Value of the Yanchep Caves: Assessing Yanchep National Park Visitor's Willingness to Pay for Environmental Improvement to the Caves

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SUMMARY

Climate change is threatening valuable ecosystems all over the world with extinction. In most cases, preserving or restoring these affected ecosystems requires continual efforts that come at a significant cost to society. Under resource constraints, often the decision about which system to preserve artificially must be made in conjunction with social values. This paper tackles this important issue of eliciting societal preferences over artificially maintaining threatened ecosystems at significant costs through a survey of visitors, and by applying a non-market valuation technique.

Caves in Yanchep National Park support important ecosystems, but their level of environmental quality is threatened by falling groundwater levels. The problem concerns a declining population of stygofauna, which are groundwater invertebrates that live in only seven of the cave water systems in Western Australia. Survival of these species requires the groundwater table to be high enough to fill the cave floor. However, the groundwater table has fallen below this optimal level. A decision has been made to ensure the survival of the stygofauna by artificially pumping water into the caves to raise the groundwater table.

The state government, through the Department of Environment and Conservation (DEC), has invested $1.7M in developing a bore, a piping system, and a water-filtering system for the Yanchep Caves Recovery Project. On top of all the capital expenditure is the ongoing cost, which is estimated to be $110,000 per year. If there is no government subsidy for the ongoing costs of the pumping project, Yanchep National Park will have to raise funds from elsewhere. This situation raises the question of whether visitors are willing to pay to support the project and to have an artificially maintained state of the environment.

A double-bounded contingent valuation method over two payment vehicles was used in this study to estimate how much visitors to the park are willing to pay towards preventing a further drop in the water level in the caves. The survey used double-bounded dichotomous choice questions to measure respondents’ willingness to pay (WTP) for higher entry fees to the National Park and the caves in order to meet the costs of the cave restoration project. The probit model estimated that the median WTP for park entry was $13.85, which represents an increase of $3.67 on the current adult entry fee. Median WTP for cave entry was $9.95, an increase of $3.45 on the current fee for adults. These increases would raise annual revenue by $184,800 per year for park entry, and $61,056 per year for cave entry. Although consistent with the ’user-pays’ principle, raising the cave entry fee only will not, unfortunately, be sufficient to cover the ongoing costs of the restoration project of $110,000 (which includes electricity, general maintenance and replacement of parts). Yanchep National Park may have to consider raising the park entry fee to help supplement the cost. The model also indicated that WTP responses were influenced by visitors’ perceptions of the restoration project, their confidence in its success, and whether or not they intend to visit the caves in the future.
1. INTRODUCTION

Water systems in the Yanchep caves have dried due to the falling water table of the superficial aquifer on the Gnangara Mound. This is mainly due to reduced rainfall as a result of climate change, but also due to ongoing abstraction for urban water use, irrigation of agriculture crops, and water use by the pine plantation upstream of the caves (F Felton, DEC, pers. comm. 2006). Groundwater Dependent Ecosystems (GDEs) that rely on the caves systems require access to groundwater to maintain their ecological structure and function. If the groundwater level, which is mostly fed by rainfall and recharge into the superficial aquifer, drops below a certain threshold, these species will have to adapt to less water or they will die. Unfortunately, it is unlikely Perth’s rainfall will increase in the near future; therefore the water demand for scheme water, agriculture, and the pine plantation from the Gnangara Mound will continue to impact the cave ecosystems.

Groundwater table abstraction is necessary for residential and commercial use. Approximately 165GL of water is abstracted from the Mound for potable use. The commercial pine plantation that covers an area of approximately 22,000 hectares on the Gnangara Mound is also suspected of having an impact on groundwater table decline. These pines were planted by the state as a resource for the building industry (DoIR, 2003). Pine trees use more water than native vegetation as they grow quickly and have relatively high evapotranspiration. Hydrological studies show that the water table will rise under the pines significantly once the plantation is cleared, and the eventual clearing of the entire plantation was predicted to increase annual recharge by 36GL (DoIR, 2003). The government already has a contract with the Laminated Veneer Lumbar Plant until 30 June 2029 under the Wood Processing (Wesbeam) Agreement Act 2002. This rules out short-term removal of the pines upstream of the cave as an option for raising the water table downstream to the cave floors.

The superficial aquifer is also tapped for bore water by horticulturists in a region south-west of Yanchep National Park, as well as homeowners, industry, local authorities, golf courses, etc. Each year 66GL of groundwater is pumped from the Mound to irrigate horticulture crops in Wanneroo. Water usage from many of these irrigation pumps was not monitored until the recent implementation of the Metering Program, where commercial bores extracting over 0.005GL (or ≈5ML) per year are being issued with meters (DoE 2005). The program may help to reduce abstraction, but there is no other incentive, nor is there a penalty to encourage bore owners to reduce use.

The Yanchep caves are an important social good for both cave visitors and those who value their existence. The caves also hold significant environmental value, as they contain GDEs called root-mat communities. These are formed when tuart trees (Eucalyptus gomphocephala) send their roots into the cave pools and streams, creating a habitat for rare and often endemic organisms. These communities are under threat due to the falling groundwater table, and...
several caves are already dry. Artificial recharge appears to be the only option for sustaining the Threatened Ecological Communities (TECs).

The government responded to the declining water levels by creating an Interim Recovery Plan (IRP) for the caves (English et al. 2000). The IRP recommended that the Caves Recovery team construct a pumping operation that will re-fill five caves with water from the superficial aquifer. The objective is to reinstate and protect the TECs. Currently, several government departments are investigating future land-use options for the Gnangara Mound. This project is gathering and integrating ecological, economic and social information to determine the consequences of future groundwater recharge scenarios. The predicted outcomes will inform Gnangara Mound decision-makers as well as the community. The value the public places on the Yanchep caves is useful for this project, as it is indicative of the social value of the Gnangara Mound.

The Department of Water (DoW) has held several stakeholder workshops in order to improve Gnangara Mound management. The first was in November 2004, and participants decided a broad, long-term management strategy should be developed which integrated all state government agencies (URS 2005). A second study in 2005 focused on the social values attached to wetlands, caves and other groundwater-dependent ecosystems on the Gnangara Mound by government employees (state and local), and interest groups such as researchers and community groups (URS 2005).

The ecosystems were ranked by interview and workshop participants and placed into four categories of importance. Crystal Cave and Loch McNess were both placed in category 1, the highest overall in situ social values, while Water, Car Park, Twilight and Boomerang Caves (all as one feature) were in category 3. However, the raw data shows eight out of 10 participants placed these caves in the first category, with four of these people citing root-mats or research potential as reasons. This is significant, as it shows that once people are informed of the caves’ ecological importance, they perceive them as valuable.

Gilgi and Cabaret Caves were not included because they were dry at the time and therefore not linked to the Gnangara Mound. This is interesting because both Gilgi and Cabaret were named in the seven critical habitats fed by groundwater that contain root-mats (habitats critical to the survival of the TECs) in the IRP (English et al. 2000).

The third workshop discussed the artificial watering issue. This issue was supported by the government representatives, but several others believed it was simply a band-aid solution and that the cause of the problem should be addressed (Beckwith 2006). Interviewees were also asked to describe the social water requirements of the caves, which are the water characteristics required to maintain the social values (Beckwith 2006). For Crystal Cave, the common view was to improve water levels through re-watering in order to maintain the tourism/education social value of the cave (Beckwith 2006). For the other four caves, stakeholders felt research values should be maintained, but believed the lack of water would reduce social value for cave enthusiasts (Beckwith 2006).

To maintain water levels and aquatic communities, water is being pumped into the caves. This presents the problem of whether the public’s perceived value of the caves is high enough to justify this cost. The caves are public environmental goods, and the value of these types of goods cannot be measured by direct reference to any market price (Bateman et al. 2002). Non-market valuations have been developed to solve this problem.
This valuation study will ask how much the public is willing to pay to artificially pump water back into the caves to maintain the water level. This is important for the environmental water allocation to the groundwater-dependent ecosystems, as it is often determined by the public’s perceived importance of the ecosystem relative to commercial interests. It is also possible that the public does not value water in the caves. This could be the case if the public’s recreation value is greater when the caves are dry and if this recreation value is higher than the conservation value.

The report begins with an introduction to Yanchep National Park and its caves. This is followed by a review of literature in terms of methodology and existing valuation studies. Specifically, non-market valuation techniques will be reviewed to determine a suitable choice for the Yanchep caves. Survey and sampling techniques, as well as the questionnaire design, are also explained in the following section. This is then followed by results from the survey and data analysis. The final section discusses the conclusion and offers suggestions for future research.

2. STUDY SITE

Yanchep National Park is located 51 kilometres north of the Perth CBD (see Figure 1), and covers an area of 28.5km² (DEC, 2007). Yanchep contains one of the few tuart woodlands remaining in the Perth region and therefore has a high ecological value. The park also contains about 300 limestone caves, seven of which contain highly threatened and highly valued root-mat communities (English et al. 2000). These caves are formed when the tuart tree roots grow deep into the ground to reach the water table and the water pools inside the caves (English et al. 2000).
Yanchep National Park received approximately 212,000 visitors in the 2005/06 financial year, with 20,000 people participating in cave tours (J Kemp, DEC, pers. comm. 2006). Figure 2 reports the number of visitors from 2002 to 2007. Only Crystal Cave is open daily, while Cabaret Cave is available for special events such as the annual Halloween Dinner. Entry to Yanchep National Park is $10.00 per car, and a cave tour costs $6.50 per adult.

There are seven caves containing the root-mat-dependent invertebrate community: Crystal, Cabaret, Boomerang, Water, Car Park, Twilight and Gilgi Caves (English et al. 2000). These are the seven priority caves that are subject to conservation work. The root-mats support rare stygofauna said to be Gondwanan relic species (in existence for at least 100 million years), and were recognised as TECs by the Commonwealth Department of Environment and Heritage (DEH) in 2000 (English et al. 2000). The Interim Recovery Plan — aquatic root-mat community of caves of the Swan Coastal Plain, 2000–2003 — was developed by the Department of Conservation and Land Management (CALM) and Environment Australia for the DEH in November 2000. This document highlighted the decline in the TECs and outlined the recovery actions which would be undertaken to reclassify the TECs from critically endangered to endangered or vulnerable (English et al. 2000).

There have been several recovery actions implemented by DEC in association with the Water Corporation and the Department of Water. The first, in 2003, pumped water from a surface stream into a pond adjoining Cabaret Cave for twenty days. The water level rose to 15cm above the cave floor, then up to 20cm when the trial was extended. In October 2003 a trial was conducted in Crystal Cave, raising levels to 10cm above the floor. These trials led to the installation of a pumping bore in June 2005. This pumped 2.6ML/day into the caves for a month, but stopped due to high iron-oxide concentrations in the bore water. This project cost approximately $1.5M, and it will continue after the installation of water filters designed to remove iron from the water (F Felton, DEC, pers. comm. 2006).

Groundwater hydrographs by Yesertener (2006) show that the water table in the caves area fell by over 1.0m in 10 years (1994–2004). He found that the hydrographs suggested that a drier climate is the biggest factor in the groundwater decline. Models were also used to estimate the

![Figure 2 Number of visitors to Yanchep National Park and Crystal Cave per year](image-url)
groundwater levels needed to be reached in order to maintain pools in the seven caves. He found that levels under Crystal Cave would need to rise by a minimum of 1.35m in 2005, and 2.25m in 2015. The total artificial recharge required to maintain all seven priority caves to 2015 is up to 3.5GL/yr (9600 m³/day) (Yesertener 2006).

Costs for the pumping project’s infrastructure — including the costs of sinking a bore, and building a pumping station and water treatment plant — were met by the DEC. In total, these were estimated to be $1.75M, comprising $1.1M for the bore and pipe work, and $650,000 for the water filtration system (P Brown, DEC, pers. comm. 2008). The lifespan of capital investments is expected to be 10 to 15 years. The running costs of the pumping, which include electricity, equipment replacement and general maintenance, are estimated to be $110,000 per year (P Brown, DEC, pers. comm. 2008). The pump is capable of pumping more than 4.8ML per day into the caves, and it is hoped this will create a ‘mini-groundwater mound’ so the water does not simply drain away. There should not be an impact on the superficial aquifer, as it will be a closed system with no net loss from the Mound (F Felton, DEC, pers. comm. 2006). This expenditure needs to be justified to ensure that funding is being spent on an investment with sufficient value. Therefore this paper will aim to measure the value derived from recreational use of the caves and the non-use value that Perth residents place on the caves.

3. LITERATURE REVIEW

3.1 Previous valuations of caves and environmental assets on the Gnangara Mound

There has been an increase in the number of studies undertaken to determine the value of environmental assets on the Gnangara Mound due to the competing uses of its ground water. There is a need for an optimal land use and land management design that will allow for increase of recharge to help maintain the ecological requirement, while not compromising other uses such as agriculture and potable water. Roberson (2005) applied choice modelling to determine community preferences for future land use on the Gnangara Mound through their WTPs. He found a community preference for nature conservation areas rather than the current pine plantations. Through increased taxes, respondents were willing to pay up to $7.34 per person per year to have a 1% increase in nature conservation area.

Tapsuwan et al. (2007) estimated the value of urban wetlands in the suburbs of Cambridge, Stirling and Vincent in the western suburbs of Perth metropolitan. They found that artificially maintaining the water level in Perry Lakes instead of letting the area dry out could have an impact on the property value of surrounding houses by around $54M.

There have also been studies to look at the in situ value of environmental assets on the Mound. Beckwith (2006) interviewed experts and community representatives regarding the value of the Yanchep caves and reported that Crystal Cave is gaining iconic status and is the main reason people visit Yanchep National Park.
Internationally, an extensive amount of literature has been written regarding the economic benefits of national parks; however, only a fraction of this literature addresses the value of caves. Morimoto (2001) measured the extra revenue generated by granting visitor access to special sites such as caves, waterfalls and artisan villages in a World Heritage site in Laos, including charging fees for access. Choice experiment was used to elicit visitors' WTP through a face-to-face survey, and the study found that visitors were willing to pay US$11.74 (approximately AUD$12.65) to visit the Pak Ou caves. However, this is only an estimate of use value and thus the total economic benefit is expected to be significantly higher for these caves. Nagypal (2005), on the other hand, attempted to measure non-use value of the Pál-völgyi and Szemlőhegyi caves in Hungary. A one-off payment into the protection fund of the caves was used as the payment vehicle. Nagypal applied open- and closed-ended dichotomous choice contingent valuation surveys and found that residents of Budapest were willing to pay $8.01 and $8.94 in the open-ended and closed-ended surveys, respectively. These showed that the public did place value on caves, and was willing to contribute towards their conservation even if they were not planning to visit them. Lewis and Mamingi (2003) applied the contingent valuation technique to estimate the TEV of Harrison's Cave in Barbados. They found that cave-goers were willing to pay 20–22% more for adult entry fee and around 4% more for child entry fee. The new fees would be around $24 and $10 for adult and child, respectively (in Y2000 AUD$ value). They also estimated a WTP for a donation to an environmental fund, to capture the non-use value of the cave. They estimated the WTP for the donation to be around $1.3–1.4M a year. With significant amounts of additional revenue being generated from donations alone, they proposed the creation of a special fund to store the additional revenues obtained from increased WTP by visitors.

On a slightly different note, Coulton (1999) applied contingent valuation to estimate the WTP for the preservation of prehistoric cave paintings in two hypothetical caves in the Peak district of the UK. Coulton found that people would be willing to pay US$1–15 (approximately AUD$1.50–16) as a one-off tax payment for the program, depending on the number of caves opened for access and whether the caves would exist for the next 50 years (cited in Navrud and Ready 2002).

3.2 Economic techniques for valuation of environmental goods

The total economic value (TEV) of an environmental good is made up of use and non-use values (Asafu-Adjaye 2000). Use values are values arising from the actual use or consumption of the environmental good (Pearce and Moran 1994). Use values are divided into direct values, such as harvesting timber, and indirect use values, such as clean air from trees. Direct values can be further divided into consumptive values, such as timber harvesting, or non-consumptive values, such as a forests visual amenity (Asafu-Adjaye 2000). Non-use values are values that are not directly related to use or consumption of the environmental good, but which still have an impact on the wellbeing of an individual (Nunes 2002). Non-use values are existence, bequest and option values. Existence value is the value the public places on knowing something is there (Asafu-Adjaye 2000), such as knowing the root-mat communities are alive. Bequest value is the value people gain from being able to conserve something for future generations. Option value is defined by Asafu-Adjaye (2000) as the amount of money someone is willing to pay to ensure a resource is available in the future, should they decide to use it.

The TEV of an environmental good can be measured using non-market valuation techniques. The main methods of non-market valuation can be divided into two categories: the revealed preference (RP) method, and the stated preference (SP) method. The RP method aims to find the value people place on a good from observed behaviour in markets for related goods (Hanley et al. 2001). The major strength of RP methods is that they are based on actual decisions made by individuals or households, thereby giving a more accurate measure of their preferences for goods and/or services (Pearce et al. 2006).
3.2.1 Revealed preference method

The two main revealed preference methods are the travel cost method (TCM) and the hedonic pricing method (HPM). The TCM values the recreational use of an environmental good, such as parks and wetlands, by estimating the cost people incur in order to travel there. The amount people pay for their travel cost should reflect the cost of the environmental good. A demand curve for the environmental good can be constructed based on people's frequency of visits and their travel costs: the lower their travel costs, the more they should visit. However, there are several problems with the TCM that can lead to inaccurate or biased estimates. Firstly, people may make multi-purpose journeys. For example, a visitor to Yanchep National Park may go boating on the lake, go for a bush walk or visit the caves. Measuring the cost of the cave visits only would require dividing the travel costs to Yanchep National Park between all the activities. This process could end up being imprecise, resulting in biased estimates. Secondly, although those living close to Yanchep have lower travel costs, they may have higher values for the site due to selection bias, and the TCM will often understimate their values. Thirdly, people may only visit the site due to lack of options, so their value might be overstated, i.e. they would choose any substitute site as long as it was closer.

The HPM uses market prices of substitute goods to value an environmental resource. The housing market is most commonly used to obtain such values. The HPM is based on the idea that properties are not homogenous: they differ with respect to a variety of characteristics, such as number of bedrooms and bathrooms, lot size, and proximity to parks and schools, etc. Property prices can be affected by all these location-specific environmental, structural, and neighbourhood characteristics. For example, if we have to value wetlands, we assume that properties near wetlands contain a capitalised amenity value for wetland proximity, so when the properties are sold the new buyers have to pay for this amenity value in the form of higher house prices (Loomis and Feldman, 2003). The HPM, however, is data intensive. Data may not be available or may have to be acquired at very high cost.

3.2.2 Stated preference method

The SP method, on the other hand, uses surveys to elicit peoples' WTP or WTA for a change in environmental quality through a hypothetical market environment. This enables the SP methods to capture both use and non-use values of the environmental goods and/or services. The two main types of SP methods are contingent valuation (CV) method and choice modelling (CM). The CV method has been applied extensively to environmental goods since the 1990s. It measures the value of a change from the status quo, such as an improvement in the environmental quality or further environmental damage. It involves asking people, through the use of several interview techniques, whether or not they are willing to pay, and if so how much, to prevent a negative environmental outcome or to have an increase of a particular environmental good or service. Alternatively, respondents could be asked the amount they are willing to accept (WTA) as compensation to forego a particular environmental good or service. According to Willig (1976) the two measures should be the same, but actual experiments have revealed significant differences. The CV method can estimate the total value of an environmental good, such as a national park, by multiplying the average WTP estimated from the survey by the number of visitors to the park.

The CM method is also a survey-based technique for measuring WTP. The environmental good in question is described in terms of its attributes and the levels that the attributes take. Attributes of caves, for example, can include the quality of the stalactite and stalagmite, the water level in the caves, the ease of access, etc. Respondents are presented with various alternative descriptions of the good, differentiated by their attributes and levels. Then respondents are asked to rank the various alternatives, to rate them, or to choose their most preferred. By including the price or cost as one of the attributes of the good, WTP can be indirectly recovered from people's rankings, ratings or choices (Hanley et al., 2001). CM's strength is that it provides an estimate of people's valuation of multiple parts of a good when its
total value is not accessible because there is no market for it (Adamowicz et al. 1998). Choice modelling can also value multidimensional changes because it obtains preferences by asking respondents to choose a bundle of goods from a set, each bundle having different attributes (Adamowicz et al. 1998).

Choice modelling results can be interpreted in standard welfare economic terms (Pearce et al. 2006). Adamowicz et al. (1998) compared the results of a CM and CV study of Woodland Caribou in Canada. They found the CM had several advantages when measuring non-use values: better description of attribute trade-offs people were willing to make; no difference in error variance between the two models; when combined, there was no difference in the parameters of marginal utility of income; welfare variances in the CM were generally smaller than in the CV.

The difference between CV and CM is in the number of alternatives of the goods and services that can be measured. The CV method can measure, usually, only one or two alternatives, whereas the CM method can evaluate several alternatives at one time. Thus, there may be cost savings for CM over CV surveys. Nonetheless, CM surveys can be more complex to create and may confuse respondents, leading to lower completion and response rates, and greater random errors and imprecision in responses (Hanley et al. 1998; Adamowicz et al. 1998). Modelling CM responses and running the statistical tests can also be difficult with surveys that have a large number of attributes, levels and choices (Adamowicz et al. 1998). Conversely, an advantage of CM is that it generally requires respondents to simply tick their most preferred option, and this may avoid the response and bias problems found in CV, where respondents may find it difficult to come up with specific dollar amounts (Pearce et al. 2006). However, this problem can be overcome through employing better elicitation techniques.

There are several CV questionnaire formats to elicit the value the respondents place on a good or service. These can be discrete choice methods, which include bidding games, payment cards and dichotomous choice questions, or they can be in the form of an open-ended question (Bateman et al. 2002). In the bidding game format, respondents are asked a series of choice questions until an estimate of their maximum WTP is found (Hanemann et al. 1991). This yields a high level of precision but requires more effort by respondents, something that should be minimised to achieve acceptable response rates (Hanemann et al. 1991). For the payment card method, the respondent is presented with a card with a dollar value that usually indicates how much people in the same income category as the respondent pay on average for the good. The respondents are then asked what value they place on the good (Mitchell and Carson 1981). However, respondents may have difficulty answering an open-ended question if they have never valued an environmental good before. Dichotomous choice (DC) formats can overcome this problem because respondents are offered a certain starting dollar amount (or so-called starting bid value). They simply have to say yes if they are willing to accept the bid, or no if the bid is higher than their WTP.
The DC format can be expanded to the double-bounded dichotomous choice (DBDC) method, where a second bid is elicited from the respondent, who sees a higher (lower) bid if they answer yes (no) to the first question (Carson et al. 1986). Because more information can be obtained from each respondent, biases and variances are generally lower than single-bounded models (Langford et al. 1996; Hanemann and Kanninen 1999). Hence, DBDC improves the statistical efficiency of the WTP estimate (Hanemann et al. 1991). They also found that in their dataset, the confidence intervals for the WTP measures were much smaller in the double-bounded format.

There is a strong argument for using SP methods, but the most contentious issue is their associated biases, such as hypothetical bias, bid vehicle bias, etc (Carson et al. 2001). Results from early CV studies were often debated, but improved study design led to valuations becoming more widely used and generally accepted (Carson et al. 2001). There are many validity tests designed to identify biases in results; the two main strands of testing are content/face validity, and construct validity (Bateman et al. 2002). Correct questionnaire design will minimise the effects, and any biases in answers will result in their deletion from the results. However, here we do not attempt to explain in detail non-market valuation techniques. For more extensive reading, such as suitability of each technique for different environmental issues, advantages and disadvantages and biases, see, for example, Mitchell and Carson (1989), Bateman et al. (2002), Freeman (2003).

3.3 Survey and sampling techniques

A sample frame is chosen by one of two methods: probabilistic, where it is a random sample (every person has an equal chance of being chosen); or non-probabilistic, where the researcher chooses the sample, such as convenient sampling (sample is chosen because of its accessibility) (Bateman et al. 2002).

3.3.1 Survey method

Survey methods include face-to-face, mail-out, internet, telephone and intercept, or on-site (Bateman et al. 2002). These methods vary in terms of cost, data quality and response rates, so the aim is to balance cost with precision. Face-to-face and telephone interviews are costly and time-consuming but can yield high-quality data, provided bias is not a factor. Gong and Aadland (2006) investigated interview bias and found interviewers did affect the WTP for recycling services. Their view was that environmental goods are prone to this bias because respondents are not familiar with valuing them. Mail-out surveys are relatively easier and cheaper than interviews, but often have low response rates and long response times (Bateman et al. 2002). Gong and Aadland (2006) found that interviewers can influence respondents, possibly to the extent that they will overstate their WTPs due to the presence of the researchers. The internet is now widely used for research purposes, and surveys can be circulated through email, hosted on websites, or conducted by survey companies (Zhang, 2000). The use of survey companies has several advantages: the cost is usually between that of mail-out and telephone surveys; responses are received quickly; surveys are usually completed in full; and it is possible to choose which demographic group you wish to target (Fricker et al., 2005). However, non-response bias (not replying or returning invalid surveys) when using email invitations can be large and variable. Manfreda and Vehova (2002) found follow-up emails and incentives such as prizes did improve the response rate.

3.3.2 Hypothetical market scenario

When valuing environmental goods that are not normally traded in the marketplace, a hypothetical market scenario needs to be created. A hypothetical market is established for a
non-market good in the absence of market prices in order to estimate the values (Bateman et al. 2002). Information describing the scenario is included in CV surveys, so respondents are aware of what goods and services are of interest in this hypothetical marketplace. It is important to provide respondents with sufficient information for their decision-making. The short-coming of a hypothetical market scenario is that WTP estimates may suffer from hypothetical bias. Generally, the WTP estimates are biased upwards, due to the hypothetical nature of the payment commitment (Bateman et al. 2002). Murphy et al. (2005) and List and Garret (2002) provide evidence that hypothetical bias is a factor in public good valuations. Some economists have had success with using “cheap talk” (which entails reading a script that explicitly highlights the hypothetical bias problem before participants make any decisions) as a means of generating unbiased responses (Murphy et al 2005).

3.3.3 Payment vehicle

Another important element to stated preference surveys involves choosing the most appropriate mechanism to elicit the WTP, which is referred to as the ‘bid or payment vehicle’. An appropriate payment vehicle needs to be chosen for the CV survey. Common payment vehicles are donations, taxes, fees and levies (Bateman et al. 2002). Entry fees are a coercive payment, as you have to pay the fee if you want to visit Yanchep Park and the caves (Pearce et al. 2006). Non-coercive payments are voluntary and are usually in the form of donations. Studies that use voluntary payments can suffer from the free-rider problem, where respondents overstate their WTP for a good in order to increase the chance of its provision (Carson et al. 1999); these respondents may not actually intend to pay for the good in question. Alternatively, respondents can overstate their WTP due to the warm-glow effect. The warm-glow effect is when respondents overstate their WTP because it gives them a sense of moral satisfaction (Bateman et al. 2002). Gong and Aadland (2006) measured preservation values by asking the WTP for a special tax levied by the government. This could have problems with protest bids, where people understate their WTP because they are opposed to tax increases and act strategically when responding to WTP (Asafu-Adjaye, 2001).

4. METHODOLOGY

In order to find the total economic value (TEV) of the Yanchep caves, a non-market valuation study must be conducted. Part of the TEV of the caves can be reflected in the fees being generated from visitor payment. However, this only reflects the use value and not the full economic value of the caves. There are other non-use values, such as bequest and existence value, that could not be captured by simply using the cave entry fee. The public may value the caves for several reasons, such as the enjoyment of visiting them (use values) or the knowledge that the cave inhabitants are protected (non-use values). The Yanchep caves have several attributes that could be valued separately, such as the level of accessibility to the public and the number of TECs maintained by artificial recharge. However, the scope of this study is only to measure how much visitors are willing to pay to support the Yanchep Cave Recovery Project, regardless of whether they will be visiting the caves or not. Hence, it is the TEV of the caves to park visitors. Based on the scope of the study, we have found that the most appropriate technique to value the Caves Recovery Project is the contingent valuation method, using double-bounded dichotomous choice questions. This method has been chosen because of its ability to measure both use and non-use values, and for its ease of use for respondents. The survey was distributed to visitors at Yanchep National Park.
4.1 Questionnaire design

The hypothetical scenario in this case study was that the Yanchep Caves Recovery Project required additional funds to cover the annual operating costs of the pumping project, and the funds would be acquired through increased entry fee. The entry fee was the preferred choice in this study, as visitors currently have to pay a fee to access the caves. People visiting the park are required to pay a gate entry fee at park level, and an additional cave entry fee if they choose to see the caves. To replicate this payment system, we have applied two alternative payment vehicles, in that visitors were asked for their WTPs at both park entry and cave entry.

The questionnaire comprised four major parts: (1) questions about respondents’ visits to Yanchep National Park and the caves; (2) WTP questions; (3) items on respondents’ opinions and attitudes towards the caves, groundwater and the pumping project; and (4) socio-economic questions. A copy of the survey can be found in Appendix 1.

The first section contained questions about the respondents’ visiting frequency, time spent at the park, who they came with, activities they undertook, and money they spent. These questions were formulated to assess their visiting behaviours; in other words to find out whether they were repeat visitors of both the park and the caves, as well as their stated intent of future visitation. Several questions in this section were included in the survey to make it possible for a travel-cost method valuation to be completed in the future. This survey also aims to capture option value, where visitors or respondents would be willing to pay to able to visit the park and/or the caves again in the future, should they wish to. All respondents were therefore asked in the questionnaire whether they intended to revisit the park and the caves.

With environmental valuation-type questionnaires, there is a possibility that respondents may have difficulty judging the value of the environmental good. In other words, respondents might not know how much they value the caves and how much they would be willing to pay for the Caves Recovery Project. Applying a closed-ended questionnaire to elicit WTP can help overcome this problem. The CV with DBDC format is suitable for this study for a couple of reasons. Firstly, the entry fee already exists as a payment vehicle; therefore, respondents may not find it difficult to simply respond with an ‘accept’ or ‘reject’ to a proposed higher level of entry fees in the dichotomous choice format. Secondly, the current cave entry fee is used as the starting value, hence eliminating starting point bias (Mitchell and Carson 1989).

The questionnaire contained two sets of DBDC questions: one for park entry fees and the other for cave entry fees. Because cave entry fees are charged separately from park entry fees, it was appropriate to separate the DBDC questions of the two payment vehicles. Each DBDC question was followed by an open-ended question that was to be completed by respondents who answered yes-yes or no-no. The latter is designed to identify those who are not willing to pay any additional money for the Recovery Project (i.e. WTP = $0). It was also predicted that some respondents’ WTP could be less than the current fee. Figure 3 shows the DBDC question format used in the survey.

Respondents were reminded of the current park and cave entry fee structure before answering the DBDC questions. They were also told that the entry fees may have to be increased due to the increased funding required to support the Caves Recovery Project. The amount of increase is uncertain at this point, as it depends on the ongoing costs and whether visitors are willing to pay to support the project. Currently it costs $10 per car for park entry and $6.50 per person for cave entry. As for the simulated scenario, the respondents’ value of the caves is how much they are willing to pay over the current entry fee. In this study we applied three versions for the entry fees. The proposed WTP bid amounts are presented in Table 1.
Current entry into the Yanchep caves costs $6.50 for one adult. Would you be willing to pay $8.50 for entry, the extra $2 being used to cover the cost of the cave pumping operation?

- [ ] Yes

  If yes, would you be willing to pay up to $10.50 for cave entry?

- [ ] Yes
- [ ] No

If yes, what is the maximum fee you would be willing to pay?

$________________

- [ ] No

If no, would you be willing to pay up to $7.50 for cave entry?

- [ ] Yes
- [ ] No

If you are not willing to pay $7.50, how much would you be prepared to pay?

$________________

---

**Table 1** WTP bid amounts used for the three survey versions

<table>
<thead>
<tr>
<th></th>
<th>Cave entry fee</th>
<th>Park entry fee</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Version 1</strong></td>
<td>7.00</td>
<td>7.50</td>
</tr>
<tr>
<td><strong>Version 2</strong></td>
<td>7.50</td>
<td>8.50</td>
</tr>
<tr>
<td><strong>Version 3</strong></td>
<td>10.00</td>
<td>12.00</td>
</tr>
</tbody>
</table>

Following the WTP questions were five attitudinal questions that required respondents to give a rating on a scale of one to seven. These questions were designed to give an indication of the respondents' opinions of the pumping project and groundwater issues, thus revealing the reasons behind their WTP answers. For example, it was expected that those who had a low level of concern for the cave water levels would have a lower WTP for the pumping project.

The final section of the survey was composed of seven socio-economic questions to ascertain respondents' information on gender, age, education, income, postcode, household description (i.e. couple family with kids), and whether the respondents were members of or donated to an environmental group. It was hypothesized that socio-economic factors may have an influence on respondents' WTP.

### 4.2 Population, sample and survey mode

Due to time and budget constraints, the target population for this study was park visitors only. An on-site intercept survey was chosen as the survey mode. Visitors were handed a copy when they entered the park (one copy per family or group). Face-to-face interviews were not necessary as the questionnaires were designed to be very user-friendly, thus significantly reducing the cost of hiring interviewers. On-site surveys were chosen over telephone and internet surveys because of cost and time constraints.
4.3 Survey implementation

A pilot survey was conducted to ensure that the questions and instructions in the questionnaire were easy to understand, and to assess the average completion time. Findings from the pilot survey indicated that the proposed entry fees may be too low, as the majority of the respondents said yes to all the bids. For statistical analysis, one would expect an even distribution of those that respond yes and no to the first and second bid. For this reason, the upper bid was increased in both the park fee and cave fee for the final version of the survey. Minor changes were made to the wording of some questions, and the suggested completion time was reduced from 15 to 10 minutes.

The survey was conducted at Yanchep National Park over two full weekends, plus two extra Sundays in September 2007. Surveys were handed out to visitors at the three main picnic areas, around the Visitor’s Centre and at the main car park. The sampling method can be classified as an intercept survey; however, the respondents were left to complete the surveys in their own time (i.e. it was self-administered and not a face-to-face survey). A number of respondents chose to complete the survey immediately and return the survey to the surveyor, while other respondents left the surveys at the gate before exiting.

4.4 Statistical analyses

Under the utility-maximising theory, it is assumed that individuals will only accept the entry fee bid if the new bid maximizes their level of utility. The models that are used for CV analysis aim to comply with this theory. The CV response model is linked to the utility theory by the concept of random utility maximisation, which assumes that a component of an individual's preference is unobservable (Hanemann and Kanninen 1999). Here we attempt to explain the basic idea behind the double-bounded dichotomous choice (DBDC) analysis. For a more detailed explanation, please see Hanemann (1984), Hanmann et al. (1991), and Hanemann and Kanninen (1999).

In order to obtain a WTP value, the DBDC data is put into a model that links the responses to the bid amounts. Data obtained from the dichotomous choice questionnaire is used to model the probability (Pr) that respondents answer yes (Pr=1) or no (Pr=0) to the bids. The double-bounded version then adds two more possible responses, giving a total of four possible responses to each valuation question. These responses are defined by Hanemann and Kanninen (1999) as

\[
\begin{align*}
Pr\{\text{yes/yes}\} &\equiv P^{yy} = 1 - G_c(A_u) \\
Pr\{\text{no/no}\} &\equiv P^{nn} = G_c(A_d) \\
Pr\{\text{yes/no}\} &\equiv P^{yn} = G_c(A_u) - G_c(A) \\
Pr\{\text{no/yes}\} &\equiv P^{yn} = G_c(A) - G_c(A_d)
\end{align*}
\]

where \(G_c(\cdot)\) represents the WTP distribution, \(A\) is the initial bid, \(A_d\) is the lower bid, and \(A_u\) is the higher bid. A number of different probability models may be used to estimate the WTP. In this case the simplest model to start off with is the standard normal (probit model)

\[
Pr\{\text{yes}\} = \Phi(\alpha - \beta A)
\]

where \(Pr\{\text{yes}\}\) is the probability of the respondent accepting the proposed bid level \(A\), \(\Phi\) represents the standard normal distribution, \(\alpha\) is the intercept and \(\beta\) is the slope coefficient.
This model is extended for the double-bound data

\[ \Pr\{\text{yes}\} = \frac{\Phi(\alpha - \beta A) - \Phi(\alpha - \beta Y)}{\Phi(\alpha) - \Phi(\alpha - \beta Y)} \quad \text{if } 0 \leq A \leq Y \]

where \( Y \) is income.

The formula is used to generate the log-likelihood function of the model

\[ \ln L = \sum_{i=1}^{n}[I_{yy} \ln P_{iy}^{yy} + I_{yn} \ln P_{iy}^{yn} + I_{ny} \ln P_{iy}^{ny} + I_{nn} \ln P_{iy}^{nn}] \]

One bias associated with the DBDC is that the respondents’ answers to the second bid may not be made using the same utility model as the first bid. Cameron and Quiggin (1994) investigated this issue and proposed the use of the bivariate probit model (biprobit), which allows the utility to be the same or different. The biprobit estimate in STATA 8.0 will indicate if the inconsistency exists, as the coefficients will be different for the two bids. It is possible to pool the bid responses by applying linear constraints to the model \( G^1_c = G^2_c \) to make coefficients the same for both WTP distributions. The responses with pooled bids are defined as

\[ \Pr\{\text{yes/yes}\} \equiv P^{yy} = 1 - G^2_c(A_y) \]

\[ \Pr\{\text{no/no}\} \equiv P^{nn} = G^2_c(A_d) \]

\[ \Pr\{\text{yes/no}\} \equiv P^{yn} = G^2_c(A_y) - G^1_c(A) \]

\[ \Pr\{\text{no/yes}\} \equiv P^{ny} = G^1_c(A) - G^2_c(A_d) \]

The two responses elicited from the DBDC can be analysed simultaneously using a bivariate probit model, or an interval data model, or a mixture of the two (Tiller et al. 1997). Applying Alberini's (1995) bivariate probit model, which is a mixture of the two, a restriction is imposed on the parameters of the two bid values to be identical, as if there was only one bid value affecting the respondents’ decisions on WTP. To test whether this constraint has significantly changed the model, the log likelihood values for the constrained and unconstrained models are compared. If the difference between the two is greater than the associated value from the chi-squared table, then the model has been significantly changed. Median WTP is estimated by dividing the constant term with the coefficient of the fixed (identical) WTP bids.

5. RESULTS

A total of 279 surveys were handed out and 156 completed copies were returned, giving a response rate of 56%. The response rate of 56% is about what was expected. Intercept surveys are generally in the range of 60–75% (Bateman et al. 2002; Richardson and Loomis 2005), but as this survey was self-administered and not face-to-face, the rate was predicted to be lower. There were five responses that were identified as protest bids, based on comments written by the individuals. It was clear that the individuals were not bidding based on their value of the caves, but on their opinion towards visitors paying for the project. These responses were excluded from the data analysis, in accordance with recommendations by Bateman et al. (2002). The open-ended questions may also have identified protest bids, but there were no obvious cases of this in the responses. The highest bid value for the open-ended bid was $20 for both the park and cave entry fee, which was only $2 and $5 higher than the proposed entry fees for the park and caves, respectively.
5.1 Descriptive statistics

Socio-economic data was used in the statistical analysis to determine whether significant relationships existed with the WTP bids. A figure worth noting is the high proportion of females who completed the surveys (Table 2). Income is slightly higher than expected, as the median annual household income in Perth is $56,472 (ABS, 2007). More surprising is the percentage of households in the high-income bracket (annual income over $81,000). A possible explanation is that lower-income earners may favour parks and recreational areas that do not charge an entry fee. Socio-economic variables were checked for collinearity, but none were statistically significant.

Table 2 Summary of demographic data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male: 37%  Female: 63%</td>
</tr>
<tr>
<td>Age</td>
<td>Mode: 36-45 (33%)  Mean: 39.3 ± 12.3</td>
</tr>
<tr>
<td>Household income</td>
<td>Mode: over $81,000 (38%)  Mean: $59,148.9 ± 22,614.5</td>
</tr>
<tr>
<td>Education</td>
<td>Higher education: 51%  Secondary: 20%</td>
</tr>
<tr>
<td>Household</td>
<td>Mode: Couple with children under 15 (43%); Couple without children (or children moved out) (29%)</td>
</tr>
<tr>
<td>Environmental</td>
<td>Belong or donate:15%</td>
</tr>
</tbody>
</table>

Our results indicated that about half the respondents can be classified as infrequent visitors because, on average, they visit once or less than once per year. Most respondents stated that they plan to visit the park in the future, but only about half intended to visit the caves, with a large percentage stating that they were unsure whether they would visit again. Table 3 summarises the respondents’ visitation characteristics and stated future visitations.

Table 3 Summary of Yanchep National Park and caves visits

<table>
<thead>
<tr>
<th>Response</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visits to Yanchep National Park in past year</td>
<td>Mode: 1 visit (51%)  Mean: 2.22 ± 1.57</td>
</tr>
<tr>
<td>Plan to visit Yanchep National Park in future</td>
<td>Yes: 83%  No: 5%  Unsure: 12%</td>
</tr>
<tr>
<td>Visited caves</td>
<td>Yes: 62%  No: 38%</td>
</tr>
<tr>
<td>Visits to caves in total (n=94)</td>
<td>Mode: 1 visit (51%)  Mean: 2.07 ± 1.38</td>
</tr>
<tr>
<td>Plan to visit caves in future</td>
<td>Yes: 52%  No: 22%  Unsure: 26%</td>
</tr>
</tbody>
</table>

Results from the attitude questions indicated that most people do not have strong opinions towards the caves and groundwater (Table 4). For example, over half the respondents answered ‘moderately confident’ on whether the Caves Recovery Project will work and whether,
in the future, there will be water in the caves. This could be because the survey did not go into the scientific details of the pumping project and the hydrological characteristics of the cave groundwater system. Respondents may feel uncomfortable in forming strong opinions in areas where they do not have a lot of knowledge. Despite their lack of confidence in the success of the project, respondents showed a strong support for the Caves Recovery Project.

Table 4 Summary of attitudinal questions

Answers are on a scale of 1 (negative attitude) to 7 (positive attitude), with 4 = indifferent or “not sure”.

<table>
<thead>
<tr>
<th>Response</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concern for water levels in caves</td>
<td>Mode: 4 (38%)</td>
</tr>
<tr>
<td></td>
<td>Mean: 4.71 ± 1.47</td>
</tr>
<tr>
<td>Confidence in Caves Recovery Project being successful</td>
<td>Mode: 4 (54%)</td>
</tr>
<tr>
<td></td>
<td>Mean: 4.11 ± 1.29</td>
</tr>
<tr>
<td>Opinion of pumping water into caves</td>
<td>Mode: 4 (33%)</td>
</tr>
<tr>
<td></td>
<td>Mean: 4.87 ± 1.71</td>
</tr>
<tr>
<td>Groundwater priority – Perth drinking water (1), environment (7)</td>
<td>Mode: 4 (33%)</td>
</tr>
<tr>
<td></td>
<td>Mean: 3.94 ± 1.82</td>
</tr>
<tr>
<td>Groundwater should be pumped into Lake Loch McNess (1) or caves (7)</td>
<td>Mode: 4 (44%)</td>
</tr>
<tr>
<td></td>
<td>Mean: 4.48 ± 1.66</td>
</tr>
</tbody>
</table>

5.2 Bivariate probit results

The STATA 9 statistical software package was used to analyse the bivariate probit model of WTP for both cave and park entry fees. Explanatory variables, such as income, age and attitudes towards pumping were examined to identify any statistically significant relationships. Estimates of the bivariate probit model, restricting DBDC bids to be equal, are presented in Tables 5 and 6 for the park and the caves, respectively. The purpose of estimating two separate models is to capture and compare the effects of the payment vehicle. We are interested in seeing whether visitors would have different WTPs for the Yanchep Caves Recovery project if the payment were to be increased at two separate entry sites. In other words, we are trying to test whether WTP would be different, even for the same environmental cause, if we were to use a different payment vehicle.

Both bid variables (PBID for park entry fee and CBID for cave entry fee) are significant and have the correct sign. Negative coefficients for both variables indicate that, as the bid value or entry fee value increases, the probability of respondents agreeing to pay decreases.

None of the attitudinal questions were significant on their own but were correlated. Therefore, factor analysis was used to jointly estimate the attitudinal variables together as one single variable. Factor analysis is a technique used for determining the extent to which variables are correlated, and which groups those variables together into one combined or latent variable rather than a series of separate variables (Cramer 2003). In this analysis, the variable ATT is the combined attitudinal variable, which is a linear combination of all the variables in Table 4. A high score for ATT represents those that are more environmentally conscious or pro-conservation, and a low score means the opposite. The coefficient of ATT is positive and significant in both models. This means that those that are pro-conservation have a higher WTP than those that are not. The degree of WTP for these people varies according to the payment vehicle.
RESULTS

Table 5 Results of the bivariate probit model for the Park

| Coef. | Std. Err. | z  | P>|z| | [95\%Conf.Interval] |
|-------|-----------|----|------|------------------|
| PBID  | -0.31808  | 0.032789 | -9.7 | 0    | -0.38235 to -0.25381 |
| ATT   | 0.235421  | 0.108815 | 2.16 | 0.031 | 0.022149 to 0.448694 |
| CNOVISIT | -0.079     | 0.223922 | -0.35 | 0.724 | -0.517882 to 0.359882 |
| CONS  | 4.39767   | 0.447188 | 9.83 | 0    | 3.521197 to 5.274143 |

\[(\rho) = 3.607214, 1.150661, 0.997, -2251.65 to 2258.861\]

Likelihood-ratio test of \(\rho=0\): \(\chi^2(1) = 8.91\), \(\text{Prob} > \chi^2 = 0.0028\)

Table 6 Results of the bivariate probit model for the caves

| Coef. | Std. Err. | z  | P>|z| | [95\%Conf.Interval] |
|-------|-----------|----|------|------------------|
| CBID  | -0.1915   | 0.053105 | -3.61 | 0    | -0.29558 to -0.08742 |
| ATT   | 0.447769  | 0.112904 | 3.97  | 0    | 0.226481 to 0.669056 |
| CNOVISIT | -0.65179     | 0.232625 | -2.8  | 0.005 | -1.10772 to -0.19585 |
| CONS  | 1.905503  | 0.489307 | 3.89  | 0    | 0.946479 to 2.864528 |

\[(\rho) = 0.653223, 0.218458, 2.99, 0.003, 0.225053 to 1.081392\]

Likelihood-ratio test of \(\rho=0\): \(\chi^2(1) = 0.736\), \(\text{Prob} > \chi^2 = 0.3909\)

The respondents’ future intentions to visit the caves (where CNOVISIT=1 if respondents stated that they will not visit the caves, and 0 otherwise) are significant for the caves model but not for the park model. Basically, visitors’ intentions to revisit the caves have no significant impact on the WTP at park entry. However, CNOVISIT is significant and negative in the caves model. This indicates that those that do not intend to visit again (CNOVISIT=1) have a lower probability of accepting the proposed fees than those that do intend to revisit. This implies that those that intend to revisit are willing to pay more, as they probably have a higher preference for the caves. Here, in this variable, we see a significant difference in WTP between the two payment vehicles.
5.3 WTP and revenue estimates

The WTP for supporting the Yanchep Caves Recovery Project was estimated for both payments at park and cave entry level. Visitors had a higher WTP at the cave level than park level. The probabilities of respondents answering yes to the bid amounts in the two DBDC questions are given in Figure 4. It is clear that respondents are less likely to accept bids as the price increases. This is consistent with consumer behaviour theory. The median WTP can be obtained from the graph by taking the bid where probability = 0.5. Median WTP for Park entry fee and caves entry fee (assuming no effect from other variables) were $13.85 and $9.95, respectively. Estimates using the median are preferred over the mean because they are not as affected by the skewness of the WTP distribution. Small differences in the right tail of the distribution can have a large effect on the mean (Hanemann and Kanninen 1999). Although WTP at park entry appears higher, it must be noted that this is the WTP for entry of a vehicle and not for an individual. Park entry fee is currently charged at $10 per vehicle for a standard car. Buses are charged at a higher rate. Cave entry fee, on the other hand, is charged per individual; the current fee is $6.50 per person.

The diagram also shows that overall there is a higher WTP through cave entry fees than park fees, even though the margin of fee increase through cave fees per person is higher.

To calculate an estimate of the change in total visitor value for the improvement to the caves, the median WTP values can be multiplied by the number of people who pay the entry fees. Yanchep National Park receives around 240,000 visitors each year, and around 10% of that number visits the caves. If cave entry fee were to be increased from $6.50 per adult to the estimated median WTP level of $9.95 per adult (an increase of 113%), the estimated increase of revenue from increased entry fee would be $176,400 per year. However, the fact is that not all visitors are adults. Results from the survey showed that 4% of visitors interviewed were over 65. If we assume that these 4% are pensioners and the remaining 96% of visitors comprise 48% adults and 48% children, and that entry fees for all adults and children were to be increased by 113% (pensioners’ fees remain unchanged), the re-estimated entry fees are presented in Table 7.
The proposed entry fees presented here are still lower than those charged for cave entry in the Margaret River area. Guided tours to Lake Cave, Mammoth Cave and Jewel Cave cost $17.00 for adults, $8.50 for children and $46.00 groups (2 adults +2 children). However, the quality of these caves is higher than that of the Yanchep caves and the tours are slightly longer. Using the above-mentioned ratio of visitors, and an entry fee based on estimated median WTP, the increase in revenue from increased cave entry fee would be $61,056 per year (calculation is shown in Appendix B Table B1).

The findings of this study are consistent with Nagypal (2005); namely, people are willing to pay to improve the environmental quality of caves. In both studies, the public benefits from an improved cave experience due to the increase in quality. However, residents of Budapest were willing to pay almost $9.00 for their cave protection fund (separate from entry fees — AUD5.59 for a ticket to visit both caves). The higher level could be because the Budapest caves are located within residential districts and therefore more accessible to people compared to the Yanchep caves (50km from the Perth CBD). However entry to the Yanchep caves is more expensive because visitors have to pay the $10 park entry and then the $6.50 cave entry fee. To compare the values properly would require a survey of all Perth residents and not only park visitors.

Calculation of revenue changed based on increased park entry fee was based on 240,000 visitors per year, assuming all visitors drive to the park in cars (i.e. sedans instead of buses), with five passengers per car. This figure of five passengers per car is based on findings from the survey; the majority of respondents (32.5%) stated that they had five passengers in the car, including the driver (see Appendix B Table B2). If all cars were charged $13.85 each to enter, the estimated increase in revenue from this fee change would be $184,800 per year. With predicted operating costs for the Yanchep Caves Recovery Project at $110,000 per year, Yanchep Park would be able to support the ongoing costs of this project through increased fees at the park level alone, assuming the average number of visitors remains unchanged.

6. SUMMARY AND CONCLUSION

The aim of this study was to elicit the WTP of Yanchep National Park visitors to support the Yanchep Caves Recovery Project for the preservation of cave ecosystems. This was performed with a contingent valuation survey. When visiting the park, visitors pay a gate entry fee at park level and a separate cave entry fee if they choose to see the caves. To replicate this payment system, we have applied two alternative payment vehicles in that visitors were asked for their WTPs at both park entry and cave entry. The data was analysed using the probit model.

These results show a clear positive value of the environmental asset that is the Yanchep cave system. The findings support the ongoing operation of the Caves Recovery Project, as the survey results showed that surveyed visitors were willing to pay higher entry fees to support the cost of the project.

One issue of concern from the survey was the high number of respondents who were not willing to pay anything for the project. This could be because they do not value an improvement in the

<table>
<thead>
<tr>
<th>Table 7 Proposed entry fees for Yanchep caves</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current fee</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Adult</td>
</tr>
<tr>
<td>Child</td>
</tr>
<tr>
<td>Concession</td>
</tr>
</tbody>
</table>
environmental quality of the caves, or it could be for other reasons. Some respondents that refused to pay gave reasons: they believed the government should be responsible for all these costs and not them; they were concerned that they would not be able to afford to pay for the next visit if the fee were to be increased; they were annual pass holders and therefore did not have to pay for entry. Additionally, some people objected to the compulsory nature of the entry fee. One respondent suggested that a donation box in front of the caves would be more appealing and would receive more support from visitors than increased fees.

In this study, only those that visit the park or the caves were surveyed. It is hypothesised that there are people who would be willing to pay to support the project regardless of whether they intend to visit the park or the caves. Suggestions for future research, therefore, include a survey of the Perth population to determine a more accurate estimate of WTP.

Competing uses of groundwater from the Gnangara Mound include agriculture, urban water scheme and pine plantation, all of which contribute negatively to the groundwater table, and as a result, the falling water levels in the caves. This study has shown that although the Yanchep caves may appear to have minor economic benefits compared to other users (the horticulture sector in Wanneroo is estimated to generate a gross value of $170M per year), social values attached to having water in the caves should not be neglected in policy-making. Therefore it is important that future decisions for the sustainable use of groundwater of the Gnangara Mound include the impact on the Yanchep caves and the groundwater-dependent ecosystems.
REFERENCES


Beckwith Environmental Planning Pty Ltd. 2006. *In situ social values of groundwater-dependent features on the Gnangara Mound*. Prepared for the Department of Water, Western Australia.


REFERENCES


Morimoto, S. 2005. ‘A choice experiment study to plan tourism expansion in Luang Prabang, Laos’. In The Economics of Tourism and Sustainable Development, Edward Elgar, Cheltenham, UK.


Yanchep Caves Survey

Thank you for agreeing to participate in this survey. We are interested in what you are willing to pay for entry into Yanchep National Park and for entry into the caves. This information will be used to identify the value people place on the Yanchep caves, and it may be used for the purposes of managing the environmental quality of the caves at an appropriate level.

Completion of the questionnaire and handing it back or posting it in the prepaid envelope provided is considered evidence of consent to participate in the study. You are, of course, free to withdraw from the study at any time. If you have any questions, please feel free to contact me at the address above.

Yours truly,

Dr Steven Schilizzi

The Human Research Ethics Committee at the University of Western Australia requires that all participants are informed that, if they have any complaint regarding the manner in which a research project is conducted, it may be made to the researcher or, alternatively to the Secretary, Human Research Ethics Committee, Registrar’s Office, University of Western Australia, 35 Stirling Highway, Crawley, WA 6009 (telephone number 6488-3703). All study participants will be provided with a copy of the Information Sheet and Consent Form for their personal records.
Valuation of the Yanchep Caves

This study is conducted for the completion of a fourth-year project at the University of Western Australia, in collaboration with CSIRO, to estimate how much people value the caves of Yanchep in order to better choose management options.

Yanchep National Park is one of Perth’s most popular parks, and it was visited by approximately 240,000 people in 2006. The region contains about 600 limestone caves, several being accessible to cavers and two being open to the public. The caves have special conservation significance, as some are home to ‘root-mat communities’, containing rare aquatic invertebrates.

One major environmental issue facing Yanchep National Park is the falling groundwater table. Water levels in the lakes and caves have dropped in the past 10 years, and some caves are now completely dry. This situation is endangering the rare aquatic species.

No information in this survey will be linked to you personally and it will only be used for the purpose of recording people’s value of the caves.

Depending on your response, you may not be asked every question in the survey. It is expected that the survey will take approximately 10 minutes to complete. We look forward to receiving your survey and would like to thank you in advance for your interest and participation.

Section I

This section is about your familiarity with Yanchep National Park and the caves.

Q1) How many times in the past year have you visited Yanchep National Park? (Please include this current trip.)
  □ More than 4
  □ 4
  □ 3
  □ 2
  □ 1

Q2) Do you normally visit Yanchep National Park as frequently as you have specified in Q1?
  □ Yes
  □ No, I usually visit less frequently than previous year.
  □ No, I usually visit more frequently than previous year.
APPENDIX A – SAMPLE QUESTIONNAIRE

Q3) How much time do you normally spend while you are at Yanchep National Park? (Please give us your best guess of an average value.)

______________________ Hours

Q4) How did you travel to Yanchep National Park?

□ Car
□ Motorcycle
□ Bus
□ Walk
□ Bicycle
□ Tour bus
□ Other (please specify)

Q5) How many people came in the same vehicle as you on this trip? (Please do not count yourself.)

______________________ people

Q6) What activities did you do or do you normally do when visiting Yanchep National Park? (You can choose more than one option.)

□ View the wildlife such as birds and koalas
□ Trail walking
□ Boating
□ Visit Yanchep Inn to eat or drink
□ Play golf
□ Picnic
□ Learn about history
□ Others (please specify) __________________________

Q7) Did you buy any food or drinks while visiting Yanchep National Park?

□ Yes (please estimate how much you spent on your own food and drinks)

$____________

□ No

Q8) Have you been into one of the caves, or are you planning to go on today’s trip?

□ Yes (please go to question 10)
□ No (please continue to question 9)

Q9) Why did you not visit the caves?

□ Did not have time
□ Tour time wasn’t convenient
□ Cost
□ Did not care to visit the cave
□ Was not aware of caves

Please go to question 13
Q10) In total, how many times have you visited the Yanchep caves?
   □ More than 5
   □ 4
   □ 3
   □ 2
   □ 1

Q11) Have you visited Crystal Cave when there was water in it?
   □ Yes
   □ No
   □ Unsure

Q12) What activities have you done in the Yanchep caves? (Tick more than one box if applicable.)
   □ A guided walk tour
   □ Caving
   □ Attended a function in Cabaret Cave
   □ Others (please specify) ____________________________

Q13) Do you plan to visit Yanchep National Park in the future? (Please note that park entry fee is $10 per vehicle.)
   □ Yes
   □ No
   □ Unsure

Q14) Do you also plan to go into the caves at Yanchep National Park in the future? (Please note that cave entry fee is $6.50/adult in addition to the park entry fee.)
   □ Yes
   □ No
   □ Unsure

Section II

Water levels in the Yanchep caves have dropped in recent years due to the falling water table. Currently Crystal Cave is completely dry, apart from several small pools made by artificial water pumps. The endangerment of the root-mat communities has led to a pumping station being built to re-fill seven of the caves with water. The station pumps groundwater that is passed through a filtration system to remove impurities such as iron, which may harm the root-mat communities. This operation requires funds to cover ongoing costs. One way to gather funds is to increase entry fees to the park and to the caves. Currently visitors are charged $10.00 per vehicle for entry to the park, and $6.50 for adult entry to Crystal Cave.

Please answer the following questions as best you can, as if they were actual scenarios. Your responses may be used to determine new entry fees which may be used to support the Caves Recovery Project. Please also keep in mind your budget constraints and how much you can realistically afford to spend.
Q15) Suppose you decided to visit Yanchep National Park again. Please answer the following question.

Current entry to Yanchep National Park is $10 per vehicle. Would you be willing to pay $12 for entry, the extra $2 being used to cover the cost of the cave pumping operation?

<table>
<thead>
<tr>
<th></th>
<th>□ Yes</th>
<th>□ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>If yes, are you willing to <strong>pay up to $14</strong> for park entry?</td>
<td>□ Yes</td>
<td>□ No</td>
</tr>
<tr>
<td>If yes, what is the maximum fee you would be willing to pay?</td>
<td>$_______________</td>
<td></td>
</tr>
<tr>
<td>If no, are you willing to <strong>pay up to $11</strong> for park entry?</td>
<td>□ Yes</td>
<td>□ No</td>
</tr>
<tr>
<td>If you are not willing to pay $11, how much would you be prepared to pay?</td>
<td>$_______________</td>
<td></td>
</tr>
</tbody>
</table>

Q16) Suppose you decided to visit the Yanchep caves (again or for the first time). Please answer the following question.

Current entry into the Yanchep caves is $6.50 for one adult. Would you be willing to pay $8.50 for entry, the extra $2 being used to cover the cost of the cave pumping operation?

<table>
<thead>
<tr>
<th></th>
<th>□ Yes</th>
<th>□ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>If yes, would you be willing to <strong>pay up to $10.50</strong> cave entry?</td>
<td>□ Yes</td>
<td>□ No</td>
</tr>
<tr>
<td>If yes, what is the maximum fee you would be willing to pay?</td>
<td>$_______________</td>
<td></td>
</tr>
<tr>
<td>If no, would you be willing to <strong>pay up to $7.50</strong> for cave entry</td>
<td>□ Yes</td>
<td>□ No</td>
</tr>
<tr>
<td>If you are not willing to pay $7.50, how much would you be prepared to pay?</td>
<td>$_______________</td>
<td></td>
</tr>
</tbody>
</table>
Q17) How would you rate your concern for the falling water levels in the Yanchep caves? (Please circle one number only.)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am not concerned about water in the caves</td>
<td>I am moderately concerned</td>
<td>I am very concerned about water in the caves</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q18) How confident are you that the Caves Recovery Project will work and that in the future there will be water in the caves? (Please circle one number only.)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am not at all confident that the water pumping project will work</td>
<td>I am moderately confident.</td>
<td>I am very confident that there will be water in the caves from the project.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q19) What is your opinion on artificially pumping filtered groundwater into the caves?

a)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>The caves are already dry and we should not alter the natural system</td>
<td>I am indifferent / I have no comment</td>
<td>We allowed the caves to dry so we should try to bring the natural system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
</table>
Section III

This section is about respondents, to ensure that we have a good representation of the population. All answers will be kept confidential.

Q20) What is your gender?
   □ Male
   □ Female

Q21) How would you best describe your household?
   □ Couple family with children over 15
   □ Couple family with children under 15
   □ Couple family without children (or children moved out of home)
   □ One parent family
   □ Shared household i.e. with flatmate
   □ Single occupant
   □ Other, please specify

I think Perth drinking water supply should have priority over groundwater use

I am indifferent / I have no comment

I think the environment, (such as caves) should have priority over groundwater

I would rather have groundwater pumped into Loch McNess than into the caves.

I am indifferent / I have no comment

I would rather have groundwater pumped into the caves than into Loch

1 2 3 4 5 6 7
Q22) What is your highest level of education? (Please tick one box only.)

- □ Not completed Year 10
- □ Completed Years 10 or 11
- □ Completed Year 12
- □ TAFE qualifications/Trade/Technical Certificate
- □ University undergraduate degree
- □ University postgraduate degree

Q23) Which of the following age groups do you fall into?

- □ 18–25
- □ 26–35
- □ 36–45
- □ 46–55
- □ 56–65
- □ Over 65

Q24) Which of the gross annual household income groups applies to you (i.e. before tax)? (Please tick one box only.)

- □ Under $10,000
- □ 10,000–$20,999
- □ 21,000–$35,999
- □ 36,000–$50,999
- □ 51,000–$65,999
- □ 66,000–$80,999
- □ Over $81,000

Q25) Do you belong to an environmental conservation group or regularly donate money to environmental causes?

- □ Yes
- □ No

Q26) What is your postcode?

Comments you may have

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
APPENDIX B

Table B 1 Calculations of revenue from increased cave entry fee

<table>
<thead>
<tr>
<th></th>
<th>(a) Current fee</th>
<th>(b) % visitors</th>
<th>(c) No of visitors</th>
<th>(d) Entry fee (based on median WTP)</th>
<th>=[(d)-(a)]*(c)</th>
<th>Increased revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>6.5</td>
<td>0.48</td>
<td>11520</td>
<td>9.95</td>
<td>84672</td>
<td></td>
</tr>
<tr>
<td>Child</td>
<td>3.5</td>
<td>0.48</td>
<td>11520</td>
<td>5.35</td>
<td>5184</td>
<td></td>
</tr>
<tr>
<td>Concession</td>
<td>5</td>
<td>0.04</td>
<td>960</td>
<td>5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>24000</td>
<td></td>
<td>89856</td>
<td></td>
</tr>
</tbody>
</table>

Table B 2 Survey response for Question 5

<table>
<thead>
<tr>
<th>No of passengers per vehicle (incl driver)</th>
<th>Freq.</th>
<th>Percent</th>
<th>Cum.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0.63</td>
<td>0.63</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0.63</td>
<td>1.25</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
<td>22.50</td>
<td>23.75</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>22.50</td>
<td>46.25</td>
</tr>
<tr>
<td>5</td>
<td>52</td>
<td>32.50</td>
<td>78.75</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>13.75</td>
<td>92.50</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>3.75</td>
<td>96.25</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>0.63</td>
<td>96.88</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>0.63</td>
<td>97.50</td>
</tr>
<tr>
<td>20</td>
<td>2</td>
<td>1.25</td>
<td>98.75</td>
</tr>
<tr>
<td>52</td>
<td>1</td>
<td>0.63</td>
<td>99.38</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0.63</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Total 160 100.00