WILLINGNESS TO PAY FOR REDUCING CROWDING EFFECT DAMAGES IN MARINE PARKS IN MALAYSIA

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Marine Parks are established to protect an area of the sea zoned as a sanctuary for the protection of its marine eco-systems, especially coral reef and its associated fauna and flora, like sea grass bed, mangrove and the sea shore. In Malaysia, there are 6 marine parks to-date. The establishment of marine parks also attracts more tourists to the areas. For example, the number of visitors to Payar Marine Park increased tremendously from 3,668 visitors in 1990 to 133,775 visitors in 2002. However, too many tourists are thought by scientists to have damaged the coral reefs. This paper will estimate how much visitors are willing to pay to reduce damages to three marine parks in Malaysia; Payar, Redang and Tioman Marine Park. Willingness to pay estimates were obtained from the visitors using a double-bounded dichotomous choice version of the Contingent Valuation method.

Keywords: Contingent valuation method; double-bounded dichotomous choice model; marine parks; Malaysia; crowding.

1. Introduction

"Marine Park" is one of many different names given to marine areas that are, to some degree, protected by spatially explicit restrictions (McNeill, 1994). The World Conservation Union (IUCN 1988) provides the following definition of an Marine Protected Area: "any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment". In Malaysia, a Marine Park is an area of the sea zoned as a sanctuary for the protection of its marine eco-systems especially coral reefs and their associated fauna and flora, sea grass beds, mangroves and the seashore (Fisheries Department of Malaysia). In most marine parks, use is regulated by government. Normally, the reserves protect the rare ecosystems or fisheries and wildlife habitats. Heavy industrial uses and other uses potentially destructive of wildlife or its habitats are usually restricted or prohibited within the confines of a marine reserve. Non-consumptive uses, such as ecotourism and scuba diving, or certain kinds of recreational fishing may be promoted.

Coral reefs have existed for approximately 450 million years and are one of the most diverse ecosystems in the world. These "rainforests of the oceans" are home to a wide variety of marine organisms. Coral reefs require tropical or sub-tropical temperatures, and are found between 30 degrees north and 30 degrees south of the equator. Coral reefs of the western Pacific are much more diverse than those of the Atlantic and Caribbean. There are up to 75% more genera and 85% more species of corals in Pacific waters (Wilkinson, 1987). They occur in shallow, clear water where light is sufficient to support photosynthesis.

There are several benefits of coral reefs to humans. First, reefs are a source of food and livelihood for at least 100 million people worldwide (Lesser, 2004) from fisheries that are supported by coral reefs. Second, they act as a natural barrier that protects coastlines from tides, storms and hurricanes. They dissipate the wave energy and decrease destructive stress upon the coast line (Sorokin, 1993). Coral reefs are also a storehouse for biodiversity, and fourth as a recreational resource.

In recognition of the value of coral reefs, by 1989, approximately 60 countries have moved to establish official protection for nearly 300 coral reef areas (Wells, 1990) and the numbers have increased since (Hoagland, 1995). Since then, there have been large increases in tourist visits to marine protected areas in many parts of the world (Tilmant, 1987; Inglis, 1999). The management of tourism and recreation activities within marine parks has become an important issue for two reasons: tourism has great potential as an activity that can have a minimal impact on the marine environment while generating income for the communities at its borders; and secondly, in recognition of the role of reefs as a source of ecological information (Murgatroyd, 1999). However, increasing tourism also brings problems. Corals are very delicate species that support complex food and energy webs that are inter-linked with nutrient inputs from outside sources (such as those brought with ocean currents and run-off from nearby rivers) and from the reef itself (where natural predation and die-off recirculate organic matter). These complex webs mean that any effect on one group of individuals will ultimately impact another, and single disturbances can have multiple effects on reef inhabitants.

According to a report from WTO, more than a quarter of the world's reefs are at high risk, and just under a third of these habitats are at moderate risk, from human disturbance (Bryant *et al.*, 1998). Of the four broad categories of potential threat to coral reefs evaluated (overexploitation of marine resources, coastal development, inland pollution and marine pollution), overexploitation of marine resources, including destructive fishing practices, and coastal development present the greatest threat. Globally, 36% of all reefs were classified as threatened by overexploitation, 30% by coastal development, 22% by inland pollution and erosion, and 12% by marine pollution. When these threats are combined, 58% of the world's reefs are at risk (defined as medium and high risk) (Bryant *et al.*, 1998).

Most disturbing is the status of reefs in Southeast Asia — a global hot spot for coral and fish diversity. More than 80% of these ecosystems are potentially at risk (under medium and high potential threat) primarily from coastal development, over-fishing, and fishing practices (Bryant *et al.*, 1998). Tourism is obviously a major driving force for the first of these, and our study concentrates on this type of damage. This is due to the tremendous increase of

Table 1. Number of Visitors to Payar, Redang and Tioman Marine Parks 1990–2002

Year	Payar	Redang	Tioman
1990	3,668	707	n.a
1991	5,611	4,725	112,916
1992	9,458	6,061	141,658
1993	13,038	7,648	122,093
1994	32,175	8,349	137,789
1995	70,419	22,725	166,046
1996	90,307	34,743	172,850
1997	91,167	36,198	182,649
1998	87,292	37,556	200,210
1999	83,246	47,008	184,954
2000	106,780	52,634	200,527
2001	125,485	73,580	243,052
2002	133,775	63,826	213,172

Source: Department of Fisheries Malaysia.

visitors to these marine parks, shown in Table 1 above. Large increases in tourism market have been accompanied by concerns about deterioration of marine parks caused by diving and snorkelling (Ward, 1990; Hawkins and Roberts, 1992, 1997; Davis *et al*., 1995; Inglis *et al*., 1999; Plathong *et al*., 2000; in Rouphael and Inglis, 2001). This damage includes tourists stepping on the corals while snorkeling, and divers bruising corals with their hands, body, equipment and fins while diving near the corals (Rouphael and Inglis, 2001).

Evidence on damages to coral reefs from divers is plentiful. A study by Hawkins in 1991 at three very popular Red Sea dive sites recorded several key attributes (numbers of hard coral species, colonies, broken coral, loose fragments of coral and abraded coral) at the three sites. They did the same for several non-dived sites to be used for comparison, monitoring all sites for a year. The study found significant differences between the dived and non-dived sites, the former containing more damaged coral, thus indicating that divers do cause damage to coral reef systems (Hawkins, 1993). This damage can cause the corals to be unable to fight off disease and parasites (Richmond, 1993).

Hawkins and Roberts looked at the effects of coral flats trampling by divers and snorkel, comparing a trampled to an un-trampled area. The trampled areas were those where divers and snorkel walked out over the reef flats to reach deeper water. Rouphael and Inglis (2001) also found that the increasing popularity of scuba diving has put more strain on coral reefs around the world. Observations on damage to corals by underwater photographers and recreational divers (Rouphael and Inglis, 2001) found that:

- 15% of divers damaged or broke corals.
- 95% of damage occurred by fin kicks.
- Divers without cameras averaged 0.3 breaks per 10 minutes.
- Divers with cameras averaged 1.6 breaks per minute.

Table 2. Collections from Entrance Fee in Three Marine Parks 1999–2003

Year	Payar	Redang	Tioman*
1999	407,505.00	163,050.00	246,240.00
2000	543,175.50	147,787.00	432,724.50
2001	599,657.50	204.152.50	438,990.00
2002	638,225.00	154,808.00	353,459.50
2003	541,127.50‡	176,031.00‡	170,545.50†

Source: Marine Park Centre, Fisheries Department Malaysia.
*an estimates; †until July 2003 only; ‡starting September, the children charge has been reduce to RM2.00.

One possible response to increasing damage due to rising marine park tourism is to introduce a charging scheme for use of such parks. Marine parks in Peninsular Malaysia started charging tourists in 1999. All the parks charge a fee of RM5.00 to local and foreign adult tourists and RM2.50 to children below 12 years old. Charge income over time is shown in Table 2 for the three marine parks which this paper focuses on.

2. Area of Study

For the purpose of our study, three marine parks are chosen for study, and are described below.

2.1. *Payar marine park*

Payar was declared a marine park in 1985. It covers 2 nautical miles off four little islands — Payar (the largest), Kaca, Lembu and Segantang. These islands can be accessed from three major points — Kuah, on Langkawi Island, Kuala Kedah and Penang, which takes about 30 to 45 minutes by boat. None of the islands are inhabited, except by onduty officers of the Fisheries Department on Payar Island. This is due to the fact that the islands are small and lack freshwater. It can be visited all year round but the best time is from the month of February until November.

The four islands of the Payar Marine Park are surrounded by coral reefs and entice visitors to swim, snorkel and scuba dive. The calm and clear water enables the visitors to enjoy the marine life. The average 30–50 feet visibility is favourable and ensures satisfaction for diving activity at all times. Payar itself has four sandy beaches totaling about 200 metres in length. Their shallow water is protected from the rough seas and is suitable for swimming and snorkeling. For the diver, the marine park offers a variety of diving conditions; one can dive on a flat terrain to the east of Payar or on a steep slope to the west and around Segantang. Based on World Wide Fund for Nature Malaysia's (WWFM) marine park study, 36 genera of hard corals, 92 other marine invertebrates and 45 genera of fish are available in this marine park.

As shown in Table 1, the number of visitors has increased considerably. In 1990, only 3,668 visitors visited Payar; but in 2002, a total of 133,775 tourists visited the island, a more than 30-fold increase, with more than 50% being foreign visitors. This is because most of visitors come from Langkawi Island, an import duty-free island that is visited by foreigners throughout the year. The tour operator in Langkawi Island has promoted Payar Marine Park almost at all entry points to Langkawi.

2.2. *Redang marine park*

The Redang archipelago, gazetted in 1985, is Malaysia's oldest marine park and most studied. It comprises nine islands, Redang Island is the largest, Pinang is much smaller and there are seven islets; Kerengga Besar, Kerengga Kecil, Paku Besar, Paku Kecil, Ekor Tebu, Ling (also called Chipor) and Lima. Redang Island has a land area of about 25 square kilometres and is located about 45 kilometres from Kuala Terengganu off the east coast of Peninsular Malaysia. Redang Marine Park can be accessed from Kuala Terengganu by boat. Kuala Terengganu is accessible by air and road from Kuala Lumpur. Visitors can also take a boat from Marang Jetty. The journey takes about one hour from the Kuala Terengganu Harbour and about 30 minutes from the Marang Jetty.

Of all the 9 islands, only Redang Island is inhabited and it is the largest. Currently there are about 2,200 residents living in Redang Island. Most of them work as fisherman once but since Redang become a marine park and tourism site, a lot of them have worked in tourism areas such as working as tour operators, opening up small businesses or working in hotels. Situated at the southern tip of Redang, is Pinang. The calm and clear water surrounding this island provides enjoyable and spectacular spots for swimming, snorkeling and diving. The fishes around this island are not afraid of human beings and can be hand-fed. The natural beauty of Ekor Tebu, Lima and Lang Tengah offers unforgettable excitement and experience for snorkelers and divers. The waters off these islands are rich in various species of soft and hard corals and fishes.

As shown in Table 1, there were not even 1,000 visitors in 1990, but this increased to 63,826 in 2002, an 80-fold increased, with 88% of the visitors being locals. This is due to lack of promotion of Redang Marine Park to foreigners.

2.3. *Tioman marine park*

The Tioman Marine Park which is situated in the South China Sea, off Pahang is about 32 nautical miles (56 km) northeast from Mersing, Johore and consists of 9 islands, i.e., Tioman, Labas, Sepoi, Gut, Tokong Bahara, Chebeh, Tulai, Sembilang and Seri Buat. Tioman is the biggest island among all, being 39 km long and 12 km wide and the most developed of the volcanic islands. (Sepoi, and Labas are uninhibited). Mountainous and covered in dense forest, Pulau Tioman is a haven for birds, bats, lizards and Mouse Deer. The underwater topography is a combination of patches of coral gardens and huge granite boulders, many over 15 m high, on sand. Some are quite bare though many are completely covered in colourful soft tree corals and small sea fans. Bluespotted Lagoon Rays (*Taeniura lymma*) are found hiding under every crevice and are unusually tame here. The multitude of beautiful angelfish includes the Blue-ring Angelfish (*Pomacanthus annularis*) and the larger Six-banded Angelfish (*Pomacanthus sextriatus*), both are quite common here but rare elsewhere in Malaysia.

The rocky outcrop of Labas Island features some of the best reefs in the area and is well known for its splendid multicoloured soft corals. For the experienced diver, the Tiger Rock which has a large submerged reef is an attractive site with strong sweeping currents which bottoms out at 30 metres between Labas Island and Sepoi Island. The Magicienne Rock which is another submerged reef is located north of Tioman Island and lies in 10 metres of water. It is rarely visited which makes it worthwhile to dive where giant manta rays have been sighted. Tioman can be accessed from several points. The nearest point of departure is from Mersing, Johor. Fast ferry services are available from Tanjung Gemok, Pahang; Mersing, Johor and Singapore. Regular flights from Kuala Lumpur, Kuantan and Singapore are also available.

3. Methodology

3.1. *Construction of questionnaire*

The questionnaire comprised 3 sections. The first section captured background information of the respondents. This concerned country of origin; sex; age; highest education level attained; annual household income; and occupation. Questions 7 to 10 concerned the respondent's visit to the marine park, in terms of how many times they have visited the park and activities that interest the respondent most. We then asked people their opinions on attributes of the park such as the water visibility; fish species; corals variety and development around the marine park that the respondents visited. Section 2 concerns journey information. Questions included are the point where the respondents started their journey, time of the journey and the number of persons they travel with. Respondents' are also asked about their spending to come to this marine park on petrol (if travel is by car); bus fare or flight fare; boat; accommodation; and others; or if they come with a tour package, the price of their package.

The third section elicited willingness-to-pay of the respondents to reduce damages to the marine park. Contingent Valuation (CV) was used to accomplish this (Bateman *et al.*, 2003). Information was first provided on the issue of tourism damages to reefs:

> *Coral reefs are not only beautiful but also important for many reasons. Most importantly, they provide protection and shelter for many different species of fish. They also control how much carbon dioxide is in the ocean water; protect coasts from strong currents and waves by slowing down the water before it gets to the shore; and hold promise for scientists seeking new drugs to combat disease such as cancer. Furthermore, they also generate income to one's country from tourism industry; second largest to Malaysia.*
> *But tourism, when unregulated, can pose problems. Tourists are capable of loving a reef to death. Snorkellers can be a threat to the corals by accidentally kicking up sediment that can suffocate the corals. Snorkellers can also stand on the corals. This seems to be the case in Payar, where corals within 1 km from the shore are all dead. Divers also can damage corals by accidentally bumping into reefs because the water they are in is too shallow, or by scraping corals with diving equipment.*

The next question posed was as follows:

In 2000, the number of visitor to Payar was 106,780; Redang 52,674 and Tioman 48,942. In your opinion, do you think there are too many people in the park today?
Yes ☐ No ☐

This was followed by a double-bounded dichotomous choice question, which suggests a policy to reduce crowding at the parks as the main tool to reduce environmental damage:

Suppose the authority wants to limit numbers of visitors to half the number who came in 2000 **to reduce the damage** to the corals, AND **increased the charge** to **RM-X** (currently RM5.00 or equal to USD 1.30 or less than GBP1.00) and you were entitled to visit this marine park, would you still have visited today?
Yes ☐ No ☐

If respondents answered "yes" to the above question, they were then asked whether they would be willing to pay (WTP) a higher amount, equal to (X + 5). If they answered "no", they were asked their WTP a lower amount, equal to (X − 5). Such "Double-Bounded" CV approaches have advantages in terms of sampling efficiency (multiple responses are obtained from respondents), and in terms of how much information is revealed on the distribution of WTP (Hanemann *et al.*, 1991), and have become very popular. They have also been claimed to be simpler to answer than open-ended question formats, but suffer from problems of anchoring effects, whereby the choice of opening bid can influence people's response to the next bid (Bateman *et al.*, op cit). For this reason, we estimate both a double-bounded CV model below, but also a single bounded model, making use only of respondents' first payment response (i.e., yes/no to RM X). 6 different starting bids were used, and were randomly allocated. They were: RM10.00, RM15.00, RM20.00, RM25.00, M35.00, and RM65.00. The charges were chosen based on a previous study done in Payar Marine Park (Ahmad *et al.*, 2002) and a pilot study done for this project.

The choice of higher entrance fees as the payment vehicle deserves some comment. According to Garrod and Willis (1999), the chosen bid vehicle should have a plausible connection with the amenity it is being used to value, and also be perceived to be "fair" and "equitable" in its incidence and in relation to those deriving benefits for the proposed good. All of the marine parks studied have charged RM5.00 per adult since early 1999, whilst the fact that we only attempt to estimate use values, and the potential to exclude non-payers, means that there should be no problems with free riding here. Finally, the pilot study showed that higher entrance fees were accepted by respondents as an appropriate way to pay for reducing environmental damages. A comparable paper by Mathieu *et al.* (2000) also used an entrance fee as the payment vehicle.

Finally, we wanted to separate protest responses from those who genuinely did not value reduced environmental damages to the coral reefs. To do this, all those who responded "no" were asked to provide a reason. Possible responses were: (1) I feel the visitors to this marine park do not harm corals; (2) I do not believe increasing the fee would solve the problem; (3) I do not agree that visitor numbers should be limited; and (4) I fail to understand the question. Protest bids were classified as responses (2) and (4).

3.2. *Econometric methods*

3.2.1. *Single-bounded dichotomous choice model*

We assume that there exists a distribution of WTP, denoted by W across the population of visitors to the marine parks in Malaysia, with a mean $\mu_W = X\beta$ and a variance σ_W^2:

$$W = X'\beta + \varepsilon, \tag{1}$$

where ε has a cumulative distribution function (CDF) with the mean and variance $\varepsilon \sim$ CDF $(0, \sigma_W^2)$. The term $X'\beta$ is a matrix of explanatory variables and their associated parameters. If the probability density function (PDF) is bell-shaped, the CDF will be S-shaped, with values that fall between zero and one. Two distributions that are typically used are the normal random variable and the logistic also used in our study. The PDFs for the logistic and normal random variables with the mean equal to zero and variance σ^2 are given by:

$$f(z) = \frac{e^z}{(1+e^z)^2} \tag{2}$$

$$g(z) = \frac{\exp(-z^2/2\sigma^2)}{(2\pi\sigma^2)^{1/2}}. \tag{3}$$

The CDFs, respectively, give the probability that the random variable takes on a value less than or equal to z, $P(Z \leq z)$ and is geometrically equal to the area under the bell-shaped PDF to the left of z:

$$\begin{aligned} P(Z \leq z) &= \int_{-\infty}^{z} \left\{ \frac{e^y}{(1+e^y)^2} \right\} dy \equiv F(z) = \frac{e^z}{1+e^z} \\ &= \frac{1}{1+e^{-z}}, \end{aligned} \tag{4a}$$

where

$$P(Z > z) = 1 - P(Z \leq z) = 1 - 1(1+e^{-z}) = \frac{1}{1+e^z}, \tag{4b}$$

and

$$P(Z \leq z) = \int_{-\infty}^{z} \frac{\exp(-y^2/2\sigma^2)}{(2\pi\sigma^2)^{1/2}} dy \equiv G(z), \tag{5}$$

where y is just a variable of integration. For symmetric PDFs, the mean, median, and mode all occur at the same value, which is the case for the normal and logistic functions. The maximum value of the PDF is higher for the standard normal random variable because the tails for logistic PDF (2) are fatter than the normal PDF (3).

Willingness to pay (WTP) is an unobserved or latent variable. What we observe is either "yes" or "no" to the asking price or bid values, A. To connect the underlying latent variable model to the CDF, the conditional probability of a randomly selected visitor responding "yes" is just the probability that the visitor's unobservable WTP is greater than the asking price. From (4b),

$$\begin{aligned} P(Yes|X) &= P(W > A) = P(X'\beta + \varepsilon > A) \\ &= P(\varepsilon > A - X'\beta) = P\left(\frac{\varepsilon}{\sigma} > \frac{A}{\sigma} - \frac{X'\beta}{\sigma}\right) \\ &= P\left(Z > \frac{A}{\sigma} - \frac{X'\beta}{\sigma}\right) = \frac{1}{1 + \varepsilon^{A/\sigma - X'\beta/\sigma}}. \end{aligned} \tag{6}$$

To actually undertake the estimation, we use LIMDEP, using both logit and probit routines that estimate the parameters σ and β and to test the hypotheses that the vector of parameters β equal zero. The approach is a form of maximum likelihood non-linear estimation. The logit model takes the form of log odds (probability of saying "yes" versus "no")

$$n_i = \log it(p_i) = \log\left(\frac{p_i}{1 - p_i}\right),$$

while assuming a linear relationship between n_i and the independent variables

$$n_i = \sum_{k=1}^{K} \beta_k x_{ik}.$$

Solving for p_i we get

$$p_i = \frac{\exp(\sum_{k=1}^{K} \beta_k x_{ik})}{1 + \exp(\sum_{k=1}^{K} \beta_k x_{ik})}.$$

This yields a logit regression model or a generalized linear model with the logit link function. The probit model is a bit more complicated. It uses a CDF of standard normal distribution

$$n_i = \text{probit}(p_i) = \phi^{-1} p_i,$$

where

$$\phi(n_i) = \int_{-\infty}^{n_i} \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}u^2\right) du,$$

or

$$p_i = \phi\left(\sum_{k=1}^{K} \beta_k x_{ik}\right),$$

where p_i = probability of saying "yes" to the bid amount, β_k = coefficients to be estimated, x_{ik} = variables that influence the probability including the bid amount.

The expected value or mean of WTP and the median are calculated using formula from Hanemann (1984);

$$\text{Mean WTP} = \frac{\ln[1 + \exp(\beta_0)]}{|\beta_1|}$$

$$\text{Median WTP} = \frac{\beta_0}{|\beta_1|},$$

where β_1 is the coefficient estimate on the bid amount and β_0 is the estimated constant or the grand constant calculated as the sum of the estimated constant plus the product of the other independent variables times their respective means.

3.2.2. *Double-bounded dichotomous choice model*

The double-bounded dichotomous choice is an extension from the single-bounded dichotomous choice model. In this model, respondents are presented two levels of bid where the second bid is contingent upon the response to the first bid. If the individual responds "yes" to the first bid, the second bid (denoted B_i^u) is an amount greater than the first bid ($B_i < B_i^u$); if the individual responds "no" to the first bid, the second bid (B_i^d) is some amount smaller than the first bid ($B_i^d < B_i$).

Thus, there are four possible outcomes: (a) both answers are "yes"; (b) both answers are "no"; (c) a "yes" followed by a "no"; and (d) a "no" followed by a "yes". The likelihoods of these outcomes are denoted $\gamma^{yy}, \gamma^{nn}, \gamma^{yn}, \gamma^{ny}$, respectively. Given the assumption that each respondent is maximizing their utility, the formulas for these likelihoods are as follows. In the first case, we have $B_i^u > B_i$ and

$$\begin{aligned}\gamma^{yy}(B_i, B_i^u) &= \Pr\{B_i \leq \max \text{WTP and } B_i^u \leq \max \text{WTP}\}\\ &= \Pr\{B_i \leq \max \text{WTP } | B_i^u \leq \max \text{WTP}\} \Pr\{B_i^u \leq \max \text{WTP}\}\\ &= \Pr\{B_i^u \leq \max \text{WTP}\} = 1 - G(B_i^u, \theta),\end{aligned}$$

since, with $B_i^u > B_i$, $\Pr\{B_i \leq \max \text{WTP} | B_i^u \leq \max \text{WTP}\} \equiv 1$. Similarly, with $B_i^u < B_i$, $\Pr\{B_i^d \leq \max \text{WTP} | B_i \leq \max \text{WTP}\} \equiv 1$. Hence,

$$\gamma^{nn}(B_i, B_i^d) = \Pr\{B_i > \max \text{WTP and } B_i^d > \max \text{WTP}\} = G(B_i^d, \theta).$$

When a "yes" is followed by a "no", we have $B_i^u > B_i$ and

$$\gamma^{yn}(B_i, B_i^u) = \Pr\{B_i \leq \max \text{WTP} \leq B_i^u\} = G(B_i^u; \theta);$$

and when a "no" is followed by a "yes", we have $B_i^d < B_i$ and

$$\gamma^{ny}(B_i, B_i^d) = \Pr\{B_i \geq \max \text{WTP} \geq B_i^d\} = G(B_i; \theta) - G(B_i^d; \theta).$$

Given a sample of N respondents, where B_i, B_i^u, and BID are the bids used for the ith respondent, the log-likelihood function takes the form

$$\begin{aligned}\ln L^D(\theta) = \sum_{i=1}^{N} \{ & d_i^{yy} \ln \gamma^{yy}(B_i, B_i^u) + d_i^{nn} \ln \gamma^{nn}(B_i, B_i^d)\\ & + d_i^{yn} \ln \gamma^{yn}(B_i, B_i^u) + d_i^{ny} \ln \gamma^{ny}(B_i, B_i^d)\},\end{aligned}$$

where $d_i^{yy}, d_i^{nn}, d_i^{yn}$ and d_i^{ny} are binary-valued indicator variables. The ML estimator for the double-bounded model, θ^D, is the solution to the equation $\partial \ln L^D(\theta^D)/\partial\theta = 0$ subject to $\partial^2 \ln L/\partial Q^2 < 0$. The double-bounded dichotomous choice model is estimated using log-normal and also log-logistic model.

The mean for double bounded approach is calculated as the area under the probability function of accepting the bid using integration technique. The area shows the proportion of the population who would consume the good at each price level, and their associated utility. It can be expressed as:

$$E(WTP) = \int_L^U (1 + e^{a+bWILLING})^{-1} db,$$

where $(1 + e^{a+bWILLING}) - 1$ is the probability of saying "yes" and U and L are the upper and lower limits of the integration respectively. Whereas the median is as follow:

$$\frac{\alpha}{B_1}.$$

Since in our analysis, we include covariates, α is a linear function of the covariates, instead of the intercept. That is $\alpha = X\beta$ where X is a vector of covariates and β is a vector of parameters. The variables used in our study are as listed in Table 3.

Table 3. Variables Used in Estimations

WILLING1	dependant variable with 1 if respondent is willing to pay for the amount asked to them, 0 otherwise
DUMRED	1 if respondent is surveyed in Redang Marine Park, 0 otherwise
DUMTIOM	1 if respondent is surveyed in Tioman Marine Park, 0 otherwise
SEX	1 if male, 0 if female
AGE	age range of the respondent, where $1 = \leq 20, 2 = 21 - 29, 3 = 30 - 39, 4 = 40 - 49, 5 = 50 - 59, 6 = \geq 60$
FL	1 if respondent is not from Malaysia (foreign visitor), 0 otherwise
DUMEDU	1 if respondent received college degree or higher, 0 otherwise
INCOME	annual household income of the respondent in Malaysian Ringgit
DUMOCC	1 if the respondent is in employment, 0 otherwise
FIRST	1 if this is the first visit to the park; 0 otherwise
TWELVE	number of times respondents have visited the park in the last 12 months
DIVING	1 if they come to the park for diving, 0 for other activities
WATERVIS	respondent's opinion on the quality level of the water visibility at the time they are at the park, where 1 = very clear, 2 = clear, 3 = cloudy, 4 = very cloudy
FISHSPEC	respondent's opinion on the fish species varieties at the time they are at the park, where 1 = amazingly many, 2 = many, 3 = not too many, 4 = very few
CORALSVA	respondent's opinion on the level of coral varieties at the time they are at the park, where 1 = amazingly many, 2 = many, 3 = not too many, 4 = very few
DEVELOPM	respondent's opinion on the level of development of the surroundings at the time they are at the park, where 1 = hardly any development, 2 = not much development, 3 = developed, 4 = very developed
ENVGROUP	1 if member of any environment group, 0 otherwise
VISITOTH	1 if respondent has visited other marine park, 0 otherwise
TRAVELFR	1 if respondent has travelled straight from home, 0 otherwise
TOTALSPE	respondent's total spending, which includes air/bus fare or petrol expenses, boat fare, accommodation on the island or package price if respondent came by package
LBD	log of bid amount offer to respondents. There are 5 sets of bid; RM10, RM15, RM20, RM35, RM65
CROWD	1 if respondent think that the park they visited is crowded (too many visitors) on the day they visited it, 0 otherwise

4. Results

4.1. *Profiles of respondents for Payar, Tioman and Redang*

Some 338 usable questionnaires were collected on-site by a team of interviewers. The profile of respondents is as in Table 4 below. How representative the sample is of the population is unknown since the tourists' population characteristics to all these marine parks are unknown. From 338 respondents, 53.6% are foreign tourist and 46.4% are local tourists. Tioman was found to have highest fraction of foreign respondents (75.2%) followed by Payar with 51.9%. Most foreign tourists visit Payar because of promotions done by tour operator in Langkawi Island as part of a tour package. This is opposite with Redang where 70.5% of the respondents are local visitors because Redang is a favourite spot of place to visit by the locals. The highest foreign respondents are from United Kingdom (21.6%) followed by Singapore (11.7%).

A majority (76.3%) of the respondents are in the 20–39 years age group. The modal class is the 20–29 years age group (50.3%), signifying that eco-tourism is a "youthful" activity (Ahmad *et al.*, 2002). Ahmad *et al.* (2000) also had the same pattern of visitors to Payar with 43% of the visitors are in the age group of 20–29 years. Only 4.8 % are below 20 years old and 5.8% are over 50 years old. This figure is the same as findings in Ahmad *et al.* (2002) with 8.7% respondents over 50 years old and 6.7% below 20 years old.

Table 4. Respondents Characteristics of Each Park

Variable	Payar	Redang	Tioman	Total
Respondents	108	105	125	338
Origin: Foreign (%)	51.9	29.5	75.2	53.6
Local (%)	48.1	70.5	24.8	46.4
Sex: Male (%)	53.7	44.8	55.2	51.5
Female (%)	46.3	55.2	44.8	48.5
Age: < 20 (%)	3.7	3.8	12.0	6.8
21–29 (%)	50.9	56.2	44.8	50.3
30–39 (%)	23.1	28.6	26.4	26.0
40–49 (%)	15.7	6.7	7.2	9.8
50–59 (%)	4.6	3.8	5.6	4.7
<60 (%)	1.9	1.0	4.0	2.4
Education: Primary (%)	0.9	0.0	1.6	0.9
Secondary/high school (%)	21.3	26.7	22.4	23.4
College/polytechnic (%)	16.7	32.4	18.4	22.2
University (%)	61.1	41.0	57.6	53.6
Occupation: Self employed (%)	14.8	20.0	12.0	15.4
Government servant (%)	16.7	4.8	16.0	12.7
Student (%)	15.7	19.0	23.2	19.5
Private sector (%)	43.5	46.7	38.4	42.6
Retired (%)	1.9	1.0	4.8	2.7
Housewife (%)	2.8	0.0	2.4	1.8
Unemployed (%)	1.9	8.6	1.6	3.8
Other (%)	2.8	0.0	1.6	1.5

Consistent with previous literature, this study also found that more than half of respondents (75.5%) are highly educated, with at least a tertiary education. Only 1.1% had a minimum of primary education, all of them foreign visitors (Table 5.2). Previous literature also suggests that nature tourists tend to be more highly educated than general tourists (Wilson, 1987; Tourism Research Group, 1988; Butler and Hvenegaard, 1988; Fennell and Smale, 1992; Cook *et al.*, 1992; Backman and Potts, 1993), as cited from different sources in Wight (1996). Dimitrios (1998) also stated "*the majority of UK ecotourists are also educated but tend to be a younger group as most of them are 17–35 years old*".

4.2. *Results*

Our estimations are undertaken using both single- and double-bounded dichotomous choice models. For our single-bounded dichotomous choice model, we estimated the WTP using both a logit and probit model, while for the double-bounded dichotomous choice analysis we used a log-logistic and log-normal model. The general model we use is:

$$\begin{aligned}\text{Willing1} = \alpha &+ \beta_1\text{REDANG} + \beta_2\text{TIOMAN} + \beta_3\text{SEX}\beta + \beta_4\text{AGE} + \beta_5\text{FL}\\ &+ \beta_6\text{DUMEDU} + \beta_7\text{INCOME} + \beta_8\text{DUMOCC} + \beta_9\text{TWELVE}\\ &+ \beta_{10}\text{WATERVIS} + \beta_{11}\text{FISHSPEC} + \beta_{12}\text{CORALSVA} + \beta_{13}\text{DEVELOPM}\\ &+ \beta_{14}\text{ENVGROUP} + \beta_{15}\text{TRAVELFR} + \beta_{16}\text{CROWD} + \beta_{17}\text{TOTALSPE}\\ &+ \beta_{18}\text{LBD}\end{aligned}$$

(see Table 3 for explanation of acronyms).

Theory and intuition provides us with good indications of what the signs on each explanatory variable can be expected to be. In our study, we expect WTP to be positive related to FL, DUMEDU, INCOME, DUMOCC, DIVING, WATERVIS, FISHSPEC, CORALSVA, ENVGROUP. We expect FL to be positive as foreign visitors are likely to have a higher probability of saying yes to the bid amount compared to locals. In the study by Ahmad *et al.* (2000) on Payar Marine Park, foreign visitors had a WTP twice as high as locals. For income, since nature tourism is widely considered to be a normal good, the higher the income, the higher the probability of saying yes to the bid amount. Past studies such as Carson *et al.* (1994), Alias *et al.* (2000) and Alias and Shazali (2000) yield a positive relationship between income and WTP. *A priori* we would expect that greater level of education will lead to a higher probability of the bid amount being accepted (hence DUMEDU > 0). This expectation is due to the assumption that educated people have more information and are more aware of environmental issues (also found in Arin and Kramer, 2002). In Lockwood *et al.* (1993), education has positive effect on WTP because it is related to income where higher level of education means higher income.

As Diving is a specialist sport, those visitors to the park for this purpose is expected to have a higher probability of saying yes to the bid amount. The attributes, water visibility, fish species varieties and coral varieties are expected to have negative relationship with the probability of saying yes to the bid amount. It is expected respondents who found that the

Table 5. Single Bounded Using Logit and Probit Model — Full Model

Variables	Logit		Probit	
	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Constant	4.276	2.486	2.477	2.431
REDANG	−0.995	−1.349	−0.567	−1.322
TIOMAN	−0.958	−1.502	−0.550	−1.477
SEX	0.541	1.411	0.318	1.419
FL	1.945	3.450	1.157	3.654
AGE	−0.319	−1.663	−0.193	−1.782
DUMEDU	−0.196	−0.411	−0.079	−0.290
INCOME	0.000	0.738	0.000	0.727
DUMOCCU	0.773	1.675	0.473	1.758
TWELVE	−0.418	−1.452	−0.276	−1.678
WATERVIS	0.028	0.077	0.026	0.118
FISHSPEC	0.063	0.194	0.027	0.142
CORALSVA	−0.360	−1.217	−0.216	−1.234
DEVELOPM	−0.038	−0.118	−0.061	−0.320
ENVGROUP	0.902	0.972	0.552	1.058
TRAVELFR	0.312	0.620	0.181	0.612
CROWD	0.697	1.818	0.439	1.939
TOTALSPE	0.001	1.369	0.000	1.296
LBD	−1.126	−3.048	−0.621	−2.979
Pseudo R^2	0.247		0.249	
Chi squared	52.729		53.110	

quality of the corals, fish and water visibility to be not good will be more willing to pay to correct the situation. Finally, for LBD, the log of the bid amount, is expected to have a negative relationship with the probability of saying yes to the bid amount where the higher the bid amount, the smaller probability of saying yes.

Table 5 present results from the full model for the single-bounded responses (where all variables are included) using both the logit and the probit model. In the model above, when INCOME is included, the number of respondents falls to 209. This is because 129 respondents did not reveal their income and therefore their responses are eliminated from the regression. The result shows that the variables FL and LBD are of the expected sign and are significant at the 1% level of significance, while CROWD, DUMOCCU and AGE are significant at the 5% level of significance. Both logit and probit models give similar results.

Upon elimination of the insignificant variables our final model is that in Table 6. With the omission of INCOME, the sample size becomes 338 observations.

The final model contains only variables that are significant at least at the 10% level of significance, except for variables REDANG and TIOMAN. Those two variables are included for there are three parks in sample and their inclusion demonstrates whether there are differences in the respondent's answers between the parks. From the above, we observe that these variables are not significant at even the 10% level of significance. We conclude that there are no significant differences in WTP for the crowding issue between respondents in different

Table 6. Single Bounded Using Logit and Probit Estimation — Final Model

Variables	Logit		Probit	
	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Constant	2.402	3.022	1.323	2.832
REDANG	−0.024	−0.071	−0.041	−0.202
TIOMAN	−0.142	−0.398	−0.093	−0.455
FL	1.828	5.917	1.054	6.073
DUMOCCU	0.592	1.994	0.328	1.902
CROWD	0.534	1.949	0.341	2.112
LBD	−0.940	−3.768	−0.517	−3.598
Pseudo R^2	0.183		0.180	
Chi squared	62.992		61.991	

parks across Malaysia. The DUMOCCU and CROWD are significant at the 5% level of significance and both have a positive sign, indicating that respondents who are employed and those that think the park has too many visitors on the day they are there are more likely agree to pay to reduce the number of visitors. In addition, FL and LBD are significant at the 1% level. FL's positive coefficient indicates that foreign respondents are more likely to agree to pay to reduce the number of visitors. LBD has negative sign denoting that the higher the dollar amount the respondent was asked to pay, the lower the probability that the respondent would willing to pay to reduce the number of visitors to the parks. All the signs are consistent with our *a priori* hypotheses outlined above.

In order to measure welfare amounts we can use either the mean or the median. The mean and median WTP are calculated using a formula outlined by Hanemann (1984) as presented above. The resulting mean willingness to pay per respondent from the logit model is RM70.43 while the median is RM69.06. The 95% confidence interval for the mean bid is RM37.46–RM127.32. It is typical of single-bounded dichotomous choice to have a huge range of confidence interval (Hanemann, 1991).

Having completed our analysis of a single-bounded dichotomous choice model we now reconduct our analysis but this time using a double-bounded approach. Table 7 presents the final model using log-logistic and log-normal models. For double-bounded dichotomous choice analysis, DUMOCCU is significant at the 5% level of significance, and FL and LBD are significant at the 1% level. DUMOCCU has a positive sign indicating that respondents who are employed are more likely agree to pay to reduce the number of visitors. FL also has a positive sign, the same as the single-bounded models. The LBD is highly significant and has a high influence on the willingness to pay of the respondents. All the variables in double-bounded approach have the same signs as single-bounded approach and the variables are the same except for CROWD which is insignificant in the double-bounded approach and is eliminated from the model. This means that the variable "CROWD" does not have significant effect on the probability of saying "yes" to the bid amount offered.

Table 7. Double Bounded Approach Using Log-Logistic and Log-Normal Model

Variables	Log-Logistic		Log-Normal	
	Coefficient	t-Statistic	Coefficient	t-Statistic
Constant	5.88540	10.070	3.47321	10.765
REDANG	−0.39713	−1.326	−0.23942	−1.336
TIOMAN	−0.26111	−0.909	−0.15247	−0.918
DUMOCCU	0.52140	2.097	0.28964	1.977
FL	1.50555	6.033	0.86008	5.935
LBD	−1.97970	−11.539	−1.16307	−12.727
Log likelihood function	405.6674		406.2195	
Akaike's Information Criterion	823.3348		824.4389	
Chi squared	811.3348		812.4389	
Mean	66.22		61.45	
Truncated Mean	66.11		49.30	
Median	31.59		31.29	
95% Confidence Interval	27.98–35.66		27.64–35.43	
90% Confidence Interval	28.53–34.97		28.19–34.73	

For the welfare measure using double-bounded approach, in contrast to the single-bounded approach, in this instance, the mean WTP is calculated by finding the area under the logit probability function of "yes" response. The mean value is RM66.22 for log-logistic model and RM61.45 with the log-normal model. The median is RM31.59 with a 95% confidence interval of RM27.64–RM35.66 for log-logistic model. The median is RM31.29 with a 95% confidence interval of RM27.64–RM35.43 for the log-normal model. As may be seen, using the Double Bounded approach results in more precise welfare estimates, although in this case the difference between the point estimates of mean WTP are rather small, the double-bounded approach giving somewhat lower values than the single-bounded approach.

5. Discussion and Conclusions

Tourism in Malaysia has grown to be an important industry, indeed it was the second largest contributor to GDP in 2000. Part of that tourism is nature-based tourism in marine parks, as Malaysia is rich in these natural resources. However, there are pressing issues with protecting natural attractions from degradation due to over use, and a need for more effective management of ecotourism as a vehicle to generate economic growth compatible with sustainable natural resource use. This study shows that visitors are willing to pay to reduce to reduce damage to coral reefs: in other words, they would respond positively to moves to reduce damages to these areas by increases in access fees.

Based on the statistical analysis of the visitors' profile**,** only 155 respondents out of 338 respondents (45%) interviewed think that the parks they visited were crowded on the day of the interview. More than half the respondents in Payar and Redang said that it was crowded but for Tioman, only 30% of respondents found the place to be crowded. Even though under half of all visitors said that the park was crowded on the day of the interview, they are still willing to pay higher than what they are paying now (RM5.00), if this means a reduction in environmental damages. From the double bounded method, visitors are found to be willing to pay between RM27 and RM35 (median estimates) to visit the park if they are to visit again with number of visitors reduced to half the number in 2000 (Payar 106,780; Redang 52,674 and Tioman 48,942 visitors). What is more, if the marine park authority charged RM31.00, with only half of the number of visitors in 2000 (amounted 104,198 visitors) to the three parks under study, the parks authority will be able to collect RM3,230,138.00. This is far higher than the revenue collected by the three parks in 2000 amounted RM1,123,687.00. These higher revenues could also be used in active management programmes to reduce damages to coral reefs. Differential pricing could be used, with higher fees being charged to overseas visitors than domestic visitors. This would be in accord with our estimation results, where foreign visitor WTP was found to be 66% higher than the local visitor WTP. It is already common for marine parks in other parts of the world to charge higher fees for foreigners than for nationals. Indeed, such two-tiered pricing may be more common in marine parks than in terrestrial parks. For example, in Belize, foreigners pay $2.50 at Hol Chan and $5 at Half Moon Caye, but Belizeans are not charged. In Egypt, foreigners at Ras Mohammed pay $5, while Egyptians pay $1.20.

The study analyses data using both single- and double-bounded method to compare both results. This study conforms to the previous literature by Hanemann *et al.* (1991) that stated "double-bounded dichotomous choice model is asymptotically more efficient than the single-bounded model resulting in tighter confidence intervals in double-bounded compared to the single-bounded model". The study chooses to use the median rather than the mean for welfare measure because the mean is very sensitive to slight changes in the shape of the distribution resulting from different estimation methods or outliers in the data, while the median is relatively robust (Hanemann, 1984). According to Harrison and Kristrom (1996), their calculations of the mean show that the mean is primarily determined by the shape of the right tail of the distribution, rather than by the actual data. Hence the mean is likely to be higher than one would be. Leon (1994) was also in favour of using median because (a) it tends to be more robust to the influence of extreme observations; and (b) it is consistent with the referendum approach to policy decision, i.e., with a majority rule for social welfare criterion.

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