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Public Valuation of and Attitudes towards the Conservation and Use of the Hawksbill Turtle: An Australian Case Study

Abstract

Managing hawksbill turtle populations for use and conservation requires (i) adequate scientific understanding of their population status and dynamics and (ii) consideration of the public's attitudes to this species. This study employs experimental surveys to assess the Australian public's attitudes towards the hawksbill turtle, their knowledge of it, their views about its sustainable commercial harvesting, and their support and financial contribution for the species' conservation. Contingent valuation reveals that the Australian public's willingness to contribute to the conservation of the hawksbill turtle is high even in comparison to threatened Australian bird and mammal fauna. Most of this stated contribution is based on the intrinsic (non-use) value associated with the hawksbill turtle. It seems that the Australian public will only accept its harvesting if the sustainability of this is assured and its population is more secure. The CITES categorisation of the hawksbill as an Appendix I species hampers the development of techniques for its sustainable use.

Keywords: attitudes, CITES, economics of conservation, *Eretmochelys imbricata*, hawksbill turtle, non-use economic value, sustainable use.

Public Valuation of and Attitudes towards the Conservation and Use of the Hawksbill Turtle: An Australian Case Study

1. INTRODUCTION

The hawksbill turtle *Eretmochelys imbricata* has substantial use value, and non-use values such as existence value to humans. Its shell has been prized by humans for its decorative value for centuries, especially in East Asia (Parsons, 1972; Hirth & Abdel Latif, 1980, p. 125). Overharvesting of the hawksbill turtle for crafting jewellery and ornaments during the 20th century caused a sharp decline in hawksbill turtle populations, raising concern for the species' survival (Groombridge & Luxmoore, 1989; Meylan & Donnelly, 1999). Trade in the species has been banned under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to protect it, but controversy continues between those wanting to resume its harvesting and trade and those who opposing this. For example, a Japanese lobby group favours reopening the tortoiseshell trade (Kaneko & Yamaoka, 1999) and Cuba had requested CITES permission to harvest its hawksbill turtle populations on a limited scale and to export accumulated tortoiseshell stockpiles (Republic of Cuba, 1998, 2000). The Marine Turtle Specialist Group of the World Conservation Union (IUCN), on the other hand, opposes such trade on the grounds that the species is 'critically endangered' (Meylan, 1998; Meylan & Donnelly, 1999).

Mrosovsky (1997, 2003) has criticised this IUCN classification, arguing that globally the hawksbill turtle is widespread. He argues for its sustainable management based on the controlled harvesting/farming and trade model similar to that for saltwater crocodiles *Crocodylus porosus* in Australia (Mrosovsky, 2000; Webb, 2002). But some marine turtle specialists are wary about this because of differences in the general biology, life cycles and life histories of sea turtles (see for example Mortimer, 1995; Bowen *et al.*, 1996; Campbell, 2002). Proponents of sustainable use of sea turtles nonetheless argue that the resilience of hawksbill turtle populations should not be underestimated since they have been harvested for millennia (Webb, 2000, 2002, p.21). Also, the only way to understand the sustainability of an ecological system may be through experimentation by exploitation (Hilborn & Ludwig, 1993, p. 551).

Aside from the natural scientific component, a workable framework for the management of living resources such as the hawksbill turtle requires an understanding of the socioeconomic component (Ludwig *et al.*, 2001). The attitudes, concerns and aspirations of the general public should be assessed (e.g., what they think about the resource, whether they would like to see it protected or exploited, whether they believe that it should be sustainably used, their willingness to donate funds or pay taxes to conserve the resource and so on). This study addresses these aspects. We used a sample of Brisbane residents to gauge the Australian public's attitudes towards the hawksbill turtle, its use and conservation. This is globally important because Australia has the largest remaining nesting populations of the hawksbill turtle in the world (Groombridge & Luxmoore, 1989; Loop, 1995; Limpus, 1995).

This paper is organised as follows. A brief overview of the hawksbill turtle and the issues surrounding it are provided first. An outline of the methodology of the experimental surveys comes next. The qualitative and quantitative results from the survey are then presented and discussed, and policy applications, limitations and conclusions follow.

2. BACKGROUND ON THE HAWKSBILL TURTLE

The hawksbill turtle is a medium-sized marine turtle identified by its beak-like jaw and a shell consisting of overlapping plates with attractive patterns of amber, yellow or reddish-brown (Cogger, 2000; Kemf *et al.*, 2000, p. 10; Cronin, 2001). It occurs in tropical and subtropical seas and nests in more than 60 countries (Groombridge & Luxmoore, 1989). In Australia, it occurs in reef habitats in tropical waters in north Queensland, the Torres Straits, the Northern Territory and Western Australia, extending down to warm temperate waters near northern New South Wales, but nests exclusively in the tropics (Cogger, 2000; Cronin, 2001).

Hawksbill turtles are eaten in many areas, such as in the Caribbean (Broderick *et al.*, 1994; UNEP-WCMC, 2004), but Australian Aborigines and Torres Strait Islanders consider them to be poisonous and rarely eat their meat (Thomson, 1934, p. 255, cited in Smith, 1987, Ch. 5; Limpus & Parmenter, 1988, p. 154). Their eggs are widely collected and eaten (UNEP-WCMC, 2004). Commercially, the hawksbill turtle has been primarily harvested for its shell in order to produce ornaments. In Japan, the tortoiseshell craft is a cultural tradition involving a multi-million dollar industry (Kaneko & Yamaoka, 1999; TRAFFIC, undated).

The hawksbill turtle was first listed in Appendix I of CITES in 1975 (CITES, 2005). Commercial trade in the species was phased out and ceased with Japan's withdrawal of its CITES trade reservation in 1992. Nevertheless, illegal exploitation of hawksbill turtles for tortoiseshell and for stuffed souvenirs continues (Plotkin, 1995; Bjorndal, 1999; van Dijk & Shepherd, 2004). Hawksbill turtles are under continuing threat from harvesting for domestic consumption, poaching of eggs, loss of nesting beaches and feeding grounds, predators, fisheries by-catch, and their ingestion of synthetic materials (NMFS & USFWS, 1993; Plotkin, 1995; Meylan and Donnelly, 1999). In 1996, the hawksbill turtle was listed as 'critically endangered' in the IUCN Red List of Threatened Species (Red List Standards & Petitions Subcommittee, 1996). However, the local Australian hawksbill turtle population is relatively secure and is listed only as 'vulnerable' under the Australian *Environment Protection and Biodiversity Conservation Act 1999* (Australian Government Department of the Environment and Heritage, 2004).

The farming of hawksbill turtles is seen by some as a conservation strategy that can potentially reduce harvest pressures on wild populations (Ross, undated). Hawksbill turtle farming and ranching is still at the experimental stage. According to Ross (undated) full-scale commercial stage has not developed because successful farming and ranching are hindered by the animal's biology (Ehrenfeld, 1982, p. 462), high costs, the high degree of technical knowledge required and unproven economic returns. In Australia, Crocodylus Park near Darwin is in the forefront of research designed to develop methods to farm this species successfully.

3. METHODOLOGY

3.1 Choice of Sampling Location

Brisbane was chosen as the sampling location for several reasons. First, the researchers are located there and this kept the cost of conducting the survey down. Second, Brisbane is the capital of Queensland and the southeast quarter of Queensland centred around Brisbane contains three-fourths of Queensland's population (Australian Bureau of Statistics, 2005). Third, hawksbill turtles occur primarily in the tropics, and although their distribution extends into southeast Queensland, they are rarely seen there. Thus Brisbane residents may have less information about the hawksbill turtle than would residents of north Queensland, and consequently, the provision of information as part of our experimental survey would have a

more pronounced effect on them and reveal more clearly possible changes in attitudes as a result of increased knowledge.

3.2 Sample Selection and Size

The sample of participants was obtained as follows. In 2002, 1,500 circulars were disseminated by letterbox drops in a mix of suburbs with differing socioeconomic characteristics. Recipients were invited to participate in a survey about the conservation and use of Australia's tropical natural resources. The precise aims of the survey were withheld to minimise the risk of self-selection bias. In the circulars, it was mentioned that those who attend the survey sessions will be given $20 for their participation, refreshments, a lecture presentation, free parking at The University of Queensland and an opportunity to win $200 in a lucky draw (note: all dollar values mentioned in this paper refer to the Australian dollar). Potential participants were told that survey sessions would be available on weekdays as well as weekends. This flexible arrangement was intended to ensure that no potential participant would be excluded because of work or similar commitments. Those expressing an interest in participating were told to phone a facilitator, who then selected the sample of 204 survey participants from the responding pool to match the age distribution of Brisbane for persons 18 years old and older.

3.3 The Conduct of the Experimental Survey

The surveys were based on two questionnaires, Survey I and Survey II, which were pre-tested on a group of university students and modified to improve clarity. The survey participants met mostly at The University of Queensland and were divided into five groups of about 40 for the survey sessions. At the beginning of each session, participants were asked to fill out Survey I. This questionnaire inquired about their background and asked various questions about 24 Australian tropical wildlife species comprising of reptiles (including the hawksbill turtle), mammals and birds. This procedure took roughly one hour. Participants were then given refreshments. In the second half of the session, participants attended a lecture focusing mainly on the mahogany glider *Petaurus gracilis*. After this, participants were given a booklet and the Survey II questionnaire.

The booklet contained colour photographs and information about all the species in the survey such as descriptions of their appearances, life histories, geographical distributions and conservation status. Participants were informed in the booklet of the IUCN's international

conservation status of the hawksbill turtle rather than the Australian one. Information about each species was brief, of approximately equal amounts, and factual. Participants were instructed to take the booklet home, read it and then fill out the questionnaire for Survey II before returning it in the self-addressed, stamped envelope provided. Survey II contained similar questions about the wildlife species to those in Survey I. These were to enable comparison of participants' responses before and after information provision about the species. After a fortnight, participants who did not return completed Survey II questionnaires were contacted by phone. All Survey II forms were eventually returned.

In both Survey I and Survey II, participants were asked three types of questions about the hawksbill turtle: (i) questions about their knowledge of it and feelings towards the species, (ii) questions about how much they value its conservation, and (iii) questions about its harvesting and use. Details of these questions are in the results section.

4. RESULTS

4.1 Participants' Level of Knowledge of the Hawksbill Turtle

Participants were asked whether they know the hawksbill turtle, and if they did, to rate their knowledge of the species on a Likert scale. The knowledge statements provided were 'very good', 'good', 'poor' and no knowledge of the species. Participants were also asked whether they have seen the animal or not.

Of the five Australian reptile species (listed later) assessed by participants, the hawksbill turtle was initially the least known: in Survey I, only 42% of participants said that they knew the species and slightly more than a quarter of participants claimed to have actually seen it. In contrast, at least two-thirds of the participants said they knew (and between almost half to nine-tenths said that they had seen) the other reptile species in the set. Of those stating that they know the hawksbill turtle, one person (1.2%) claimed that her knowledge of the species is 'very good', 28.2% stated that their knowledge of the species is 'good' but 70.6% said that their knowledge of the hawksbill turtle is poor.

After information provision (the booklet of readings), Survey II results show that 92% of participants claimed to have knowledge of the species. The increase between surveys is statistically significant (McNemar's test: $\chi^2 = 75.0$, $p < 0.0001$). Of these participants, eight

(4.2%) said that their knowledge of the species is 'very good', 52.9% mentioned their knowledge is 'good' and 42.8% stated that their knowledge is poor.

4.2 The Likeability of the Hawksbill Turtle and Support for its Survival

Employing a Likert scale again, participants' likeability of the species was measured. The reptile species assessed are those listed in the table in the following sub-section. Respondents were asked to state whether they 'strongly like', 'like', 'dislike' or 'strongly dislike' the species, or are 'uncertain of feelings towards the focal species'. In addition, participants were asked whether they are in favour of the continued existence of the species or not, or whether they are indifferent to it. Support for survival is indicated by the proportion of participants who responded 'yes' to the question of whether they favoured the continued existence of the hawksbill turtle.

The hawksbill turtle was initially the second most liked reptile species in the focal set, with 71.1% of all participants stating that they either 'strongly like' or 'like' it (77.5% for the northern long-necked turtle, *Chelodina rugosa*). In Survey II, a change in the order of likeability occurred. The hawksbill turtle overtook the long-necked turtle to become the most liked reptile species: 87.3% of participants stated that they either 'strongly like' or 'like' the species (compared to 82.4% for the northern long-necked turtle). The increase in likeability for the hawksbill turtle is statistically significant (McNemar's test: $\chi^2 = 12.1$, $p = 0.0005$). Almost a quarter of participants stated initially they were uncertain of their feelings towards the hawksbill turtle, but with information provision, the percentage of participants expressing ambivalence in Survey II fell by two-thirds.

Support for the survival of the hawksbill turtle was high— 95.1% in Survey I (second highest after the long-necked turtle) but was 96.1% in Survey II, the highest amongst the reptilians considered. In contrast, the least liked species in the set, the taipan snake *Oxyuranus scutellatus* recorded 82.8% and 86.3% respondents in favour of its survival in Survey I and Survey II respectively.

4.2 Comparative Willingness of the Public to Allocate Given Funds for the Conservation of the Hawksbill Turtle (Fixed-Pie Allocation amongst the Reptilians)

A fixed-pie financial allocation question involving the reptile species was asked. This question format has been used in wildlife valuation studies, such as those by Samples et al.

(1986), Tkac (1998), DeKay & McClelland (1996) and Gunnthorsdottir (2001), and has the advantages of reducing income effects and minimising strategic bias. The following question was posed:

Suppose that you are given Aus $1,000, but you can only use it to donate funds to support the conservation of the reptiles in Australia listed below. Suppose that a reliable organisation were to carry out the conservation work and your money would supplement other funds for this purpose. What percentage of your $1,000 would you contribute for the conservation of each of the reptiles listed below? Your total should add up to 100%.

Reptiles	**(%)**
Saltwater crocodiles	
Freshwater crocodiles [*Crocodylus johnstoni*]	
Hawksbill sea turtles (a marine species with a beautiful shell)	
Northern long-necked turtle (freshwater) turtle	
Taipan snakes (also know as Fierce snakes)	
	100

The average allocations of funds by participants for each species in Survey I and Survey II were calculated. Only responses from participants who gave clear answers in both surveys for the species were used in calculations in order to ensure comparability of average values in both surveys.

The hawksbill turtle received the largest mean allocation amongst the species, 33.5% in Survey I and 48.2% in Survey II (Figure 1). After information provision, the only increase in allocation for any species was for the hawksbill turtle. This increase is statistically significant (Wilcoxon test: $W = -6.70$, $p < 0.0001$, $n = 193$). Decreases in the allocation for the other reptiles are all significant except that for the taipan snake.

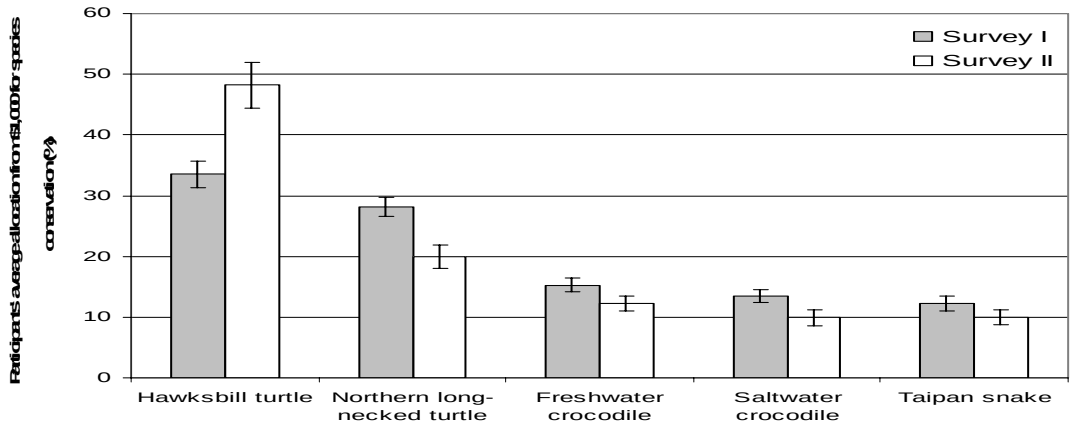

Figure 1: Participants' allocation of a hypothetical sum of $1,000 to conservation organisations to help conserve the reptile species in the study.

4.3 Stated Willingness of the Public to Contribute Their Own Funds to Support the Conservation of the Hawksbill Turtle (Donation Specifically for the Hawksbill Turtle)

Participants were asked how much money they would contribute from their own pockets for conserving the hawksbill turtle. The format of this contingent valuation question is the single dichotomous choice format, where participants are asked whether they will agree to pay to an $\$X$ amount for an environmental improvement. The dichotomous choice format was recommended for contingent valuation by the blue-ribbon NOAA panel (Arrow et al., 1993) because it avoids many biases (but not all) that can result from other contingent valuation formats (Cameron & Quiggin, 1994, p. 218). The following was put to participants:

Now assume that there is a campaign to raise funds to protect Hawksbill sea turtles that nest on the beaches of northern Australia. In this case, would you be willing to have your take-home income or income from other sources reduced by $2 a week, that is, about $100 per year, for the next ten years to conduct research, protect and conserve Hawksbill turtles that nest on the beaches of northern Australia?

☐ Yes ☐ Would like to pay more ☐ Would like to pay less

If they were willing to pay more (or less), they were then asked to state the amount.

Table 1 shows the distribution of participants' responses. Note the large concentration on $2. This may indicate starting point bias (Mitchell & Carson, 1989, p. 24; Herriges & Shogren, 1996).

Table 1:

Distribution of responses concerning participants' willingness to donate $2 a week for ten years towards the conservation of hawksbill turtles in northern Australia

Responses	Survey I *n* (%)		Survey II *n* (%)	
Participants who are willing to pay just $2	95	(46.6)	102	(50.0)
Participants who would like to pay more	6	(2.9)	4	(2.0)
Participants who would like to pay less	88	(43.1)	88	(42.2)
Non-responses	12	(5.9)	11	(5.4)
Others	3	(1.5)	1	(0.5)
Total	**204**	**(100)**	**204**	**(100)**

There were no statistically significant differences at the 95% confidence level between the percentage of participants willing to pay $2 or more and the percentage of those who would like to pay less in both surveys (chi-square goodness-of-fit: $\chi^2_{\text{Survey I}} = 0.89$, $p = 0.35$; $\chi^2_{\text{Survey II}} = 1.67$, $p = 0.20$).

Based on participants who responded properly to the above question in both surveys, the average weekly willingness-to-pay for hawksbill turtle conservation was calculated. For Survey I and Survey II, the average amounts are $1.58 and $1.63 weekly respectively, or $82.16 and $84.76 annually. A Wilcoxon test reveals no significant difference between the values in both surveys ($W = 1099$, $p = 0.97$, $n = 171$).

Participants were then asked:

What percentage of this payment (roughly) depends on your personal chances of being able to see Hawksbill sea turtles in the wild (not in an aquarium), or you benefiting ***personally and directly*** *from their presence in the sea?*

☐ 0-20 ☐ 21-40 ☐ 41-60 ☐ 61-80 ☐ 81-100

The distribution of responses is summarised in Figure 2.

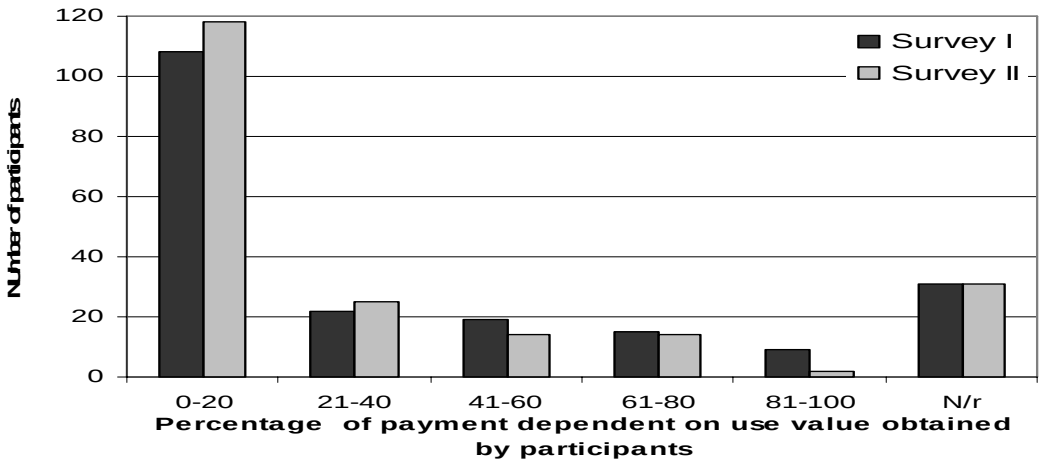

Figure 2: Distribution of participants' responses to the question asking what proportion of their donations is dependent solely on the instrumental use value of the hawksbill turtle.

The majority of participants (52.9% in Survey I and 57.8% in Survey II) stated that only 20% or less of their donation depends on their personally benefiting from the hawksbill turtle. The difference in the proportion of participants in this class between surveys is not statistically significant (McNemar's test: $\chi^2 = 0.45$, $p = 0.50$). In contrast, only 21.1% of participants in Survey I and 14.7% in Survey II stated that an average of 50% or more (classes 41-60% to 81-100%) of their payment depends on instrumental value. The difference observed in the proportion of participants in these classes between surveys is not statistically significant (McNemar's test: $\chi^2 = 0.43$, $p = 0.51$). The proportion of participants who fall into the 0 to 20% class is significantly larger than the proportion of participants in all the other classes put together (chi-square goodness-of-fit: $\chi^2_{\text{Survey I}} = 10.69$, $p = 0.0011$; $\chi^2_{\text{Survey II}} = 22.94$, $p < 0.0001$). This indicates that the stated decision of most participants to donate funds to conserve the hawksbill turtle is dominated by its non-use value rather than its use value. This is supported by the statements of respondents who were asked to state briefly why they chose the percentages they did.

In Survey I, around a third of participants who were willing to pay to conserve the hawksbill turtle said that they would like to see it. Two-thirds said that their payment does not depend on their seeing the animal. In Survey II, an even smaller proportion of participants (around 15%) stated that they would donate and hope to see the animal, whereas 85% now stated that their payment does not depend on seeing the turtle. Comments by participants who said their payment does not depend on seeing the animal included the following:

Would just like to know or would be happy to know the species survives; personal needs are not important; happy to contribute to the cause; feel good to know it [the hawksbill turtle] exists; its existence is important regardless of personal benefit.

4.4 Stated Willingness of the Public to Donate Their Own Funds for Conserving Each of Three Species including the Hawksbill Turtle

Participants were asked to assume that there was a campaign to raise money to conserve three species from different taxa – the tree kangaroo *Dendrolagus lumholtzi*, an endemic mammal IUCN-classified as near threatened; the golden-shouldered parrot *Psephotus chrysopterygius*, an endangered endemic bird; and the hawksbill turtle (a globally distributed reptilian) IUCN-classified as critically endangered (IUCN, 2004). They were requested to state the maximum amount they would be willing to pay weekly, for each of the species, for the next 10 years. They were told to bear in mind that the money would have to come from their budget. The average maximum amounts of participants' willingness to pay are shown in Table 2.

Table 2:

Open-ended contingent valuation: average amount of money in dollars participants are willing to donate weekly/annually for the conservation of the listed three species (*n* = 168)

Species	Survey I $		Survey II $	
	Weekly	Annually	Weekly	Annually
Tree kangaroo	1.15	59.80	1.47	76.44
Golden-shouldered parrot	1.14	59.28	1.49	77.48
Hawksbill turtle	1.30	62.60	1.40	72.80
Total	3.59	186.68	4.36	226.72

A Friedman test was performed to compare these mean amounts between species in both surveys. The average amounts are highly significantly different in Survey I ($\chi^2 = 19.48$, $p < 0.0001$) but are only significantly different in Survey II at the 95% confidence level ($\chi^2 = 8.19$, $p = 0.02$). There is no statistically significant difference in the average amounts for the hawksbill turtle in Survey I and Survey II (Wilcoxon test: $W = -0.42$, $p = 0.68$). The increase in the average amount for the tree kangaroo is statistically significant at the 90% confidence level (Wilcoxon test: $W = -1.74$, $p = 0.08$) and for the golden-shouldered parrot, the increase is statistically significant at the 95% confidence level (Wilcoxon test: $W = -2.48$, $p = 0.013$).

The amount of money pledged for the conservation of hawksbill turtle is larger than those for the other species in Survey I, but in Survey II, the average amounts for the tree kangaroo and the golden-shouldered parrot increase and converge with that for the hawksbill turtle. Between surveys, there is no statistically significant difference at the 95% confidence level in the total average amounts participants are willing to contribute for the conservation of all three species (Wilcoxon test: $W = -1.60$, $p = 0.11$).

Observe that the average amount of money participants stated they are willing to donate to the hawksbill turtle when considered together with the tree kangaroo and the golden-shouldered parrot is smaller than the average amount they were willing to give to the hawksbill turtle when its conservation is valued on its own (Table 3).

Table 3

Comparison of participants' average willingness to pay weekly/annually for the conservation of the hawksbill turtle when valued on its own and when valued with two other animal species

	Hawksbill turtle conservation				
	Valued on its own \$ (*n* = 168)		**Valued with two the tree kangaroo and golden-shouldered parrot \$ (*n* = 171)**		**Mann-Whitney test**
	Weekly	**Annually**	**Weekly**	**Annually**	
Survey I	1.58	82.16	1.30	67.60	$U = 10960$, $p = 0.0001$
Survey II	1.63	84.76	1.40	72.80	$U = 11051$, $p = 0.0001$

4.5 Attitude of Participants towards the Sustainable Commercial Harvesting and Use of the Hawksbill Turtle

Participants were asked whether sustainable commercial harvesting of the hawksbill turtle from the wild should be allowed. They were to choose between the following responses: 'Yes', 'No', 'Indifferent' and 'Unsure'.

The majority of participant in both surveys disagreed with the statement that sustainable commercial harvesting of the hawksbill turtle from the wild should be allowed (Table 4) but almost 20% of participants in Survey I and Survey II supported the harvesting proposition.

The proportions of responses are only slightly different in both surveys but there was a small increase in opposition to harvesting and a small decrease in the proportion unsure about it.

Table 4:

Distribution of responses of participants for the question of whether sustainable commercial harvesting of the hawksbill turtle from the wild should be allowed

Responses	**Survey I**		**Survey II**	
	***n* (%)**		***n* (%)**	
Yes	39	(19.12)	38	(18.63)
No	127	(62.25)	136	(66.67)
Indifferent	5	(2.45)	6	(2.94)
Unsure	28	(13.73)	19	(9.31)
Non-responses	5	(2.45)	5	(2.45)
Total	**204**	**(100)**	**204**	**(100)**

Participants were also asked the following question about the use of hawksbill turtle for human consumption:

Do you agree that use of shells of hawksbill turtles for making jewellery and other products for commercial use should be banned?

☐ Yes ☐ No ☐ Unsure

Most agreed that the use of tortoiseshell should be banned (61.3% in Survey I and 62.7% in Survey II). The main reasons given are that the species is endangered, that we should not kill the animal for commercial purposes or to beautify humans or for personal utility and there are other substitute materials for making jewellery.

A larger proportion of participants opposed this ban in Survey II (17.2%) than in Survey I (10.3%) but this difference is not statistically significant (McNemar's test: $\chi^2 = 0.48$, $p = 0.49$). The main reason given was that use of its shell should not be banned as long as the practice is sustainable or if the species is not endangered.

Most participants who stated they were unsure about the proposition to ban the commercial use of hawksbill turtle shell mentioned that their decision would depend on whether the species existence will be jeopardised. Some also stated that they were unsure but would agree

to use if shells were obtained from already dead turtles or if sustainable approaches are possible.

5. APPLICATIONS AND LIMITATIONS

If the point values listed in Table 3 can be transferred from the sample to larger groupings of the public, estimates of the aggregate willingness of these groups to pay for the conservation of the hawksbill turtle can be obtained (see for example Bateman *et al.*, 2000). For example, Table 5 gives the results if our sample is representative for the larger Brisbane area (southeast Queensland), Queensland and for Australia. The annual sums in Table 3 have been multiplied by the adult population (2004 estimates) of southeast Queensland (2.28 million), Queensland (2.9 million) and Australia (15.31 million) respectively (Australian Bureau of Statistics, 2005), following Bateman et al. (2002, Ch. 9).

Table 5:

Point estimates of annual willingness to pay in millions of dollars of adult Queenslanders and the aggregate Australian population for the conservation of the hawksbill turtle

	If only for the hawksbill turtle $ (mil)			**If for the hawksbill turtle plus the two other species $ (mil)**		
	Southeast Queensland	**Queensland**	**Australia**	**Southeast Queensland**	**Queensland**	**Australia**
Survey I	187.3	238.3	1257.9	154.1	196.0	1035.0
Survey II	193.3	245.8	1297.7	166.0	211.1	1114.6

Even the smallest of the sums in Table 5 is considerable. This table indicates, for example, that if the *only* increased conservation expenditure is on the hawksbill turtle in Australia then there would be a social economic benefit for spending up to $1297.7 million on this annually. This assumes that the potential Paretian improvement criterion (also called the Kaldor-Hicks criterion) applies (Tisdell, 2005, Ch. 1). The sum is slightly higher if the public is better informed, and somewhat lower if increased expenditure on conserving other species is also planned.

Willingness to pay for the conservation of the hawksbill turtle is lower when funds are simultaneously requested for its conservation and for that of the tree kangaroo and the golden-shouldered parrot. This is probably mainly a result of income constraints on the

willingness of individuals to pay. The differences may, however, also reflect the fact that when the hawksbill turtle was considered alone for donations, the dichotomous choice method of contingent valuation was used with a common starting point of $2 whereas in the latter case involving the three species, the single bid method was adopted. The common starting point of $2 may have imparted some upward bias in the initial case. In the single bid case, according to Bishop and Heberlein (1990), estimates are usually on the conservative side.

However, caution is required in relying on the willingness-to-pay aggregation method. The validity of the aggregation depends on how similar the wider populations are to the sample. The wider the geographical area of a selected population, the more likely is it to diverge significantly from the sample and the less reliable is the aggregate estimate. Thus in the above case, one would expect the aggregation estimate for southeast Queensland to be more reliable than that for Queensland, and the Queensland estimate in turn is likely to be more reliable than that for Australia.

Projecting the above estimates in a similar way globally would not be appropriate given the diversity of human populations and considerable socioeconomic variations between countries. However, there may be some willingness to pay from those outside Australia for conservation of hawksbill turtles in Australia. Less additional support might be available for the conservation of the tree kangaroo and the golden-shouldered parrot. Thus globally, there may be more support for conserving the hawksbill turtle than the golden-shouldered parrot even though the available evidence indicate that the endemic golden-shouldered parrot, found only in two small areas of north Queensland (Garnett and Crowley, 2002), is at greater risk of extinction than the hawksbill turtle.

6. DISCUSSION AND CONCLUSIONS

From our study, we can infer that fewer Queenslanders know about the hawksbill turtle than about more common reptiles such as the crocodiles. Although less than half of our sample claimed any knowledge of the hawksbill turtle initially, a much greater proportion of participants expressed their liking for the species. This positive attitude may have stemmed from the charismatic and gentle nature that turtles are seen to possess in general. The likeability of the hawksbill turtle increased significantly in Survey II after information

provision, and it ranked highly amongst several mammal and bird species considered in our overall study (see Tisdell *et al.*, 2005).

Participants stated that they were willing on average to pay sums of $67.60 and $84.76 annually for 10 years for the conservation of the hawksbill turtle. These sums are about as large as those payments to conserve each of two species from the bird and mammal taxa with different conservation status. The likeability and the critically endangered conservation status of the hawksbill turtle may explain the high level of willingness to pay for its conservation. Many of the participants ascribed 80% or more of their payment to the hawksbill turtle's non-use values, such as its existence and bequest values, and only a small portion to the species' direct or indirect use values. Participants value the hawksbill turtle highly for its intrinsic worth.

Although most participants opposed the sustainable commercial harvesting of hawksbill turtles from the wild (about two-thirds in Survey II), close to 20% of participants in both surveys supported the proposition. Most participants seemed to be dubious about the possibility of attaining sustainable commercial harvesting given the IUCN classification of the hawksbill turtle as critically endangered. Most participants opposed the use of hawksbill turtle shell for the production of jewellery and ornaments on grounds that it is unethical to kill an animal for beautifying humans rather than for food, especially if it belongs to a species that is highly endangered.

We did not ask participants whether they favoured or opposed the possible farming or ranching of hawksbill turtles. They may have been more supportive of closed or relatively closed-cycle farming of hawksbill turtles than their sustainable commercial harvesting from the wild. Support for ranching of hawksbill turtles might be intermediate between these two possibilities. However, given the CITES ban on commercial trade in hawksbill turtle products, the development of hawksbill turtle farming and ranching faces an uphill economic battle. Even if economic methods for farming the hawksbill turtle could be developed, uncertainty about whether the marketing of these products will continue to be banned is a major commercial deterrent to this development and, therefore, to the development of techniques that could potentially result in the sustainable commercial use of this species.

Furthermore, if the degree of endangerment of this species is exaggerated by the IUCN, as has been claimed (Mrosovsky, 2003), this adds to the public's opposition to commercial use of the species. Tisdell *et al.* (2004) found for example that the public's opposition to the sustainable commercial harvesting of wildlife species increases with the extent to which they believe it to be endangered. This creates a policy dilemma. Although the Convention on Biological Diversity favours sustainable use of species as a way of conserving these (Secretariat of the Convention on Biodiversity, undated a, undated b), CITES bans the commercial use of endangered species and thereby hampers the potential development of methods for their sustainable use. The conservation situation of the hawksbill turtle highlights the problem.

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