



Economic valuation of the coral reefs of Hawai'i

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Short title: Recreational value of coral reefs, Hawaii

Key Message: An economic valuation study targets a reduction in reef damage due to tourism and results in legal action through the implementation of a penalty bill.

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Picture 1: The marine life in the Hawaiian seas
Courtesy: Pieter van Beukering



Picture 2: The sunset at Maui, Hawaii
Courtesy: Pieter van Beukering

What is the problem?

The state of Hawaii (Main Hawaiian Islands) is bequeathed with over 410,000 acres of coral reefs. Coral reefs are integral to the economic wellbeing of the Hawaiian people. Tourists from around the world visit Hawaii to dive or snorkel to see the reefs. There are about 200,000 divers and more than 3 million snorkelers who enjoy the Hawaiian reefs every year. Furthermore, 2002 estimates show that there are over 100 dive and snorkeling operators registered in Hawaii who earn between \$50 to \$60 million per annum (Cesar et al, 2002)¹.

However, tourism has drawbacks to the health of the coral reefs. Divers often stir up sediment, disturb and trample the coral and algae, drop trash, feed the fish and leave a slick of suntan

¹ These values refer the whole of Hawaii, not just the Hanauma Bay area

lotion on the bay's surface (Cesar et. al, 2002). More generally, mismanaged tourism could lead to irreparable damage to the coral reefs and decrease the attractiveness of Hawaiian reefs and diminish future gains from tourism. Therefore, there is a need to both carefully manage tourist inflow and alert incoming tourists about the possible damages they may cause to the coral reefs and how they can avoid this.

What ecosystem services were considered and how?

Coral reefs provide a multitude of goods and services. Goods comprise of the renewable resources which include sea food, raw materials and medicines. The reefs also provide coastal protection services by absorbing wave energy. Additionally, the reef ecosystem generates bio-geo-chemical services including nitrogen fixation and CO₂ production (Moberg and Folke, 1999)². Amongst these ecosystem services, the coral reefs of Hawaii generate substantial economic value through socio-cultural activities spawning from recreation, tourism, gaming as well as religious and spiritual values (Moberg and Folke, 1999)

Which approach was taken?

This study uses the Hanauma Bay Nature Preserve as a case in point. The Hanauma Bay receives about 3000 tourists a day or 1 million tourists a year. However, this is far lower than the pre-1998 estimates of 3 million tourists a year (Beukering et al, 2002). The fall in tourists was an intentional outcome of policies introduced by the Nature Preserve that recognized the damage caused to the marine ecosystem³. In 2002, an educational centre was established to require every tourist to watch a 9-minute video about coral reefs, geology, oceanography, fishes and marine conservation. The centre cost an initial \$13.5 million and is estimated to cost \$0.5 million a year for functioning. The additional costs of the education program aggregate over time to an amount of \$29 million per year at a discount rate of 4%.

The case study aimed to (a) determine the value of the reef at Hawaii, specifically for Hanauma Bay (and the consumer surplus) and accordingly surmise an appropriate entrance fee, and (b) evaluate the effectiveness of the investment in the education center in terms of costs and benefits.

Both the Travel Cost (TC) and the Contingent Valuation Method were used to calculate the consumer surplus. Using the Travel Cost method, all tourists were segregated into 14 zones according to their travel time to visit the Hawaiian reefs. Unsurprisingly visitation rates fell dramatically with distance. Next, the travel costs were determined for the visitors from different zones. Three type of travel-related costs were included: (1) the actual costs of transportation; (2) the costs related to the travel time; and (3) the local expenditures. To calculate the consumer surplus a choke price was needed. The choke price is defined as the price at which visitation is zero. In this case the choke price was assumed to be \$3,805 or roughly twice the actual average costs per visitor.

What did the results show?

² On geologic time scales, reefs act as sinks for CO₂; but are minor net sources of CO₂ on time scales relevant to humans.

³ A fish feeding ban, a smoking ban and a prohibition on fishing and alcoholic beverages was introduced in 1998 as well as an entrance fee. Furthermore, the city bus service to the bay was limited to one bus arrival every half-hour. Parking along Kalaniana'ole Highway, which leads to the bay from Honolulu and from O'ahu's northeast side, was also prohibited.

1. Reef associated consumer surplus for 2001 was \$97 million using the Travel Cost Method and \$133 million using the Contingent Valuation Method. After adding the direct and indirect expenditure to the CVM value the study finds the total recreational value of the coral reefs in 2001 at \$304 million.
2. Furthermore, the study adds the recreational value to the other valuations of the reef ecosystem – amenity values, biodiversity, fisheries and educational spill over values to find the total value of the Hawaiian reefs at \$364 million for the year 2001. Using this with a time period of 50 years, a discount rate of 3% and the assumption that benefits remain constant over time, we find the net present value of the coral reefs of Hawaii at \$10 billion.
3. For Hanauma the recreational value is estimated at \$36 million per year as of 2001. The total annual benefits are estimated at \$37.57 million or a NPV of \$1 billion in 2001.
4. The study also found that that without the education centre there would be a fall in the coral cover from 27% to 19%. But with the education centre there would be some decrease in careless damage to the reef and the coral cover would remain around 27%. In monetary terms this implies that there will be a fall in the annual benefits to \$35 million in 2050 (in the scenario of no education centre). In the scenario with the education centre net benefit will increase to \$100 million a year (at a discount rate of 4%). This far exceeds the cost of the program (~\$29 million a year).

What input was required to do so?

A survey was conducted in 2001/02, carried out by SMS Research. Roughly 450 tourists and residents were interviewed at various locations to retrieve specific information about their perception of different types of coral habitats. Two types of approaches were followed. First, face-to-face interviews were held with snorkelers and scuba divers as well as with other tourists and residents at the airport and other selected locations. Second, snorkelers, divers and others were handed out a card with an internet-address, inviting them to fill out a questionnaire after their last diving experience. At Hanauma Bay, 152 interviews were conducted. Of these, 97 surveys were self-administered, i.e., respondents were handed surveys which they filled out and returned them to the interviewer.

What was the policy uptake, and what were the conditions for this effort to actually influence public management?

Voluntary donation scheme: Recognizing the need to support the state's work, dive and snorkel operators and local conservation organizations joined forces in 2005 to raise money for marine conservation on the Big Island and Maui. Through an innovative new program called the Reef Fund, dive and snorkel operators solicit voluntary donations from their clients to fund high priority marine protection programs on their islands, such as the repair and installation of mooring buoys, the protection of nesting and resting beaches for rare and endangered sea turtles and monk seals, and the establishment of local education and outreach programs to protect marine resources (Beukering et al., 2010). While the majority of other fee-based marine protection funds around the world are mandated by the local or national governments, Hawaii's fund is voluntary. On Maui, the Reef Fund is coordinated by the local non-profit Hawaii Wildlife Fund. On the Big Island, the fund is managed by the Waimea-based non-profit Malama Kai. Donations collected by marine recreation operators are pooled into a collective fund on each island, and managed by the non-profit which is advised by a committee of operators,

conservationists, scientists, and other stakeholders. The advisory committees decide how the funds will be spent on their islands (Beukering et al., 2010).

Reef damage penalty bill: There was an absence of penalties for reef damage due to the inability to determine a reasonable penalty. The bill H.B.3176 was proposed in 2008 to allow the Department of Land and Natural Resources (DLNR) to impose a fine for large-scale reef damage (State of Hawaii, 2008). In setting the level of the penalties, ample use was made of an economic valuation study for coral reefs in Hawaii (Cesar and van Beukering, 2004). This is a case where an economic valuation has been used as a measure to determine the possible loss and penalize the violator.

References

Beukering, P.v. and Cesar, H. (2004) Ecological Economic Modeling of Coral Reefs: Evaluating Tourist Overuse at Hanauma Bay and Algae Blooms at the Kihei Coast, Hawai'i, *Pacific Science* 58(2), 243-260.

Cesar, H. S. J., P. J. H. van Beukering, W. Pintz, and J. Dierking. 2002. Economic valuation of the coral reefs of Hawai'i. Hawai'i Coral Reef Initiative, University of Hawai'i, Honolulu. 123 pp.

Beukering, P.v., P.J.H., R. Slootweg and D. Immerzeel (2010) Valuation of ecosystem services: influential cases (Annex). In: Slootweg, R., A. Rajvanshi, V.B. Mathur & A. Kolhoff. Biodiversity in Environmental Impact Assessment. Cambridge University Press. 334-398.

Cesar, H.S.J. & Beukering, P.J.H. van (2004). Economic valuation of the coral reefs of Hawaii , *Pacific Science*, 58(2), 231-242.

Jokiel, P.J., E. K. Brown, A. Friedlander, S. K. Rodgers and W.R. Smith (2001), "Coral Reef Assessment and Monitoring Program (CRAMP) - Final Report 1999-2000, Hawaii Coral Reef Initiative, SSRI, University of Hawaii, Oahu, Hawaii, USA.

Moberg, F. and Folke, C. (1999) Ecological Goods and Services of Coral Reef Ecosystems. *Ecological Economics* (29) 2: 215-33.

State of Hawaii (2008) HB.3176, Relating to Administrative Penalties for Damage to Stony Coral and Live Rock. A Bill For An Act. House Of Representatives, Twenty-Fourth Legislature, 2008. State Of Hawaii.

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Picture 3: Diving is an important recreational activity
in Hawaii
Courtesy: Pieter van Beukering



Picture 4: An aerial view of the Molokini Islands in
Kehei, Hawaii
Courtesy: Pieter van Beukering