there are certain species that have substantial individual value, such as an annual WTP of $ 26 for the gray whales or $35 for the whooping crane. (Loomis and White 1996). Meta-analyses of the WTP for individual species have found that there is a significant preference for a few charismatic species relative to the vast bulk of less noted or notable ones, and that this preference is rooted in a wide range of psychological and cultural factors (Metick and Weitzman (1996), Loomis and White (1996), Loomis and Giraud (1997), Kontoleon (1996)).

The flagship species are often used as representatives of the general problem of endangered species and biodiversity. All of the above species are endangered, and for most the primary cause of their endangerment is the loss of their habitat. Despite the importance of habitat conservation for effective preservation, many attempts to solve the former problem are focused on the latter. For example, conservation NGOs often focus their appeals for funding around the plight of a particular charismatic species, as in "adopt an elephant" appeals. The World Wide Fund for Nature (WWF) even uses the Giant Panda as the emblem of its general campaign for the conservation of natural systems.[2] So, these species are not just highly valued for themselves, but also highly valued in their representative status.

This fascination with a few individual species might be a boon for general nature conservation, or it might not. At the same time that we see these species being feted as the cause for conservation, we also observe the paradox that some of these flagship species are themselves being subjected to *ex situ* conservation efforts (usually artificial breeding centers with little possibility of reintroduction into natural habitat) (Olney *et al* (1995). Some notable examples include the tiger (Meacham 1997) and the Giant Panda (Swanson and Kontoleon 2000). There is a long standing debate concerning the relationship between *in situ* and *ex situ* conservation strategies, and the willingness to pay for individual charismatic species (rather than habitats) lies at the core of this debate. This demand for individual species conservation can be either a complement to or a substitute for the demand for habitat conservation.

[2] For example this focus on charismatic species is the explicit and primary strategy of the WWF: "The WWF global network focuses particular attention on a small number of globally important 'flagship' species: the giant panda, tiger, marine turtles, great apes, whales, elephants (African and Asian) and rhinos (in both Africa and Asia)." The WWF even has explicitly chosen 10 species to base its entire fund raising compaign. These are the Chimpanzee, Elephant, Giant panda, Golden lion tamarin, Mountain gorilla, North Atlantic Right Whale Orang utan, Rhino, Snow leopard, and Tiger.

These issues concerning the relationship between the demand for a specific charismatic species and that for general nature conservation will be examined in a case study of one particularly charismatic species, the Giant Panda. The case of the Panda is particularly relevant to the questions raised above since it exhibits an interesting and two-pronged paradox. Firstly, the species is highly endangered by reason of habitat disruption, despite being one of the most widely recognisable and cherished species in the world. Secondly, despite being such a prominent flagship species, the conservation efforts being contemplated for its survival do not include habitat conservation but rely increasingly on captive breeding programmes in *ex situ* facilities. Thus, if the Giant Panda is unable to demonstrate the ability to pay for its own property, then there is probably no other species capable of doing so; and, if society is unwilling to conserve this habitat for the Panda, then for what reason would it conserve that habitat?

We consider three issues in particular detail.

First, can a particular high profile endangered species such as the Giant Panda generate funding for the conservation of its own habitat? That is, does the WTP for the panda include a WTP to pay for the property rights it requires? What does this commitment imply? Loomis and White (1996) have argued that the valuation of certain 'charismatic' species:

> "may often include implicit valuation for the components of the ecosystem that supports these high-profile species. For example, humans may value watching bald eagles yet be unaware or indifferent towards pocket gophers. Yet, if pocket gophers are a critical part of the raptors' food supply, then humans have a derived value for the pocket gophers and heir habitat."(p.198).

As will be described in more detail below, there are at present only about one thousand pandas remaining in their natural habitat in Sichuan province, China. Would society be willing to purchase the property rights to the remaining panda habitat to conserve this species? This is an important policy question concerning the WTP to save the species within its natural habitat, i.e. by means of *in situ* conservation. The first part of our study investigates the WTP for lands to be provided for the sole purpose of panda conservation, and we find that a significant WTP for such land exists.

The remainder of the study investigates the nature of this WTP for panda habitat. We choose to focus on the question of whether the flagship species is in itself capable of acting as an instrument for general nature conservation. That is, is the fascination with the panda a substitute for general nature conservation, or is it a complement? We approach this problem in two steps.

First, we examine the nature of the demand for “panda habitat”. This value could be conceived of as that utility gained from the knowledge that the species lives undisturbed in its natural environment. If so, then this value can be viewed as a form of *derived demand* for all of the other plant and animal species that together comprise the species’ natural habitat. In order to assess the relative importance of this derived demand, we decompose the WTP for the conservation of the giant panda into three components: 1) its mere genetic existence (or stock levels); 2) its enhanced welfare (or quality of life); and 3) its naturalness (or existence within a natural environment). We argue that it is only the third part of this demand for panda conservation that might be construed as derived demand for panda habitat. In the second part of this study we investigate the extent to which this value of “naturalness” exists, and the extent to which it is a logically distinct entity from the other values. We find that there is an important, substantial and distinct value attaching to the conservation of the panda within its natural habitat.

Finally, we investigate the ability of respondents to separate the value of "panda habitat" from the value of the panda. That is, to what extent is the flagship species a necessary instrument for the conservation of its habitat. We find that there is some evidence to support the proposition that the WTP for the panda habitat would not exist, if the panda did not exist.

At the end of the paper we discuss our findings, and argue the following three points concerning charismatic species and nature conservation. First, the construct of individual "flagship" species is necessary to generate interest in the more abstract concept of nature or biodiversity conservation; the general public can support nature conservation but it requires concrete and specific figureheads on which to lodge this support. Second, this construct may then be used as an instrument by which to generate funding for general nature conservation; the general public is able to understand and support general nature conservation as a means to the ends of supplying habitat to well-known species. Third, the particularistic demand for these charismatic species can become a substitute rather than an instrument for nature conservation, if the policy makers respond with *ex situ* rather than *in situ* policies. In short, there is support for nature conservation that must be channelled through the mechanism of providing habitat for charismatic species, and if this is not done, it is support that is lost.

The next section briefly describes the paradox of the panda and why the panda is a particularly interesting case to examine the questions raised here. Section 3 presents the conceptual framework on which the CV design was based upon. Section 4 presents the design of the study while Sections 5 to 9 the study results. Section 11 concludes with some final remarks

2. The Paradox of the Giant Panda

The Giant Panda (*Ailuropoda melanoleuca*) is one of the world's most well known and popular species. It has been cherished due to its external appearance and mysterious behaviour and has even served as a symbol for biodiversity conservation in general by being adopted as the official logo of the World Wild Fund for Nature.[3] At the same time, the case of the Giant Panda exhibits an interesting paradox. This paradox has two dimensions. First, this widely recognisable and cherished species is one of the most endangered animals in the world with less than 1000 pandas still remaining in existence in the mountainous regions of Sichuan Province, China (Schaller, 1993). Secondly, despite being the best example of a flagship species that has been used to promote the 'species' approach to biodiversity conservation, the conservation plans for the Panda itself mainly focus on the *ex situ* breeding and maintaining of the Panda stock with almost no provisions for re-introducing the species back to its natural habitat.[4]

[3] The WWF raises about $150m from its 5 million supporters world wide.

[4] A more thorough presentation of this paradox can be found in Swanson *et al* (2001) and Swanson and Kontoleon (2000).

2.1. Paradox of in situ Panda Conservation

Contrary to popular belief the reasons for the curtailment in the panda population have little to do with shortages in their main food supply (bamboo), with problems of illegal poaching or with difficulties in mating or procreating. Instead, the primary force restricting the expansion of the panda population is the continuing subsistence use of the panda habitat by local communities. (Lie *et al* (2001), MacKinnon and De Wulf (1994), Mackinnon et al (1989)). Figure 1 depicts the historical dispersion of the panda and the restriction of its habitat. In response to this habitat encroachment, the Chinese government has designated 25 nature reserves in Sichuan province occupying a total area of about 11,500 km^2 for the protection of this unique species. The same figure shows the distribution of 12 of the largest Panda reserves. The most well known panda reserve is the Wolong Reserve that hosts that largest population of pandas (about 10% of remaining stocks). Yet, as has happened in most other developing countries, the classic parks and protected areas approach has failed the Giant Panda Reserves as well. The lack of appropriate funding, the lack of local incentives and benefit sharing and the inefficiencies of bureaucratic management have rendered these areas into mere 'paper parks'.

A recently published analysis of habitat data from satellite images of the Wolong reserve shows that despite the restrictions imposed on the local people in the reserve and the relatively large sums of money the reserve has received compared to other Panda sanctuaries the habitat suitable for panda conservation has been steadily shrinking even after the reserve was established in the mid 1970's (see Figure 2). It is estimated that the rate of decline in panda habitat after the reserve's establishment has been about 4.54% per annum. This decline in suitable panda habitat in Wolong has lead to a decline in the panda population from 145 in 1974 to 72 animals in 1986. Based on wildlife-habitat relationships and the decreasing frequency of finding pandas in the wild the current number of wild pandas in Wolong is likely to be even smaller (Liu *et al* 2001). [5] This decline results from local peoples' subsistence hunting and gathering, and minor logging activities. The total value of such activities has been estimated at achieving returns of no more than a few hundred dollars (in aggregate) per hectare per annum. (Kontoleon and Swanson 2000)

The first aspect of the Panda paradox lies in the combination of the powerful global image of the panda together with the penurious local circumstances in which it finds itself. While the panda remains one of the most highly visible and notable of the world's charismatic species, it continues in its decline for want of a few thousand hectares of undisturbed habitat.

2.2. Paradox of ex situ panda conservation

Everyone in the world knows of the plight of the giant panda as an endangered species; in part, this is because it figures as the logo of the world's most prominent nature conservation organisation. However, the currently applied programme for the conservation of the panda is far from natural. In light of the failure of the reserve system the Chinese authorities have been pursuing a series of *ex situ* breeding programmes.[6] These include programmes in specially designed captive breeding centres in Wolong and

[5] Predictions for decline in panda numbers in other reserves are even more dire. For example, a population of 197 pandas in the Wanglang Reserve in 1969 reduced to only 10-20 by 1980 while it is estimated that there are no pandas at present in this reserve.

[6] Also, certain human resettlement policies have been attempted but with no success. These have also failed. See Swanson *et al* (2001) for a more thorough institutional analysis of the Panda reserves.

Chengdu (the capital of Sichuan Province) as well as smaller scale breeding programmes in various zoos around the world (mainly in the US, Mexico, Germany, Japan, and Hong Kong). Despite the increased success in reducing infant mortality of captively breed pandas plans, for the re-introduction of the species are non-existent. “Of the 400 pandas bred in captivity since 1936 none have ever been released into the wild" (Chapman, 2001, Wild Times). Moreover, reintroduction rates are not likely to improve in the future since the issues pertaining to habitat conversion are not adequately addressed. In essence, advocates of these policies have thrown in the towel in the battle to save panda habitat *in situ* and are content with preserving the species in artificial surroundings.[7]

The second paradox of the panda lies in the fact that the one species in the world that has figured most prominently as a 'flagship' for promoting nature conservation is itself being pushed down the path toward *ex situ* conservation.

3. Defining Wildlife Values

Common welfare theoretic definitions of wildlife values that have been used to formulate CV studies are presented in Freeman (1996), Fredman (1993) and Loomis (1988). These authors have all modelled wildlife values as a function of their stock sizes. In this study we employed an alternative definition of value that explores other facets of wildlife value. We will focus on both the impact of the quantity (or stock) of wildlife in valuation decisions, and also on the impact of the quality (or welfare) of wildlife. That is, our definition takes into account that wildlife conservation policies have multidimensional impacts on the state, q, of a particular species, affecting both its quantitative aspects (mainly stock size) as well as its qualitative aspects (namely living environment). Thus, the definition of value used here treats q as a vector.[8]

For convenience we assume that q consists of two dimensions, the quantity and the quality of a speces’ existence, $q = (q_1, q_2)$. The former is assumed to be measured by stock size while the latter is measured by the quality of the environment afforded to a species. The individual preference function is specified as $u = u(x,(q_1, q_2))$. Then, for a

[7] The latest and most ambitious panda conservation programme pursued in China (Under 'China's Agenda 21'-White Paper on China's Population, Environment, and Development in the 21st Century) is titled the "*Ex situ* conservation of the Giant Panda in Sichuan province". The project seeks to increase the giant panda population, promote its viability, and supplement *in situ* conservation. The main implementing agencies are the Chengdu Research Base of Giant Panda Breeding, the China Conservation and Research Centre for the Giant Panda in Wolong and WWF-China. The time line runs from 1997-2005 and its budget amounts to US$ 7.45 million (of which US$ 3.24 million comes from domestic sources while foreign aid covers the remaining US$ 4.21 million). The programme aims at breeding 80-90 Pandas with a survival rate of 85%. Note that this budget covers the aims of increasing the stock of *captive* pandas and does not cover the costs of *maintaining* these stocks in captivity nor the costs of re-introduction. It has been tacitly assumed or expected by Panda conservation agencies that international assistance will cover these expenses. These expectations are based on the charismatic appeal of the panda coupled with a tendency of presenting captive breeding and keeping of the species as a ‘necessity’ or ‘inevitability’. Results of the success in birth rates of the programme are not available. Yet, even if the birth target is met it is highly unlikely that the alleged aim of re-introduction will ever materialise since no (incentive compatible) measures are taken to curb the continuing decline in panda suitable habitat.

[8] Several economists have cautioned that q need not be viewed as a single scalar measure but as a vector of attributes and that different elements of this vector may give rise to different values. For example Kopp (1992) points out that "what is certainly clear is that elements of the vector q that are appropriate for the motivation of use values … may not be well-suited to the motivation of non-use values" (p.28).

specified level of $q = (q_1, q_2)$, income *m* and market prices *p*, we can describe the well-being attained by each individual from species conservation by an indirect utility function $v = v(p, q_1, q_2, m)$. For an initial level of income m^0 and species quantity/quality q^0, the initial or reference level of utility would be given by u^0. Then the dual optimisation problem min $e(p, q_1, q_2, u)$, $st.\ u = u(x, (q_1, q_2)) \geq u$, would yield compensating demand functions for *x* as well as Hicksian compensating or equivalent welfare measures for changes in the vector *q*. For a multidimensional policy change that results in the simultaneous change in two or more dimensions in *q*, the Hicksian compensating welfare measure is the amount of income paid or received that would leave the individual at the initial level of utility subsequent to the multiple impacts of policy. For the change from q^0 to q^1 a holistic measure of value is represented by:

$$WTP(q^0, q^1) = e(p, q_1^0, q_2^0, u^0) - e(p, q_1^1, q_2^1, u^0) \qquad \text{Eq. 1}$$

Component values can be subsequently defined from Eq. 1 by using a simultaneous valuation path that begins at $q^0 = (q_1^0, q_2^0)$ and ends at $q^1 = (q_1^1, q_2^1)$. The simultaneous valuation path values the effect of each element of *q* as the *overall* vector changes from q^0 to q^1. The desegregated expression for Eq. 1 is then given by:

$$WTP(q^0, q^1) = \int_{q^0}^{q^1} \left[\frac{\partial e(p, q_1, q_2, u^0)}{\partial q_1} \right] dq_1 + \int_{q^0}^{q^1} \left[\frac{\partial e(p, q_1, q_2, u^0)}{\partial q_2} \right] dq_2 \qquad \text{Eq. 2}$$

where each of the two components of Eq. 2 evaluates a derivative of the expenditure function $\partial e(p, q_1, q_2, u^0)/\partial q_i$, $i \in \{1,2\}$ as the overall wildlife conservation policy shifts from its initial to its post-policy level (Hoehn 1991). *Using this framework we can allow for different forms of value to be a function of different dimensions of q.*

In line with what has been discussed above, we will assume that there are two main values that people hold for remote species such as the Giant Panda. These are “gene flow values” related to the preservation of the stock of the species, and the “animal welfare values” related to preserving some quality of life for the species. These last sorts of values could be related to benefits from maintaining or attaining specific animal welfare by means of preserving a natural and undisturbed environment in which the panda might continue to live.[9]

Gene flow values would then be defined as the welfare obtained by a change in the level of wildlife stock keeping the quality of life constant (the first part of Eq. 2). Welfare value would be defined as the value for a change in the level of species quality or well-being while keeping stock levels constant (the second part of Eq. 2). Defined in this way, *the welfare portion of this value is the marginal willingness to pay for the conservation of a species - in addition to that which is offered for its mere biological preservation*.

[9] Note that all other forms of value such as recreational values and bequests are not considered here since we are considering remote species for which very few use values exist. Also, the animal welfare, existence, and intrinsic values mentioned here are anthropocentric in nature. Non-anthropocentric conceptions of animal welfare are not considered here.

In effect, in this study we are decomposing so-called *existence values* into distinct genetic and welfare components. Freeman maintains that formal definitions of existence value are a "matter of taste" (Freeman 1993b). Yet, the merit of any formal definition lies in its ability to better explain human behaviour, in its capacity to construct meaningful empirical hypotheses as well as in how well it conforms to the intuition underlying a particular concept. The definition of wildlife value presented above seems to better satisfy these requirements compared to the standard formal definition. First, the definition of value provided here allows for a simultaneous change in more than one attributes of q which captures the realities of conservation policies. Secondly, it captures the idea that different elements in q may be associated with different component values. This allows for a definition of existence value which does not depend on species stock. Instead existence value is best seen as being related to other aspects of wildlife conservation and includes both animal welfare as well as (implicit) biodiversity values. Lastly, the definition can be viewed as capturing the spirit underlying the conceptual work on existence value (e.g. Krutilla (1976), Loomis (1988), Pearce and Turner (1991)).

4. A contingent valuation study for the preservation of the Giant Panda.

A contingent valuation study was designed and implemented in 1998 that examined the relative magnitude of the types of values held by non-Chinese for conserving the Panda. Three conservation policy scenarios were valued, each involving an impact on the population density, the animal welfare levels and the degree of wildness of the species. The total WTP for each scenario was defined as the value for the simultaneous change in the quantity (stock) and quality (living environment) of the species from the current reference to a new level. By design each scenario entailed and/or restricted different types of values. Hence, the difference between scenarios would provide an indication of the magnitudes of relative components of value. This approach to decomposing values is also referred to as the scenario difference approach. It is to be preferred to other approaches where individuals are directly asked to partition their total values into component values (Mitchell and Carson (1989), Bateman and Willis (2000)).[10] Full details of the study can be found in Swanson *et al* (2001). Here we focus on presenting aspects of the survey design that are most relevant for this paper.

4.1. Extent of the market and sampling frame.

Form the outset it was decided to investigate global public good values for Panda conservation. In addition, it was acknowledged that these values are likely to be higher in the developed world. Hence the target group or relevant market was delineated to be residences of OECD countries. Yet, the constraints of the project required that the CV study were to be undertaken in China. This restricted our sampling frame to the population of foreign tourists visiting China. To enhance the quality of the sample a partnership was achieved with the China International Travel Service (CITS) which offered access to tourist groups as well as information that would allow for some basic stratification (nationality, estimated income and age of group). This strategy aimed at

[10] Due to budgetary constraints a split sample approach could not be used and hence the same respondents were asked to answer several WTP questions. This approach avoids some of the problems with the strategies for decomposing values but at the same times raises some other issues concerning the estimation of multiple responses from the same individual. The next section describes how the study was designed and implemented.

assuring that a sufficiently large and representative sample was collected, ensured that respondent attentiveness was enhanced and that response rates were be maximised.[11]

4.2. Description of Scenarios Valued.

In the final version of the questionnaire three different Panda conservation scenarios were chosen.[12] Each individual was asked to value all three scenarios irrespective of his/her answer to the other valuation questions. [13]

Before asking the valuation questions for the three scenarios respondents were provided with information about the Giant Panda, its habitat and distribution. This was provided orally by the moderators. Visual aids such as maps, bar graphs and photos were also used. Participants were informed about the decline in the population of the Giant Panda. Human use and conversion of the habitat suitable for panda preservation was described as the its main threat. Also, respondents were told that both local and international demand for Panda products (such as fur or meat) was non existent. This piece of information intended to make clear that there are no direct consumptive uses related to the Panda. In addition, it was stressed that the possibility of viewing these animals in the wild was unlikely thus ruling out any *in situ* tourism (option or bequest) values. Moreover, it was mentioned that the Panda habitat also hosts many plants, mammals, birds and reptiles species but non of these were considered to be rare or under threat of extinction.

Respondents were then informed that the highest concentration of pandas was found in the Wolong reserve, amounting to about 200 animals. The population of pandas in Wolong consisted of both caged animals in the local breeding centre as well as wild pandas in the reserve. It was further stated that conservation efforts would focus on just this reserve since this offers the only realistic chance of saving the species. Moreover, respondents were told that the species can only be saved if its population increases to 500 animals which is considered by scientists as the viable minimum population. (MacKinnon and Wulf (1994)).

Further, it was explained that the Chinese authorities are contemplating three alternative conservation programmes for the Giant Panda. It was made clear that only one (if any) of the three scenarios would be implemented. Moreover, it was stated that whichever of the conservation programmes was adopted the species would be saved with equal certainty but that the scenarios differed in the means by which this would be achieved. The means of conservation were explained as having to do with the quality of the living

[11] Interviews were conducted in person in English, German and French. Also, currency conversion sheets were used to assist people in stating their WTP bids.

[12] The number of three programmes appeared to be the most that individuals could handle in a valuation exercise. Moreover, the chosen scenarios were the ones that were mostly policy relevant.

[13] An important aspect in developing the final questionnaire format concerned how to deal with the special design issues that emerge when multiple WTP bids are elicited from the same individual. First, the reference level of utility for each scenario had to be determined. It was decided to use the same reference level and obtain WTP for the changes $q^0 \rightarrow q^1, q^0 \rightarrow q^2, q^0 \rightarrow q^3$. This approach avoids the problems with substitution and income effects that would emerge if we had used a sequential design (Randall (1991)) since respondents are in essence asked to re-adjust their budget constraints as they go from one question to the other. Such a design has been labelled the "exclusive-list" format and is to be contrasted with the "inclusive list format" where respondents provide incremental values to a sequence of WTP questions (Bateman *et al* (2001a and 2001b)). Based on recent research by Bateman *et al* (2001a and 2001b) the 'advanced disclosure' design as opposed to 'step-wise' disclosure approach was used. This decision was based on findings that the advanced disclosure nullifies the biases that can emerge from the choice of the order with which the scenarios are presented. In this study the 'bottom-top' ordering was employed.

environmental that would be allotted to the conserved panda population. Further, it was stressed that without international financial support this goal would unlikely be achieved and the panda would become extinct in the near future. Moreover, it was stated that the programme would be managed by the Chinese authorities, while it would be financed *via* a compulsory airport-tax surcharge levied on all foreign tourists leaving China.[14] Finally, the payment ladder approach was used to elicit WTP values.[15]

In line with the definition of wildlife value presented above, each of the three conservation scenarios was described as having a two dimensional impact on the state of the Giant Panda (compared to the current *status quo*). First, the stock of the species would be changed in that it will be increased and maintained at the MVP level and at the same time a different type of living environment would be allotted to each panda. The latter would effect the well-being of the species in two ways. First, the different living environments would allot different amounts of space to each panda. It is assumed that more space entails increased (albeit diminishing) animal welfare levels and assuming a paternalistic altruism framework this would in turn increase individual utility. Secondly, the different living environments would entail a different amount of biodiversity and/or degree of wildness or naturalness. Again, this enhanced degree of wildness or naturalness may be perceived as welfare enhancing.

More specifically, individuals were informed that each Panda conservation programme being considered would increase the size of the Panda population from the current level of 200 animals to a viable population level of 500 animals. Yet, an additional qualitative dimension was also affected in each policy change. This referred to the amount of land that would be purchased and allocated to each Panda. In the first scenario a breeding programme would be developed that would conserve Pandas in captivity in standard zoo-type cages. Each panda would be allocated 100 square meters (see Figure 3). In total five hectares of land would be required for this programme. This scenario corresponds to the programme currently contemplated for Wolong by the organisations involved in Panda conservation. Further, it was made clear that it would not be able to re-introduced the pandas into the wild at any later time since neither the habitat would be suitable nor would the species be able to re-adapt. This clarification was made so as to avoid presenting this scenario as a possible temporary programme. Total value for this 'cage' scenario would be the value for the simultaneous change in both the stock, q_1, and quality, q_2, levels of the state of the Panda. Let the reference level of be q^0 and the new level provided by the 'cage' scenario be q^1, then total WTP is given by:

[14] It should be kept in mind that the choice of undertaking the survey in China as well as the decision to use an airport tax sir-charge in essence delineates the sampling population to individuals that are likely to travel to China by plane. This is in itself a self-selected group and hence any inferences to a larger a larger population of individuals must be made with great care. The 'affected population' is of course much larger than the population of tourists.

[15] This approach is a hybrid elicitation format the combines the payment card with the discrete choice format. As in the discrete choice format, individuals are asked to state whether they would be willing to pay a particular amount. Yet, individuals are asked to respond to as series of values starting from zero and ranging up to a predefined value (in our case this was $100). In essence the payment ladder approach yields multiple bound discrete choice data. The data can be analyses as interval data (Cameron and Huppert (1988)) or if the intervals are narrowly defined with standard limited dependent variable models (Donaldson *et al* (1998). Recent application of this elicitation format can be found in Bateman *et al* (2001a) and Cameron *et al* (2002).

$$WTP(q^0,q^1)=\int_{q^0}^{q^1}\left[\frac{\partial e(p,q_1,q_2,u^0)}{\partial q_1}\right]dq_1+\int_{q^0}^{q^1}\left[\frac{\partial e(p,q_1,q_2,u^0)}{\partial q_2}\right]dq_2 \qquad \text{Eq. 3}$$

Since it has been hypothesised that species quality is a function of wildlife living conditions and that this enters as a positive argument in individual utility then the 'cage' scenario would conserve the species with a minimum (if any) level of animal welfare. That is, the marginal value with respect to species quality (the term $\partial e(p,q_1,q_2,u^0)/\partial q_2$) would be close to zero or in fact may even be negative.

The second conservation scenario would conserve and maintain the same number of species (500 pandas) but would do so in pens instead of cages. As in the 'cage' scenario, the species would indefinitely be preserved in captivity but now each panda would be allocated 5000 square meters (or half a hectare). This area was described as being roughly the size of a foot-ball pitch (see Figure 4). In total 250 hectares of land for the entire programme would be required. Considering the same reference state, q^0, and the post reference state from the 'pen' scenario as being, q^2 , the total WTP for this multi-impact scenario would be defined similarly as in Eq. 3

The marginal value with respect to stock size would be the same as that in Eq. 3 since it is assumed that gene values are perceived to be the same under alternative quality regimes.[16] The value for animal welfare may be equal or larger than that in Eq. 3 on account of animal welfare being a monotonically increasing argument in the individual's utility function. Hence, total WTP for the 'pen' should be equal or greater to that of the 'cage' scenario. Finally, note that this scenario provides no biodiversity benefits in that the species is simply conserved in a larger captive and artificial environment.

Finally, the third conservation scenario involved *in situ* conservation of the Panda in its natural habitat. This would require the acquisition of substantially lager amounts of land. Under this scenario each panda would be allocated 400 hectares (see Figure 5). This amounts to 200,000 hectares in total which is roughly the size of the entire Wolong reserve. Total WTP for a change form the same reference state, q^0, to the post reference, q^3, would be defined as above. Again, it is assumed that gene stock value is the same as in the previous scenarios while animal welfare or existence value should be equal or larger. However, in this scenario animal welfare or existence value does not stem from simply allocating more space to each panda as is in the 'pen' scenario but form providing the entire natural habitat (and the biodiversity wherein) to the species itself. It is contemplated that this is a form of animal welfare or existence value in that the direct 'beneficiary' is the species itself. It is postulated that human benefits from preserving biodiversity in its own right are merely incidental. Moreover, this form of value was described above as a form of derived demand for biodiversity (Loomis and White (1996)). The emergence of this implicit or derived biodiversity value is entirely dependent on the desire to provide a natural undisturbed environment to the species itself. People may acknowledge that preserving the habitat constitutes 'value for money' in that

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[16] This may not be true in the long run since alternative conservation policies may take a species down different evolutionary paths. Also, even in the short term, it is conceivable that people may perceive that genes from 'free-range' as opposed to caged pandas are somehow superior. Yet, for the purposes of this study it is assumed that the gene value from all scenarios is the same.

society obtains the added benefit of conserving more species. Yet, what is important is that the source of value is the species itself and not the appeal or benefits from saving a part of nature *per se*. This form of value constitutes an addition to the values expected to arise in the ‘cage’ ‘pen’ cases hence total WTP for the 'reserve' scenario should be equal or larger than that other two scenarios.

4.3. Embedding and WTP for wildlife conservation.

The survey design addressed potential embedding biases that may result when valuing such public goods. The term 'embedding' in the valuation literature has acquired an elusive connotation in the past two decades incorporating various types of biases or anomalies and meaning different things to different researchers.[17] In the current context embedding refers to the danger that the respondents are valuing a larger good than that which the researcher intended. This invalidates the usefulness of the results since the researcher cannot know which part of the estimated benefits reflect the species being conserve and which are related to 'something else'. Embedding bias may be a particular problem when valuing charismatic and high profile species because of the emotive and symbolic characteristics with which they are associated. In this CV study there were three types of embedding that seemed to be potentially troublesome.

First, individuals may be providing a value for "saving all species" or "all environmental resources" rather than just the panda. Treating this form of embedding and minimising its effects can be achieved by adequate survey design and appropriate information provision (Carson *et al* (2001)).[18] Yet, survey design cannot be infallible and thus internal tests may be used to examine its presence. In our case, one indication that the elicited values are not bids for all environmental causes would be provided if the values were observed to be sensitive to the amount of land associated with each conservation programme. This in essence amounts to an internal scope test (Bateman *et al* 2001a and 2001b).

Second, some economists have argued that stated values for wildlife conservation are nothing but mere expressions of one's environmental or other social attitudes and not expressions of his/her Hicksian consumer surplus. (see Blamey (1998), Rekola *et al* (2001), Opaluch and. Grigalunas (1992)). This criticism is included as a form of embedding since it implies that individuals are providing a much wider expression of their preferences than is requested by the CV exercise. The presence of this form of embedding is assessed by examining whether the elicited values can be explained by a series of socio-economic variables in a manner that suggests that they are not mere expressions of general attitudes but are consistent with economic models of behaviour.

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[17] For a discussion of embedding with different interpretations and in different contexts see Carson *et al* (2001), Schulze, *et al* (1998), Randall and Hoehn. (1996), Mitchell and Carson. (1995), Loomis *et al* (1993), Fischhoff *et al* (1993), Kahneman and Knetsch (1992).

[18] This included adequate description of the scope of the good being valued as well as reminding participants that their responses should take account of their budget constraints as well as other possible substitute goods. Moreover, the consequences of paying and not paying were made explicit. These design elements attempted to make the trade-off between income and the change in the level of the specific public good as realistic as possible. Still, embedding effects may persist and hence *ex post* steps must be taken to examine the extent they are present. The most common approach is to ask respondents follow-up questions on whether their values correspond to the particular good referred to in the study or are attributed to a more general good. Respondents that are found to express embedding values are usually excluded from the analysis. Such follow-up questions were ascertained in this study as well.

The last form of potential embedding that is most common in studies that value the conservation of a species in its natural habitat. The embedding effect emerges because individuals may be valuing the benefit from preserving the entire ecosystem as such as opposed to the benefits from a single species. In our case, this form of embedding is relevant only for the third valuation scenario. The danger here lies in that any WTP stated in excess of that offered for the 'cage' and 'pen' scenarios may not be attributed to animal welfare or existence value (which is the hypothesis of the study) but to the benefits from preserving the ecosystem or habitat itself *irrespective of its relationship to the particular species.* Again, under this form of embedding the individuals would be providing values that would be associated with a much larger good.

It was argued above that the valuation of certain 'charismatic' species may often include implicit valuation for the components of the ecosystem that supports these high-profile species (Loomis and White (1996)). What is crucial for the credibility of the results from single species CV studies is that the *all habitat values stem from and are specific to the species being valued*. This would be the case when habitat *per se* is perceived as having many close substitutes and little value on its own. In this case habitat would only have value when associated with a charismatic endangered species with very few perceived substitutes.[19]

Both the focus groups and the pilot study suggested that in contrast to the Giant Panda people did not perceive China's natural environment in general as a global public good.[20] Still, the danger of this form of embedding remained and in order to minimise its effects respondents were informed that though the mountainous regions of the Sichuan host many plant, animal and bird species, none of these were ‘rare’ or under threat of extinction. This implied that the habitat when not providing a home to the panda had many close substitutes in China and abroad. Finally, an auxiliary scenario was presented after the values of the three main conservation programmes had been elicited that tried to obtain an additional indication of whether this form of embedding effect was at play. Respondents were asked to state their WTP for the preservation of the Wolong Reserve but were told that the authorities could only guarantee with certainty the conservation of only 300 (and not 500) pandas. Hence, the long-run conservation of the panda was described as being highly uncertain.[21] Yet, individuals were told that the remaining flora and fauna would be preserved. In essence, this scenario offered to conserve the reserve but with a very low probability that the species will be saved. No doubt, this scenario has some credibility issues and other design flaws.[22] Yet, it does provide an indication of whether the Wolong reserve has any public good value when it does not provide habitat to the Panda.

[19] It is becoming increasingly apparent that in many cases single species valuation may not make much sense and segregating species from habitat values may not be possible. (e.g. Loomis and White (1996), Fredman (1996)). Yet, single species studies are often relevant as is the case with many 'charismatic megavertabrates' and thus it is crucial for the credibility of the results to ensure that the estimated values are specific to the species being valued.

[20] Common responses on this point from the focus groups and pilots were of the form "we have our own forests to worry about" or "this is China's problem."

[21] The term highly unlikely was used.

[22] For example, individual's may be confused as to why the authorities could not guarantee panda conservation when in the previous scenarios they were told that this would be the case. Also, the scenario was not included in the presentation of all the visible choice set in the advance warning design. This may be a source of further noise in the results.

5. Sample characteristics

Following the sampling strategy described above a final sample of 23 tour groups was selected providing 305 useable completed surveys. Three stratification variables were used for sampling the groups, namely nationality, expected income and expected age of the group. This information was provided by the CITS based on previous market research and from personal experience. The sampling strategy proved to be very successful indeed with an average within group response rate of 70%. Moreover, Table 1 shows that the mean values of the variables used for sample stratification (as provided by CITS) were very close to the corresponding figures obtained in the sample. The sample exhibits some under-representation of Asians. This was due to difficulties in undertaking the survey in a language other than English, German or French. Also, the year the survey was conducted (1998) most of East Asia experienced a harsh financial crisis which considerably reduced the overall number of Asian tourists visiting China that year.

Table 2 reports the socio-economic profile of the sample. Most of the sample fell in the age range of forty through seventy years old. There are is large percentage of people with a university degree (71.4%) and the average income is relatively high at US$4350, but this is to be expected since China generally attracts upper market non-mass tourism. Moreover, most respondents were visiting China on a package tour of about two weeks' duration. The average cost of such a holiday was about USD 3600. Over 80% were making their first visit to China, and 40% reported that they were likely to visit China again in the future.

Overall the survey instrument appeared to work quite well in the field with 55.8% of the sample finding the survey interesting and only 6.5% of the respondents finding the questions difficult to understand. Only a very small proportion of the surveyed group seemed to object strongly to its presentation (0.7% bored) (see Table 3).

6. Summary statistics of WTP bids

Table 4 provides sample summary statistics of the three stated WTP distributions while Figure 1 provide their visual representation. The sample means and median values are increasing in the direction in which scenarios are nested (bottom-top) with mean (median) values of US$3.9 (US$1), US$8.4 (US$5) and US$14.8 (US$10) respectively. All values are significantly different from zero (at 1% and 5% respectfully). Moreover, examining the three WTP responses of *each individual* it can be shown that all participants responded to all three WTP questions in the predicted direction with no respondent expressing a larger WTP value for a good further down in the nested sequence. This confirms the findings from the focus groups and pre-tests that increases in land allocated to a species (keeping species population constant) is viewed as welfare enhancing.

Moreover, all three WTP distributions exhibit the commonly observed shape, with a large mass at low figures and a long tail (see Figure 7). The range of the tails is US$30, US$75 and US$100 respectively. Further, we see that the percentage of zero responses substantially decreases (from 37% to 7%) as we move from the 'cage' to the 'reserve' scenario. Since, all design aspects (such as the payment vehicle) remained constant across scenarios it can be inferred that the decline in the proportion of zero responses is due to increases in the amount of land provided to the species. This suggests that most respondents perceived the scenarios as credible and responded in accordance to their preferences for the benefits entailed in each programme and not in reaction to some design attribute. Zero responses are of a particular problem in revealed WTP data when they are considered to be forms of protest to some aspect of the scenario or programme.

7. WTP for panda conservation as a function of land

The results thus far show that there is a strict preference for purchasing the property rights for additional amounts of panda habitat, in that the elicited amounts for the three programmes increased in respect to the land area offered. Further, a Man-Whitney test (see

Table 6) confirms that the differences between the elicited values for Panda conservation are different from zero, which implies that values are scope sensitive with respect to changes in the amount of land provided to each panda.[23] Moreover, it can also be seen that not only are values exhibiting statistically significant increases in the desired direction, but they are also exhibiting diminishing returns with respect to land provided to each Panda. Using sample means of total values we see that marginal WTP for the first 5 hectares associated with the 'cage' scenarios is $0.72/hectare.[24] The marginal WTP for the additional 200 hectares required for the 'pen' scenario is $0.002/hectare while the marginal WTP for the additional hectares (199750) required for the 'reserve' scenario is $0.000054/hectare.

Further the functional relationship between the WTP for panda conservation and additional levels of land was estimated using a stacked regression models. This would models WTP for panda conservation as function of different amounts of land as well other individual-specific variables. The model (through simulations) also allows for the estimation of marginal WTP values for a larger span of land values. This functional relationship can be used by policy makers to assess the net benefit of conserving the marginal hectare of land.[25]

A random effects Tobit is the appropriate specification since this accounted for (a) potential censoring at zero (Donaldson *et al* 2000) and (b) possible correlation across the three WTP responses (since they come from the same individual) (Greene, 1990, Madalla, 1987). Further, Madalla (1987) shows that in such stacked data models the coefficients on the influence of an individual's personal characteristics on WTP responses can only be identified with a random (and not fixed) effects model. The random effects model includes a random disturbance that is common to and constant over a given individual's responses and assumed to be uncorrelated with the other regressors (Madalla, 1987) as well as a transitory error due to random response shocks across individuals (Alberini *et al*, 1994). Similar models have been used by Larson and Loomis (1994), Loomis and Caban (1998) and Payne *et al* (2000).

The results of this model are presented in Table 7. Only the best fit and most parsimonious model is presented. The variable on 'land' enters the set of regressors in logarithmic form since economic theory suggests diminishing marginal values with respect to habitat (e.g. Mäler (1974), Hoehn (1991)). The explanation of the regressors is offered in Table 9 The co-efficient results all have the expected sign. More importantly, the parameter on land is positive and highly significant.

Table 8 and Figure 10 show simulated marginal values for different levels of lands provided as panda habitat. The graphs clearly show the pattern of increasing but diminishing values.

In sum, these general results from the study demonstrate that there is a significant and logically consistent WTP for "panda habitat". The interest in the charismatic species translates into a WTP for the lands on which it naturally resides. The existence of such a

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[23] The Anderson-Darling tests rejected that the WTP distributions are normally distributed and hence non-parametric tests of significance ware employed. The Man-Whitney test rejects the null at the 1% significance level in all cases .

[24] In line with Rollins and Lyke (1998) marginal WTP values are calculated as difference in value between programmes divided by the difference in hectares implied by the programmes.

[25] A similar functional relationship has been estimated by Loomis and Caban (1998) for the case of the spotted owl habitat.

demand should enable policy makers to purchase the property rights to some of these lands for the purpose of providing a natural quality of life for the endangered species. In short, there is a demonstrable WTP for property rights for the panda.

8. Decomposing Values

Our more substantial enquiry in this paper concerns the nature of this WTP for panda habitat. Does it exist as a distinct and separable value from the value of the giant panda itself? Is the charismatic species a necessary instrument for the value to exist? We now pursue these issues in a series of analyses concerning the decomposition of the WTP for the Giant Panda in this study.

As mentioned in section three of the paper, we developed this part of the study by means a modelling the panda as a multifaceted good, comprising both quantity and quality aspects. We refer to the purely quantitative aspects of the panda (its stock) as the "gene flow" benefits from the species. We refer to the purely qualitative aspects of the species (its quality of life) as the "welfare" benefits from the species.

It has been the hypothesis throughout the paper that the WTP for the 'cage' scenario would capture the value respondents place on the gene flow benefits from panda conservation.[26] The WTP for panda gene preservation was found to have a mean value of US$3.9 while its median dropped to US$1. Further, it has been hypothesised that the WTP values for the 'pen' and 'reserve' scenarios would represent both gene flow *and* different levels of animal welfare values. Since the level of gene flow value is assumed to remain constant across all programmes, the difference between scenarios would provide an estimate of the magnitude of different levels of animal welfare value. Taking the difference between the three WTP distributions will produce *inferred* welfare measures:

$$WTP_{pen-cage} = WTP_{pen} - WTP_{cage} \qquad \text{Eq. 4}$$
$$WTP_{reserve-pen} = WTP_{reserve} - WTP_{pen} \qquad \text{Eq. 5}$$
$$WTP_{reserve-cage} = WTP_{reserve} - WTP_{cage} \qquad \text{Eq. 6}$$

Eq. 4 provides the additional WTP for removing Pandas from the breeding centre with cages to one where animals are kept in pens. This value is US$4.53 and represent the value individuals would be willing to pay to purchase 200 additional hectares of land for the benefit of the species itself. This extra land would have no contribution to the genetic survival of the species nor to overall biodiversity preservation but would simply enhance the welfare of the Panda. This form of animal welfare value constitutes 54% of the total bid for the 'pen' scenario. Eq. 5 provides the additional WTP for removing Pandas from the pen-based breeding centre and purchasing the land required for an *in situ* conservation programme. This value is US$6.43 and is the value associated with buying 199750 extra hectares of land, in order to move to a "natural" quality of life for the species. This value has been interpreted as a form of implicit valuation of "natural habitat" and it constitutes 43% of the total bid.

[26] Some minimum level of animal welfare value could still be present even in the cage scenario. This would be justified in the lines argued in Blackorby and Donaldson (1992) and Cowen (2001).

If we consider the gene flow value to be a use value, then total existence value (animal welfare and implicit biodiversity value) associated with the 'reserve' scenario (Eq. 6) is then US$10.96 which constitutes 73% of the total stated bid. Such a high figure for the proportion of existence value in the 'reserve' scenario is in line with other attempts to decompose values for *in situ* wildlife conservation using the percentage split approaches described above (e.g. see Langford *et al* (2001)).

Our decomposition of the WTP for the giant panda demonstrates that the panda's flagship status translates into substantial WTP for natural habitat. Table 5 and Figure 8 summarises the decomposition of NUVs for the Giant Panda. The charismatic species generates interests in its genetic existence and its individual welfare, but this represents only about half of the total WTP for the species. There is an increase in the WTP for the species from USD 8.43 to USD 14.86, generated by the provision of a "natural" quality of life. This represents 43 per cent. of the total WTP for the charismatic species. This is value from the panda that is available to nature conservation for *in situ* conservation, but is unavailable when *ex situ* is elected. Clearly, the giant panda might be used as an important instrument for general nature conservation purposes.

9. WTP for in situ Panda conservation when long term survival is not certain

The final issue of interest to us was the extent to which the giant panda is a necessary instrument for the conservation of nature. That is, if the panda is not used to conserve its habitat, then would an independent WTP exist to provide for the conservation of these lands? This is important for the purpose of determining the extent to which the construct of charismatic species has substituted for the general motivation to provide for the conservation of nature, and it addresses directly the question of the extent to which ex situ conservation is a substitute for or a complement of in situ conservation.

We examined these questions in the context of a final part of the panda survey. As mentioned in section 4.3, an auxiliary scenario was presented after the values of the three main conservation programmes had been elicited that tried to obtain an indication of whether individuals valued the Wolong reserve independently from its function as Panda habitat. Table 12 presents the summary statistics from this WTP question. As can be seen the sample overwhelmingly stated a zero WTP for a conservation programme that (although securing the preservation of the Wolong reserve), did not guarantee the conservation of the Panda.[27]

Thus, the WTP for the giant panda is not only a potential instrument for nature conservation, it is potentially a necessary instrument for nature conservation. Once having created the construct of charismatic species, it is the continuing existence of such constructs that drives the WTP of the public for nature in general.

10. Validity Checks : Comparison of determinants of WTP for component values

The above inferred distributions for gene, pure animal welfare and implicit biodiversity values were subjected to multivariate regression analysis.

[27] Admittedly, the scenario suffers from credibility issues. It is possible that individuals are rejecting a scenario inconsistent with those provided earlier in the survey.

Investigation of the determinants of the elicited WTP values provides further insights as to the nature of these values. Moreover parametric regression results provide an indication of the degree to which the measured values are expression of consistent (economic) preferences and are not simply random responses or expressions of general attitudes and beliefs. This offers additional internal (construct) validation of CV results (Mitchell and Carson (1989), p.206).

10.1. Independent Variables.

The independent variables that were used for the regression analysis are described in more detail in Table 9. The variables include the commonly used socio-economic variables such as income, sex and age. Also, an index of the subjective rating of the credibility of the panda conservation programmes ('programme index') was constructed as well as a series of four motivation indexes. The table also includes a series of motivational indexes. These are of little use when the aim is to predict expected conditional WTP or to construct a benefits transfer function. Yet, the use of motivational indexes is of particular importance when examining the nature and internal construct validity of CV results.

The first of these four indexes was constructed by *directly* asking people for the reasons they may value panda conservation. Using these responses an index was constructed that provided a measure of the *relative* importance that individuals place on instrumental (or use) reasons for conserving the Panda versus non-instrumental (or non-use) motives. For this reason it is labelled as "Use/non-use" index.[28] The other three motivational indexes were constructed with the aid of factor analysis.[29]

The aim of the factor analysis in this study was to reveal indicators of latent factors that are associated with existence values. These have been argued as being related to altruistic, stewardship, ethical and empathy motives. A series of attitudinal and behavioural questions were asked prior to the WTP questions that would be potential indicators of such latent motives. These are presented in Table 10.[30] All questions were coded using a 1 to 5 Likert scale. No *a priori* hypothesis was made as to which variables would constitute a factor. Hence, so called 'exploratory' factor-analysis was used. The analysis was undertaken in STATA using the principal factor extraction method. Factors with eigenvalues above one where retained. Varimax rotation suggested the existence of

[28] Respondents were provided with a series of 10 reasons for conservation the Giant panda that ranged from highly instrumentalists (e.g.. "Loss of genetic material probably useful in the future") to non-instrumentalist (e.g. "Pandas have a right to survive"). The order of the statements was mixed and individuals were asked to choose *up to three* of their most important reasons. An open-ended option was also included. Open-ended responses were classified on the basis of their proximity to one of the predetermined reasons in the list. Each response received a score from zero (for very instrumentalists) to five (for very non-instrumentalists). An index was then obtained by dividing the sum of the scores by the number of responses provided by each individual (at most three). This provided a measure of the *relative* importance that individuals placed on instrumental versus non-instrumental motives for conserving the Panda.

[29] Factor analysis is a technique used to construct proxy (observable) indexes that can be used as exogenous regressors in the place of latent (unobservable) motivational variables (or factors) that determine observed behaviour or stated responses to CV questions. The technique has been widely used in phsyco-metrics and as well as on other fields of micro-econometrics. Oddly it has only recently received attention in the stated preference and environmental valuation literatures. Some of the rare applications of factor analysis in CV studies can be found in Boxall and Adamowicz (1999), Nunes and Schokkaert (2002), Langford *et al* (2001), Karppinen (2000), Whitehead and Thompson (1993), and Jorgensen *et al* (2001).

[30] The questions were chosen on the basis of Bartholomew (1987) and Schilderinck (1978).

three factors. The indexes were named on the basis of the variables that 'factored' together as well as the relative magnitude of the factor loadings.[31] The first factor consisted of variables that could be easily associated with various motives. A high score in this factor would be associated with an individual who would not desire excess or unnecessary harm caused to animals. Yet, these individuals would be willing to accept the use of animals for medical purposes and they do not have strong views or preferences in favour of 'animal friendly' food production processes. Moreover this factor could also be associated with people who desire to be perceived as doing the 'right thing' (demonstrating) or as belong to a group with particular shared social or ecological values (group membership or identification). This general index was labelled as "animal welfare index". The two variables that loaded into the second factor signify a substantially different latent variable than that implied by 'factor 1'. This factor includes individuals who are more likely to be strict vegetarians *as well as* people who would be against the use of animals even for medical experiments. Hence, this factor could signify some latent animal rights or objectivist-type environmental ethic. For brevity factor 2 was labelled as 'ethics index'. Lastly, the variables that loaded into the third factor suggest affection or empathy towards animals (e.g. pet ownership received the highest factor loading). This factor was labelled as 'sympathy' index'.

10.2. Econometric Specification and Results

The data generating process of this experiment as well as the limited or censored nature of the elicited WTP distributions requires that variants of limited dependent variable (LDV) models are employed. Only the 'best fit' models for each distribution are presented and only sign and significance of the estimated parameters of the explanatory variables are discussed since this is most relevant in examining construct validity. For ease of comparison the same set of explanatory variables are used in all models.

The responses to the WTP question for the 'cage' scenario is best described by a mixture discrete/continuous distribution model. In these mixture models the individual is assumed to be making two decisions. The first concerns a discrete (binary) 'participation' decision that dictates whether the individual will be recorded as having a zero or non-zero WTP. A recorded zero WTP would imply that the individual is indifferent between the reference and post-reference state of the public good. In this study a zero would be recorded if the individual does not care about panda conservation, perceives that they cannot afford to pay anything or mis-reports his/her true value (a form of protesting). The second part of the mixture model accounts for the WTP or payment decision. This would be the decision over how much to contribute to each programme (given that it were the only programme available). The general statistical structure of these mixture models can be explained by a behavioural model of discrete random preference regimes (Pudney (1989)). Under such a model the participation decision is more likely to be explained by motivational and latent taste variables while the payment decision is expected to be affected by taste *and* socioeconomic variables such as income, sex and age. The specific type of mixture models presented in this section are double hurdle or *bivariate* Tobit models.

In contrast, the distribution for the inferred distributions from the differences in WTP between scenarios are best described by *univariate* Tobit models. The behavioural model

[31] The second and third factors only consists of two variables. In some cases this may be indicative of a spurious factor. Yet in out case the egienvalues are above 1 and the factor loading s are very high which provides confidence that these can be considered as legitimate factors.

underlying the Tobit structure suggests that the participation and payment decisions are dictated by the same latent variable and thus, they do not constitute separate decisions.

Table 11 present the regression results of the LDV models for three WTP distributions on gene, animal welfare and biodiversity value respectively. In both the bivariate and univariate models diagnostic testing for normality suggested that transformation of the dependent variable was required. Here we present the results from an inverse hyperbolic sine transformation. Moreover, diagnostic testing for the presence of heteroskedastcity suggested that the variance term, s , must be parameterised (Madalla (1987), Yen and Jones (1997)).

Looking at the results from the 'payment panel' we see that instrumental motives are associated with higher values for gene flow values while non-instrumental values explain WTP for animal welfare and implicit biodiversity values. In fact this effect is increasing as captured by the rise in the (absolute) value of the parameter and its significance. It is also interesting that the coefficients of 'ethics' and 'sympathy' are negative for the gene value but are positive for animal welfare value. They are not significant for the biodiversity value. Clearly, these different subcategories of values are very different from one another, and are driven by very different motivations.

11. Discussion and Concluding Remarks

We would now like to address the issues raised in the title of the paper. First, can the Panda pay for the property rights it requires to survive? The Wolong Reserve consists of 200,000 hectares of land, capable of maintaining a population of approximately 500 giant pandas indefinitely, and this is approximately half of all the population that currently exists. Our study finds that there is a clear WTP for property rights for these panda lands. The nature of this demand is both convincing and logically coherent: the WTP for wildlife conservation is an increasing function of land (at a diminishing rate).

In order to put the WTP for panda lands into perspective, consider first that the current annual budget for Wolong reserve is about US$250,000, or $1.25 per hectare. And furthermore, under the current benefit sharing regime, the local peoples living in and near (and using) the reserve are receiving 4% of the annual budget, or approximately $0.05 per hectare. Given this low level of returns from panda conservation (i.e. the restrictions on the use of the reserve), it is readily apparent why it would be the case that local peoples would be hostile to both the reserve and to the pandas that live within it.

The remainder of the budget is spent on enforcement measures (battling local peoples with objectives different from the reserve) and a captive breeding programme (keeping pandas in captivity rather than the reserve). The "cage scenario" used in the survey is based on the cages actually in use for panda ex situ conservation within Wolong Reserve. As panda populations in the reserve continue to decline, there is an ever-increasing share of Wolong pandas living in captivity rather than in their natural habitat. We believe that the case of the panda is exemplar of that occurring for many endangered species in many parts of the world.

Now consider the potential impact of the WTP for panda lands on the panda's plight. A conservative estimate (using the median WTP and assuming 5 million foreign western tourists to China (1997 figures)) provides a figure of US$50 million per annum for the Wolong reserve which amounts to US$250/hectare. If the local people continued to receive a royalty of 4%, this would amount to a return of US$10 per hectare for them (under the existing benefit sharing regime). This would increase the returns from reserve status by a factor of twenty. If these payments were made contingent on the presence of pandas in the reserve, it would likewise greatly enhance the likelihood that the objectives of the local people and the panda conservationists would become congruent. This would then reduce the likelihood of intrusions into the reserve, and reduce the amount of the reserve budget that need be spent on monitoring and enforcement. In the sense that this WTP might be able to translate into a secure tenure by a stable population of pandas, it is apparent that this particular species clearly does have the capacity to purchase its property rights.

There is the clear capacity for using this charismatic species (panda) to acquire its own lands, but is it possible to make use of it as an instrument for nature conservation? The insistence on behalf of management agencies on saving particular species rests partly on the belief that this approach will be able to secure funding for the preservation of its habitat and by consequence of the (potential) biodiversity located wherein.[32] It is widely believed to be the case that charismatic species are the flagships for general nature conservation.

Our study finds that this belief is well-founded. The total WTP for in situ panda conservation can be decomposed into three subcategories: genetic or stock values (27%), animal welfare values (30%) and implicit biodiversity values (43%). Existence values in total (animal welfare and biodiversity values) constitute 73% of the entire bid for *in situ* panda conservation. Thus, a substantial proportion of the value of the giant panda would be lost if *ex situ* conservation were to be pursued exclusively. Almost half of the value given to the species would not be expressed in the context of mere genetic preservation (as opposed to *in situ* conservation). Therefore it makes sense to use such charismatic species as nature conservation “flagships”: there is a lot of added value for conservation that would be wasted if the habitat were not tied to the charismatic species.

But would the habitat be conserved irrespective of the charismatic species? In our study the WTP for *in situ* conservation drops to zero when the probability of survival of the flagship species is low. Hence, biodiversity values in this case are dependent on the preservation of the flagship species. The giant panda is not only a potential instrument for conservation, it is potentially a necessary instrument.

The debate over the most appropriate means for conserving biodiversity is often polarised between advocates of the so-called “species” and “ecosystems” approach to conservation. The former focuses on the protection, both (*in situ* and *ex situ*) of endangered, often high profile, species. The latter seeks to conserve entire ecosystems (irrespective of whether they host any high profile species) with the sole aim of preserving as much diversity as possible (Van Kooten and Bulte 2000). Irrespective of which approach is preferable at a normative level, brief consideration of the results of this study and the prevailing policies indicates that the construct of the charismatic species is now a “fact of life”. For example, Metrick and Wietzman (1996) show that 54% of all wildlife funding in the US is devoted to the conservation of just 1.8% of all listed endangered animals. Moreover, they show that the amount of funding spent on the conservation of a particular species does not depend on ecological criteria (such rarity and degree of endangerment) but rather on the public appeal and "charisma" of the species.

[32] See Metrick and Weitzman 1996 for institutional reasons for why the flagship approach has been preferred.

Therefore, the fate of nature conservation is now inextricably interlinked with the fate of particular charismatic species. The construct of the important endangered species has been created and sold, and policy makers now are going to have to live with the phenomenon. The final issue concerns the costs of the instrument in the pursuit of general biodiversity conservation.

That is, to what extent is the flagship approach capable of contributing to wider biodiversity conservation? Van Kooten and Bulte (2000) identify two conditions for this to be the case: habitats that are species rich in one taxon must also be species rich for others and/or rare and endangered species should occur in species-rich areas. Yet, more often than not neither of these conditions are met. Studies by Prendergast *et al* (1993), and Williams *et al* (2000) show that the flagship approach has little positive effect on biodiversity conservation (for widely accepted ecological definition of biodiversity). This is so because biodiversity hot-spots do not usually host flagship species. Therefore, the costs of the instrument lie in the constraints that exist on the ranges of charismatic species.

Given that the flagship approach is not delivering higher levels of biodiversity conservation then policy makers may be faced with trade-offs between conserving diversity *per se* and certain rare (and perhaps high profile) species (van Koote and Bulte 2000). Alternatively, the policy maker might attempt to educate the population to discard the “charismatic species” approach (at the risk of destroying some WTP for nature conservation), or alternatively attempt to create some new charismatic species that are more closely associated with the various biodiversity hotspots. Perhaps it is time to replace the panda (as the symbol of international nature conservation) with a beetle?

12. References

Alberini, A., Kanninen, B., Carson, R., 1994. A general model for double-bounded discrete choice contingent valuation data. Paper presented at the AERE Session of the ASSA

Alexander, Robert R.(2000) , Modelling species extinction: the case for non-consumptive values, *Ecological Economics* (35)2 (2000) pp. 259-269

Bartholomew, D.J. (1987) *Latent variable models and factor analysis*, London: Griffin

Bateman, I.J, Cole, M , Cooper, P. , Georgiou, S. , Hadley, D. and POE, G.L., (2001a) Visible Choice Sets and Scope Sensitivity: An Experimental and Field Test of Study Design Effects upon Contingent Values, Paper submitted to *The Eleventh Annual Conference of the European Association of Environmental and Resource Economists (EAERE)* University of Southampton, United Kingdom, June 28th - June 30th 2001.

Bateman, Ian J., Antreas Tsoumas,Stavros Georgiou and Ian H. Langford (2001a) Investigating The Characteristics Of Stated Preferences For Reducing Air Pollution Impacts: A Contingent Valuation Study, CSERGE Working Paper GEC 95-30

Bateman, Ian. and Willis, K. G. (Eds) (2000) Valuing environmental preferences : theory and practice of the contingent valuation method in the US, EU, and developing countries New York : Oxford University Press.

Blackorby, C. and David Donaldson (1992) 'Pigs and Guinea Pigs: A Note on the Ethics of Animal Exploitation', *The Economic a Journal*, Vol. 102, No. 415. , pp. 1345-1369.

Blamey, Russell K. (1998) Decisiveness, Attitude Expression and Symbolic Responses in Contingent Valuation Surveys, *Journal of Economic Behavior and Organization*, 34(4), pp.577-601.

Boxall, Peter C. and Wiktor L. Adamowicz. *Understanding Heterogeneous Preferences in Random Utility Models: The Use of Latent Class Analysis.* Department of Rural Economy, University of Alberta Staff Paper 99-02

Van Kooten, Cornelis, G. and Erwin .H. Bulte (2000) The Economics of Nature: Managing Biological Assets, Oxford, Blackwell

Cameron, T.A. and D.D. Huppert (1988) OLS versus ML estimation of Non-market resource values with payment Card Interval Data

Cameron, Trudy Ann, G. Poe, Robert G. Ethier and William D. Schulze (2002) Alternative Nonmarket Value-Elicitation Methods: Are the Underlying Preferences the Same?, *forthcoming Journal of Environmental Economics and Management*

Carson, R.C., N. E. Flores, and N. F. Meade, (2001) ‘Contingent valuation: Controversies and evidence’, *Environmental and Resource Economics*-forthcoming.

Chapman, Stuart (2001) WWF-UK Communication to the BBC World Report, Friday, 16, February, 2001.

Cowen, T. (2001) Animals and Welfare Economics, *Department of Economics, George Mason University Seminar Paper*

Donaldson, C et al (1998) 'Limited Dependent Variables in Willingness to Pay Studies: Applications in Health Care, *Applied Economics*, 30, pp. 667-677.

Fischhoff, B., M.J. Quandrel, M. Kamlet, G. Lowenstein, R. Dawes, P. Fishbeck, S. Klepper, J. Leland, and P. Stroh. (1993) "Embedding Effects: Stimulus Representation and Response Modes." *Journal of Risk and Uncertainty* 6, pp. 211-234.

Fredman, P. (1995). The Existence of existence value: a study of the economic benefits of an endangered species. *Journal of Forest Economics* 1(3): 307-327.

Freeman, M.A. (1993) 'Non-use values in Natural Resource Damage Assessment' in Kopp and Smith (Eds) (1993) *Valuing natural assets : the economics of natural resource damage assessment*, Washington, D.C : Resources for the Future.

Greene, W., 1990. Econometric Analysis, Macmillan, New York.

Hoehn, J.P. (1991) 'Valuing the Multi-Dimensional Impacts of Environmental Policy: Theory and Methods' *American Journal of Agricultural Economies*, 73, pp. 289-299.

Jorgensen, Bradley S. Mathew A. Wilson, Thomas A. Heberlein (2001), 'Fairness in the contingent valuation of environmental public goods: attitude toward paying for environmental improvements at two levels of scope', *Ecological Economics* (36)1, pp. 133-148

Kahneman, D. and J. Knetsch (1992) 'Valuing Public Goods: The Purchase of Moral Satisfaction', *Journal of Environmental Economics and Management* 22, 55-70.

Karppinen, H. (2000) Forest values and the objectives of forest ownership, METLA working paper

Kontoleon, A (1996) Determinants of WTP for Endangered Species: A meta-analysis of contingent valuation studies, *MPhil Dissertation, Faculty of Economics and Politics, University of Cambridge.*

Kontoleon, A and T. Swanson (2002) 'Motivating Existence Value' in Daniel Bromley and Jouni Paavola (Eds.) *Economics, Ethics, and Environmental Policy: Contested Choices*, Blackwell Publishers, 2002.

Kopp, Raymond J. (1992) 'Ethical Motivations and Non use Values' *Resources for the Future Discussion Paper QE92*-10 Washington DC: Resources for the Future

Krutilla, J. (1967). 'Conservation Reconsidered', *American Economic Review*, 57, no 4, pp.777-786.

Langford et al (2001) Use and Non-use values for conserving endangered species: the case of the Mediterranean monk seal, EAERE conference 2001

Larson, D.M. and Loomis J.B. (1994) 'Separating Marginal Values of Public Goods From Warm Glows in Contingent Valuation Studies.' Department of Agricultural Economics, University of California, Davis.

Liu, Jianguo, Marc Linderman, Zhiyun Ouyang, Li An, Jian Yang, and Hemin Zhang (2001) 'Ecological Degradation in Protected Areas: The Case of Wolong Nature Reserve for Giant Pandas', *Science*, 6 April 2001, Vol. 292, pp.98-101.

Loomis, J. and A.G. Caban (1988) A Willingness to pay for function for protecting acres of spotted owl habitat, *Ecological Economics*, 25, pp.315-322

Loomis, J. *et al* (1993). 'Some Empirical Evidence on Embedding Effects in Contingent Valuation of Forest Protection', *Journal of Environmental Economies and Management*, 24, pp. 45-55.

Loomis, J.B. (1988) ‘Broadening the concept and measurement of existence value’, *Northeastern Journal of Agricultural Resource Economics*, 17, pp.23-29.

Loomis, J.B. and K. Giraud (1997) *Economic Benefits of Endangered Fish and Wildlife Species: Literature Review and Case Study of Values for Preventing Extinction of Fish Species,* Department of Agr and Resource Economics, Colorado State University, Mimeograph: 45pp.

Loomis, John, B. and Douglas, S. White, (1996) 'Economic Benefits of Rare and Endangered Species: Summary and Meta-analysis', *Ecological Economics* 18(3), pp.197-206.

MacKinnon, J. & De Wulf, R. (1994) Designing protected areas for giant pandas in China. In: Miller, R.I. (ed). Mapping the Diversity of Nature. Chapman and Hall: London. 127-142.

Mackinnon, J., F. Bi, M. Qiu, C. Fan, H. Wang, S. Yuan, A. Tian, J. Li (1989) ‘National Conservation Plan for the Giant Panda and its Habitat’ *Report Prepared for the Ministry of Forestry, P.R. China and WWF*

Madalla, G.S., 1987. Limited dependent variable models using panel data. J. Hum. Resour. 22, 307–338.

Mäler, K. G. (1974) *Environmental Economics: A Theoretical Inquiry*, Johns Hopkins Press, Baltimore, MD

Meacham, Cory (1997) *How the Tiger Lost Its Stripes: An Exploration into the Endangerment of a Species*, Harcourt Brace and Company, New York. 288 pp.

Metrick, A. and M. Weitzman (1996). ‘Patterns of Behavior in Endangered Species Preservation’, *Land Economics*, 71 (1), pp.1-16

Mitchell, R.C. and Carson, R.T. (1998) *Using Surveys to Value Public Goods: The Contingent Valuation Method;* Johns Hopkins University Press.

Nunes, P. and E. Schokkaert (2002) ' Warm glow and embedding in contingent valuation' under review in Journal of Environmental Economics and Management.

Olney, P.J.S. , G.M. MacE, and A.T.C. Feistner (Eds.) (1994) *Creative Conservation : Interactive Management of Wild and Captive Animals*, London: Chaprman & Hall

Opaluch, J.J. and T.A. Grigalunas (1992) 'Ethical values and personal preferences as determinants of non use values: Implications for natural resource damage assessment' Staff paper, Department of Resource Economics, University of Rhode Island

Payne, John W., *et al*. (2000) Valuation of Multiple Environmental Programs, *Journal of Risk and Uncertainty*;21(1), July 2000, pages 95-115.

Pearce, David W. and Turner, R. Kerry (1990) *Economics of Natural Resources And The Environment*, Baltimore: Johns Hopkins University Press.

Prendergast *et al* (1993) 'Rare Species, the Coincidence of diversity: Hotspots and Conservation Strategies', *Nature 365:335-7.*

Randall, A. and J.P. Hoehn. (1996) "Embedding in Market Demand Systems." *Journal of Environmental Economics and Management*, 30, pp. 369-380.

Rekola, Mika and Pouta Eija (2001) Lexicographic Preferences In Contingent Valuation – Theoretical Framework And Measurement Experiment, A Paper To Be Presented In The EAERE 2001 At Theuniversity Of Southampton, Southampton, U.K. 8 January, 2001

Rollins, Kimberly and Lyke, Audrey,(1998) ‘The Case for Diminishing Marginal Existence Values’, *Journal of Environmental Economics and Management*,6(3), pp.324-44.

Schaller, G.B. (1993) *The Last Panda*. The University of Chicago Press.

Schilderinck, J. H. F. (1978) *Regression and factor analysis applied in econometrics,* Second Edition. Leiden: Martinus Nijhoff Social Sciences Division

Schulze, W.D, *et al* (1998) 'Embedding and calibration in measuring non-use values', *Resource and Energy Economics* 20, p. 163-178

Swanson, Timothy, Wang Qiwen, Andreas Kontoleon, Qiao Xuejun and Catherine Yang (2001) *The Economics of Panda Reserve Management: A Case Study of Wolong Reserve, Sichuan, China.*, Environmental Economics Working Group, China Council for International Cooperation on the Environment and Development, Maryland, USA.

Swanson, T and A. Kontoleon (2000) 'Why Did the protected Areas Fail the Giant Panda? The Economics of conserving endangered species in developing countries' (with Timothy Swanson), *World Economics*, 1(4), pp.135-148.

Van-Kooten, Cornelis, G. and Erwin .H. Bulte (2000) The Economics of Nature: Managing Biological Assets, Oxford, Blackwell

Whitehead, John, C. and Thompson, Carol, Y. (1993) Environmental Preservation Demand:Altruistic, Bequest, and Intrinsic Motives *American Journal of Economics and Sociology*; 52(1), January 1993, pages 19-30.

Williams, P.H., Burgess, N.D. & Rahbek, C. (2000). Flagship species, ecological complementarity, and conserving the diversity of mammals and birds in sub-Saharan Africa. Animal Conservation3: 249-260.

Yen, Steven T, and Jones, Andrew M. (1997) 'Household Consumption of Cheese: An Inverse Hyperbolic Sine Double-Hurdle Model with Dependent Errors' *American Journal of Agricultural Economics*;79(1), pp. 246-51

13. Appendix

Figure 1 Historical Dispersion of Panda Population, Decline of Panda habitat and Distribution of largest Panda Reserves.

Figure 2 Change in the amount of Panda habitat in Wolong before and after the establishment of the reserve in march 1975 (*Source: Liu et al 2001*).

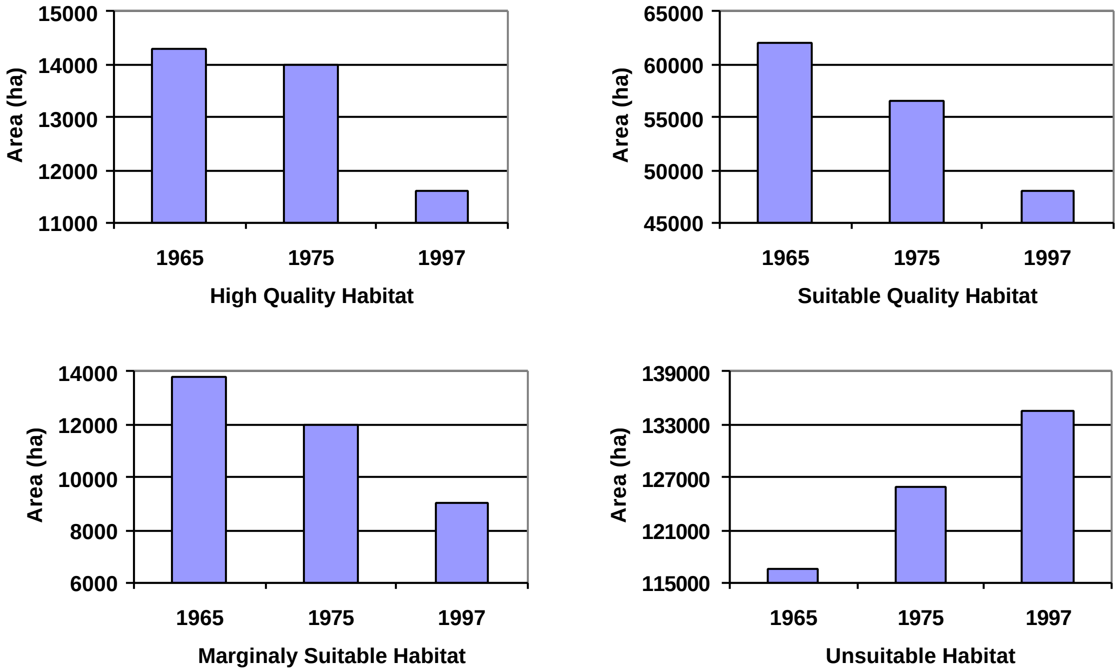


Figure 3 :First Conservation Scenario: Pandas in Cages (100 sq. m.)

Figure 4: Second Conservation Scenario: Pandas in Pens (0.5 ha. per panda).

Figure 5 : Third Conservation Scenario: Pandas in their Natural Habitat (400 ha).

Note: these figures are a subset of the visual aids used in the final survey.

Table 1 Sample Representativeness

	Market share of tourist by country of origin		SURVEY GROUP N=305 (%)	1997 CITS Data	Sample	1997 CITS Data	Sample	1997 CITS Data	Sample
	1993 (%)	1995 (%)	Sample (%)	Income (US$)		Age (years)		% of People with University Degree	
Europe	34.19	30.61	33.88	3600	4328	45	47	0.60	0.64
North America	11.12	11.01	48.67	3850	4721	58	57	0.65	0.75
South/Latin America	1.27	1.54	0.97	3100	3750	48	40	0.78	0
East Asia/Pacific	50.62	56.12	14.51	3650	4179	43	37	0.7	0.8
South Asia	2.21	0.29	1.97	2600	3500	41	37	0.45	0.33
Africa	0.59	0.43	0	-	-	-	-	-	-
	100	100	100	3700	4500	54	49	79	71.4

Source: World Tourism Organization, Yearbook of Tourism Statistics, 1995.; CITS
Note: Figures include only tourists and excluded visitors for the purpose of business, research or any other non-recreational activity

Table 2 Socio-economic Characteristics of Sample.

Socio-economic profile	Percent
Gender:	
Male	50.8
Female	50.2
Marital Status:	
Single	25.3
Married	59.9
Divorced	7.2
Widowed	7.6
Age group	
>20	3.0
20-30	9.2
31-40	13.1
41-50	21.6
51-60	23.6
61-70	19.0
over 70	10.5
Mean Age: 49 years old	
Education	
Primary School	1.6
High School	14.5
Vocational training	9.9
University/College Degree	48.7
Postgraduate Degree	22.7
Occupation	
Not working	6.4
Looking after house full time	5.7
Employed part-time	7.0
Retired	31.1
Employed full-time	49.8
Average Household Size: 3 people	
Mean Monthly Disposable Income: S$4500	

Table 3. Sample Attitudes Towards the Survey

Opinion about Survey	(%)
Interesting	55.8
Boring	0.7
Too Long	32.7
Difficult to understand	6.5
Partial	4.4

Table 4 Sample Summary Statistics of WTP responses

	WTP_{cage}	WTP_{pen}	$WTP_{reserve}$
Mean	3.90	8.43	14.86
Median	1.00	5.00	10.00
Standard Deviation	5.34	10.13	15.69
Minimum	0.00	0.00	0.00
Maximum	30.00	75.00	100.00
% of zero responses	37.05	24.59	7.54
Sample Size	305	305	305

Figure 6 WTP values for three Panda Conservation scenarios (mean and median figures in 1988 US$)

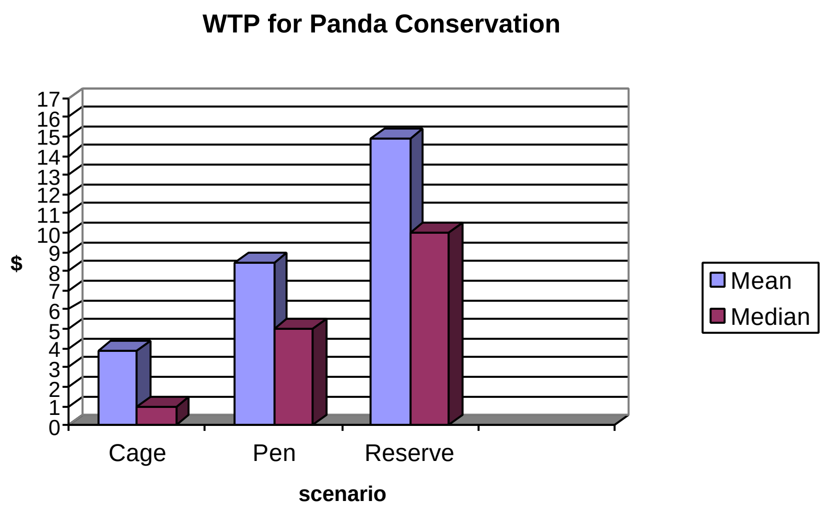
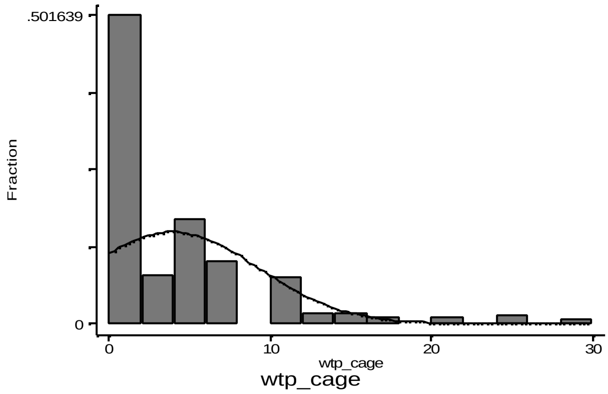
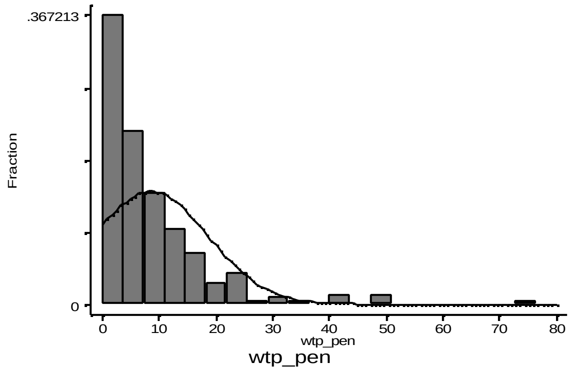


Figure 7 Distribution of WTP Responses.





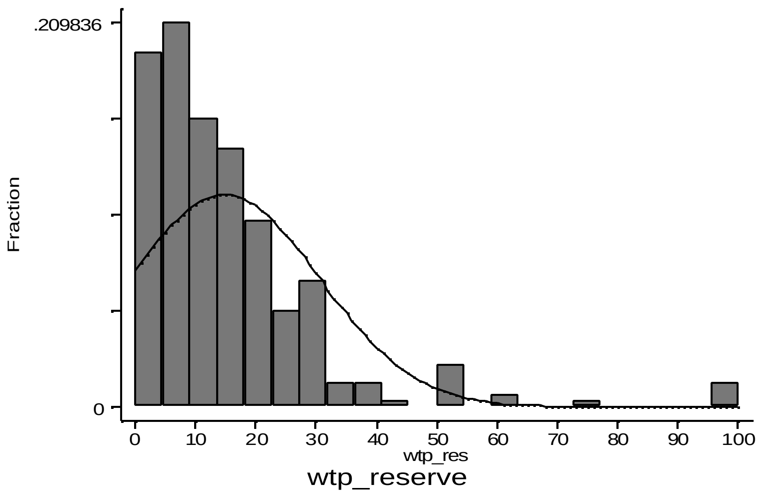


Table 5 Decomposition of WTP for the Giant Panda

	WTP for Total value (US$)	WTP for gene flow (US$)	WTP for wildlife existence value (US$)	WTP for implicit biodiversity values (US$)
WTP_{cage}	3.90 (100%)	3.90 (100%)	0 (0%)	0 (0%)
WTP_{pen}	8.43 (100%)	3.90 (46%)	4.53 (54%)	0 (0%)
$WTP_{reserve}$	14.86 (100%)	3.90 (27%)	4.53 (30%)	6.43 (43%)

Note: percentage of total value in parentheses.

Figure 8 Component values for in situ panda conservation

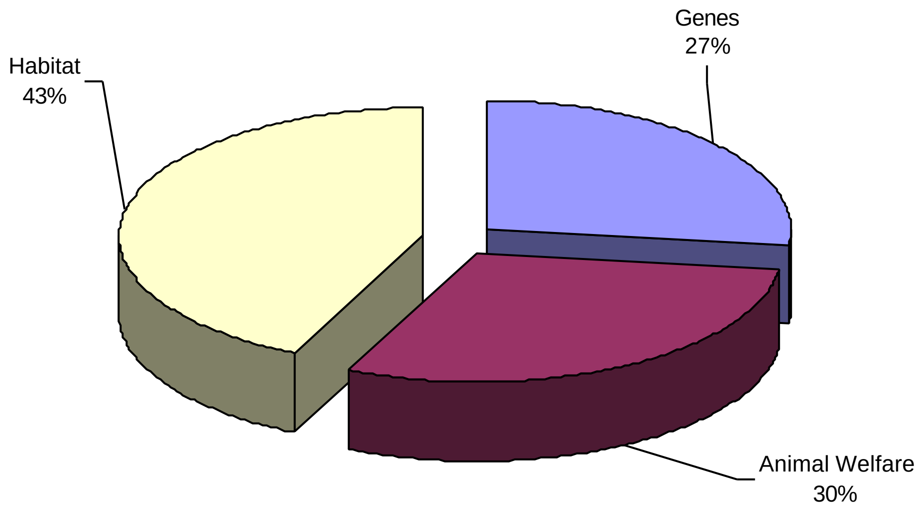


Table 6 Testing for Scope Sensitivity

	$WTP_{pen} - WTP_{cage} = 0$	$WTP_{reserve} - WTP_{pen} = 0$	$WTP_{reserve} - WTP_{cage} = 0$
Mann-Whitney tests for differences in means	Reject 1%	Reject 1%	Reject 1%
Wilcoxon Signed Ranks test for differences in medians	Reject 1%	Reject 1%	Reject 1%

Figure 9 Step function (with trend-line) of diminishing marginal values per hectare (sample values)

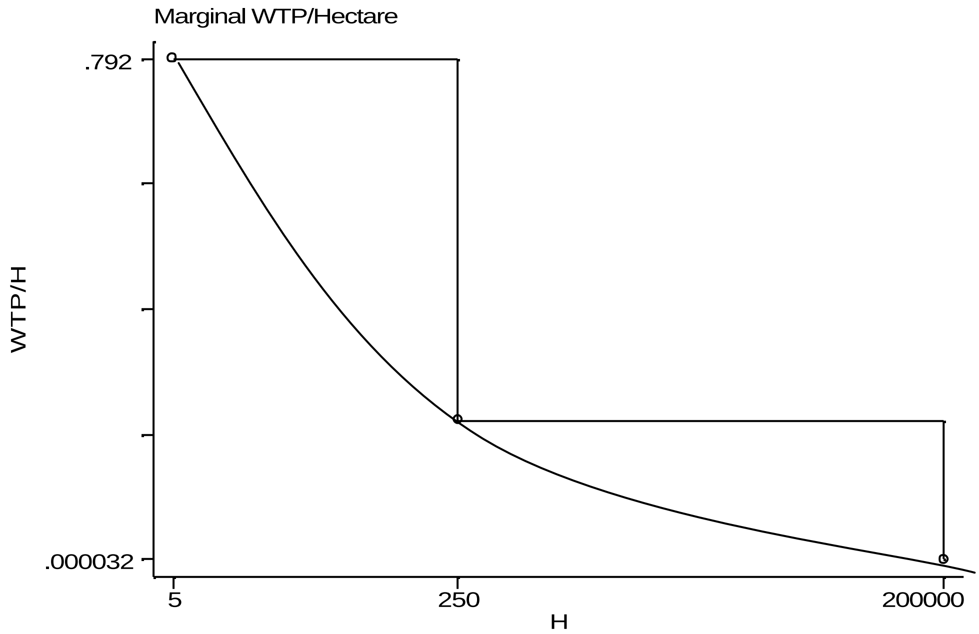


Table 7 Random Effects Tobit

	WTP Pandas			
	Coef.	Std. Err.	t-value	P-value
Variable				
Land (in logs)	1.314	0.071	18.538	0.000
Animal welfare index	3.690	0.728	5.070	0.000
Programme Index	2.129	0.811	2.626	0.009
Income (logs)	7.845	1.095	7.162	0.000
Constant	-68.554	7.917	-8.659	0.000
LnL	-2808.4134			
Wald chi2(4)	497.91			
Prob > chi2	0.0000			
N	915			

Table 8 Estimated Total and Marginal WTP to purchase land for panda conservation

Land protected* (Hectares)	Estimated WTP per individual (US$)	Estimated Marginal WTP per individual per hectare (US$)	Aggregate values per hectare** (US$)
1	0.496968	-	-
5	2.85134	0.09417	470874
50	3.522564	0.03356	167806
200	5.344155	0.01214	60720
250	5.637366	0.00586	29321
1000	7.458957	0.00243	12144
5000	9.573758	0.00053	2644
20000	11.39535	0.00012	607
50000	12.59935	0.0000401	201
100000	13.51015	0.0000182	91
150000	14.04293	0.0000107	53
200000	14.42095	0.0000076	38
250000	14.71416	0.0000059	29
300000	14.95373	0.0000048	24
350000	15.15628	0.0000041	20

**5 hectares corresponds to the entire cage scenario, 250 to the pen and 2000 to the reserve sceanrio.*
***Assuming 5 million tourists*

Figure 10 Predicted Diminishing Marginal WTP/Hectares from random effects Tobit

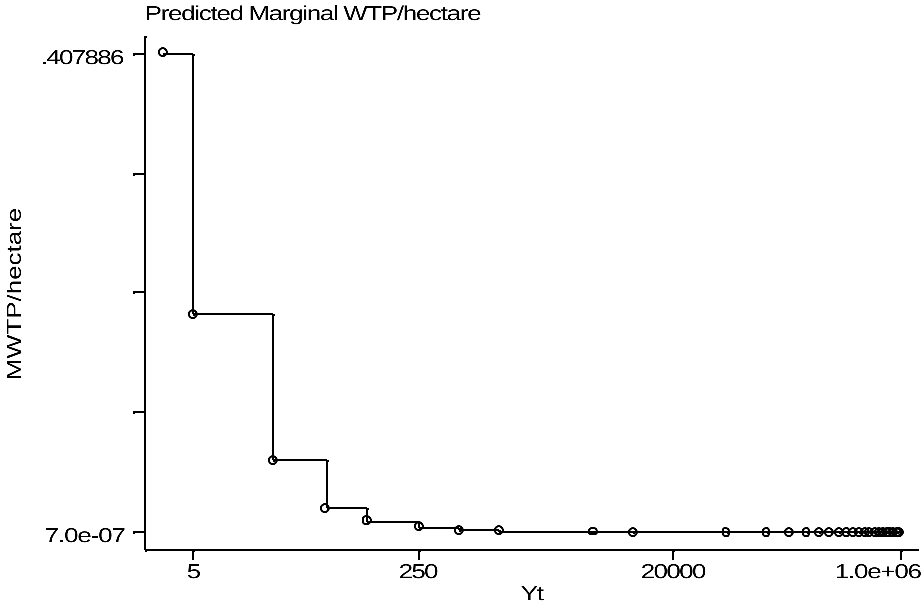


Table 9 Description of independent Variables

Name of Variable	Description
Income (logs)	Personal disposable annual income in 1998 US Dollars
Sex	1=male; 0=female
Age	In years; Range 18-70
Programme Index	Index of subjective assessment of the credibility of the panda conservation programme. Respondents provided answers on five-point Likert scale to the questions: 1. What kind of support do you think the Wolong Panda Conservation Programme would receive from foreigners visiting China? 2. Do you think that the airport tax increase described above is a fair method of financing the expenses connected with the implementation of the Wolong Panda Conservation Programme? 3. To what degree do you trust the capabilities of the relevant authorities to implement and enforce conservation measures for Giant Pandas if they have adequate funding? 4. If the Wolong Panda Conservation Programme would be implemented, do you think it would attain the desired conservation objective (e.g. sustaining a population of 500 Pandas)? Calculation of index: $\left(\sum_{1}^{4} m_i\right)/5$ Range 1-5
Use/Non-use index	Index of *relative* importance of instrumental or use over non-instrumental or non-use reasons for wanting to preserve the Giant Panda. Calculation of index: $\frac{\sum \text{score of responses}}{\text{\# of responses}}$ Range: 0-5
Animal welfare index	Factor score from factor analysis.
Ethics index	Factor score from factor analysis.
Sympathy Index	Factor score from factor analysis.

Table 10 Results of Factor Analysis

	Factor Loadings		
	Factor 1 *(Animal welfare)*	Factor 2 *(Ethics)*	Factor 3 *(Sympathy)*
Green Foods food	0.28	0.10	0.54
Vegetarianism	0.07	0.60	0.02
Pet Ownership	0.12	0.09	0.53
Willingness to wear fur	0.37	0.06	0.09
Willingness to use cosmetic tested on animals	0.64	0.14	0.22
Willingness to use medicine tested on animals	0.15	0.61	0.13
Willingness to support ban on leg hold traps	0.71	0.07	0.08
Willingness to support for animal welfare society	0.69	0.08	0.10
Eigenvalues	**2.1**	**1.32**	**1.01**

Table 11 Comparison of determinants of WTP for gene, pure animal welfare and implicit biodiversity values.

	WTP_{cage}				$WTP_{pen-cage}$				$WTP_{reserve-pen}$			
	Coef.	Std. Err.	t-value	P-value	Coef.	Std. Err.	t-value	P-value	Coef.	Std. Err.	t-value	P-value
Participation Decision												
Use/Non-use index	4.87	1.34	3.63	0.00	-	-	-	-	-	-	-	-
Animal welfare index	1.63	0.67	2.45	0.01	-	-	-	-	-	-	-	-
Ethics index	-1.56	0.57	-2.74	0.01	-	-	-	-	-	-	-	-
Sympathy Index	-1.19	0.61	-1.95	0.05	-	-	-	-	-	-	-	-
Programme Index	0.18	0.60	0.29	0.77	-	-	-	-	-	-	-	-
Income (logs)	-0.39	0.53	-0.74	0.46	-	-	-	-	-	-	-	-
Sex	0.54	0.68	0.80	0.42	-	-	-	-	-	-	-	-
Age	-0.03	0.02	-1.44	0.15	-	-	-	-	-	-	-	-
Constant	-0.82	4.90	-0.17	0.87	-	-	-	-	-	-	-	-
Payment (WTP) Decision												
Use/Non-use index	0.75	0.23	3.34	0.00	-0.86	0.23	-3.74	0.00	-2.14	0.29	-7.49	0.00
Animal welfare index	1.29	0.31	4.12	0.00	1.76	0.38	4.68	0.00	1.29	0.36	3.62	0.00
Ethics index	-0.42	0.32	-1.29	0.20	0.77	0.37	2.08	0.04	0.40	0.31	1.30	0.19
Sympathy Index	-1.04	0.37	-2.84	0.01	1.26	0.41	3.08	0.00	0.38	0.35	1.08	0.28
Programme Index	1.05	0.35	2.99	0.00	1.09	0.39	2.80	0.01	1.32	0.39	3.41	0.00
Income (logs)	2.20	0.50	4.44	0.00	1.46	0.58	2.49	0.01	2.74	0.53	5.12	0.00
Sex	0.44	0.48	0.91	0.36	-0.58	0.49	-1.17	0.24	-0.31	0.45	-0.69	0.49
Age	0.01	0.01	0.38	0.71	-0.05	0.02	-2.87	0.00	0.00	0.01	0.33	0.74
Constant	-19.03	4.01	-4.74	0.00	-6.58	4.15	-1.58	0.11	-18.68	4.13	-4.52	0.00
σ												
Sex	-0.29	0.11	-2.55	0.01	-	-	-	-	-0.22	0.11	-2.06	0.04
Age	-0.01	0.00	-1.90	0.06	-	-	-	-	-	-	-	-
Income (logs)	-	-	-	-	0.65	0.14	4.57	0.00	-	-	-	-
Constant	1.64	0.23	7.20	0.00	-3.69	1.05	-3.50	0.00	1.24	0.13	9.62	0.00
ρ	0.58	0.21	2.76	0.01	-	-	-	-	-	-	-	-
θ	0.18	0.04	4.85	0.00	0.12	0.03	3.94	0.00	0.19	0.03	5.76	0.00
lnL	-603.51656				-555.90938				-669.98419			
Wald chi2(8)	20.54				81.37				82.61			
Prob > chi2	0.0085				0.000001				0.000001			
Sample	305				203*				282*			
Model	IHS Dependent				IHS Tobit				IHS Tobit			

Notes" not all individuals provided data on differences.*

Table 12 Summary Statistics of WTP values for Panda conservation when probability of panda survival is low.

	WTP (US$)
Mean	0.10
Median	0
Standard Deviation	0.43
Minimum	0
Maximum	3
% of zero responses	95%
Sample Size	305