Journal of Environmental Science and Management 21-2: 94-101 (December 2018) ISSN 0119-1144

Estimating the Recreational Benefits of Coral Restoration in Northwestern, Philippines

ABSTRACT

In this study, the recreational value of restoring corals reefs was estimated in the context of a site in Northwestern Philippines. This study applied the travel cost method with a variation that integrates a contingent behavior question. This allowed for the estimation of marginal benefits in the context of a change in recreational asset quality. The recreational study site, including the reef in its damaged state, gave rise to average per visit benefits of around US$63.00. With a restored reef, that average value increased to approximately US$113.00 per visit. Hence, the average marginal benefits associated with an investment in reef restoration for this case study site is in the order of US$50 per visit, with a 95% confidence interval of US$0.72 million to US$3.34 M yr^{-1}.

Key words: *travel cost method, contingent behavior, coral restoration, larval enhancement*

Tara Alessandra S. Abrina[1,2*]
Jeffrey William Bennett[3]

[1] Marine Environment and Resources Foundation, Inc.
[2] University of the Philippines School of Economics, Diliman, Quezon City, Philippines
[3] Crawford School of Public Policy, Australian National University, Canberra ACT 0200, Australia

*Corresponding author: taraabrina@gmail.com

INTRODUCTION

Previous environmental valuation studies in Northwestern Philippines have shown that coral reefs in the area play an important role in aquaculture, wild-caught fisheries, and coastal protection (*Cruz-Trinidad et al. 2009*; *Cruz-Trinidad et al. 2011*). However, no previous studies have considered the benefits generated by investments in active coral reef restoration in the Philippines. This is a serious omission given that decades of coral damage from different causes are now providing the impetus for interventions that aid in reef recovery (*dela Cruz and Harrison 2017*). Without estimates of the marginal benefits generated by investments in restoration activities, assessment of the net social value of such interventions cannot be made successfully.

Coral reef rehabilitation and restoration has been explored from a technical perspective over the past two decades (*Harrison et al. 1984*; *Rinkevich 2005*; *Harrison 2006*; *Villanueva et al. 2012*). In the Northwestern Philippines, it has been shown to have the potential to boost a coral reef's rate of recovery (*Guest et al. 2014*; *dela Cruz et al. 2014*; *dela Cruz and Harrison 2017*). However, restoration is relatively costly (*Edwards 2010*). The cost issue is particularly apparent in under-developed and developing countries where local funding sources are difficult to identify. Moreover, these are often the areas where the degradation problem, particularly from blast fishing, is most severe (*dela Cruz et al. 2014*).

To facilitate the assessment of reef restoration investments in a cost-benefit analysis framework, this study estimates the recreational benefits of coral reef restoration at Magsaysay Reef in Anda, Pangasinan Province, in the Northwest region of the Philippines. The non-market valuation technique used was the Travel Cost Method (TCM). However, the classical application of the TCM only permits the estimation of ex-post average benefits, and these estimates relate only to the quantity rather than quality of the recreational experience (*Bann 1998*; *Bateman and Willis 1999*). These limitations make it difficult for the TCM to assess possible changes in behavior due to restoration investments. *Gillespie et al.* (*2017*) offered insight into a contingent behavior extension to the TCM that allows for an investigation into changing travel patterns post-restoration. This study is an application of that approach.

Study Site and Conditions: Tondol White Sand Beach and Magsaysay Reef

The recreational site focused in this study was Tondol White Sand Beach (TWSB). It includes Magsaysay Reef, which is a shallow reef found 200 m offshore. TWSB is a popular destination for tourists in the Northwest, and the jump-off point for boat trips to the Reef.

Magsaysay Reef, a 14-ha Marine Protected Area (MPA) is known officially in Anda Municipal Order No. 01-2001 as Magsaysay Fish Sanctuary. It was also chosen as a restoration site because of its damaged condition and relatively low mean density of hard coral cover (HCC) of 15.6% (*dela Cruz and Harrison 2017*). Previous studies have identified several causes for reef degradation in the area (*Cruz-Trinidad et al. 2011*). In particular, the reefs have suffered from damage associated with over and illegal fishing, unregulated aquaculture, poor waterway systems, as well as predation from crown of thorns starfish (*Harrison et al. 2016*). Thus, from 41% mean HCC in 1908, to 22% mean cover in 1999 (C*ruz-Trinidad et al. 2009*; *dela Cruz and Harrison 2017*), *Licuanan et al.* (*2017*) now reports a current mean HCC of 14% in the stations surveyed in this area.

Coral restoration experiments in the degraded sections of the reef have been on-going since 2011 (*Harrison et al. 2016*). The restoration technique being used is known as mass coral larval enhancement or "larval reseeding". It is a novel approach that addresses many of the issues that come with conventional active restoration methods, such as asexual reproduction (*Shaish et al. 2010*; *Barton et al. 2015*; *van Oppen et al. 2015*). While asexual reproduction involves fragments of adult coral being transplanted into damaged areas, reseeding involves coral spawn being collected from healthy reef sites and allowed to settle on damaged sites (*Harriott and Harrison 1984*). This technique has been used in the Bolinao-Anda Reef Complex since 2008 for larval enhancement studies, where some of the coral transplants have already become sexually mature and capable of producing their own offspring (*Guest et al. 2014*).

MATERIALS AND METHOD

Travel Cost Method

In a travel cost study, the objective is to estimate the average benefit per visit enjoyed by users of a recreational or tourism site. An individual user's demand function for a site is estimated by taking the individual's number of visits to the site within a given timeframe, expressed as a function of the average costs incurred to make these trips and a range of other factors that influence visit frequency. This is given by the Trip Generation Function (TGF):

$$log\, VC_n = f\,(TC_n + X_n + \varepsilon_n) \qquad (1)$$

where:

VC_n is the number of visits made by individual n to the site in the last 12 months;

TC_n, the total return trip expenses for individual n;

X_n, the vector of socio-demographic and unique characteristics of individual *n*; and,

ε_n, which is the error term.

Because the Magsaysay Reef application required the estimation of the marginal recreational benefits associated with a change in asset (reef) quality, the travel cost method was supplemented to include a contingent behavior question (*Gillespie et al. 2017*). This was designed to estimate a second TGF that involved a hypothetical change in asset conditions.

In welfare economics, consumer surplus is used as the metric for economic benefits. In travel cost studies, the average consumer surplus per visit, that is, how much visitors are willing to pay for a visit on average, is used as the measure of recreational value. In the TGF's log-linear form, the average consumer surplus per trip is the inverse of the travel cost parameter coefficient as determined in the estimation of Equation 1, given in *Mwebaze and Bennett* (*2012*) as:

$$CS = -\frac{1}{\beta_{TC}}, \qquad (2)$$

where the 95% confidence intervals were estimated using the following (*Mwebaze and Bennett 2012*):

$$CS_L = -\frac{1}{[\beta TC - 1.96\,(se\,\beta TC)]}\;;\; CSu = -\frac{1}{[\beta TC + 1.96\,(se\,\beta TC)]} \qquad (3)$$

The estimation of the TGF involved using the log of the number of trips an individual has taken as the dependent variable. Because it was a count variable, which can only take non-negative, and in this case, non-zero, integer values, it does not follow a normal distribution that is required of a variable treated with an ordinary least squares (OLS) regression estimation. Instead, count data models were used (*Wooldridge 2012*). In particular, where the dependent variable is a count variable that can only take on a few values, such as the number of visits a tourist makes, it takes on a Poisson distribution. Thus, a trip generation function, the dependent variable of which is the count of trips an individual makes within a time period, can be estimated using a Poisson regression model. Where over-dispersion is present (that is, where the mean and the variance of the dependent variable are different) the negative binomial (NB) model is more appropriate. Over-dispersion is then measured in the NB alpha coefficient.

The Questionnaire and Survey Methods

The questionnaire developed for the survey included questions on:

- respondents' trips to the site, including their group's travel costs, distance travelled from residence, location of the interview, number of people in the group, mode of transportation, frequency of visits in the past twelve months and recreational activity undertaken;
- change in visitation rates if the reef's conditions were improved (the contingent behavior component); and,
- socio-demographic variables.

To implement the contingent behavior section of the questionnaire, three attributes were used to describe the condition of the reef in its current and expected post-restoration (improved) condition:

- percentage of the reef that is covered with live coral (Coral Cover);
- number of individual fish that can be seen in any random 5x5 m plot at any given time (Fish Abundance); and,
- number of different species of fish that can be seen in any random 5 x 5 m plot at any given time (Fish Diversity).

Estimates for these attributes under each scenario were based on current observations and the results of past restoration experiments. On that basis, larval seeding restoration was assumed to restore the degraded reef to the level of the current, healthy conditions evident in the sections of the Magsaysay Reef that were not damaged (*Harrison et al. 2016*; *Cabaitan et al. 2008*) (**Table 1**).

Table 1. Current and Improved Conditions in Magsaysay Reef.

	Coral Cover	Fish Abundance	Fish Diversity
Current	15%	17•25 m^{-2}	9•25 m^{-2}
Improved	60-80%	34•25 m^{-2}	18•25 m^{-2}

Restoration of the reef must be considered over a time frame. A ten-year frame was used in this study. In particular, the recovery of a reef will be determined through time not only by the extent of restoration effort but also by the measures taken to protect it from future threats. In the Philippines, it has been shown that without protection, the probability of restoration success decreases (*Raymundo et al. 2007*). However, in the case of Magsaysay Reef, the degraded areas under restoration are within the MPA where protective efforts have been improved. In addition, the restoration activity is assumed to expedite the rate of restoration, which would occur from natural re-seeding through time.

Respondents were asked if their number of visits in the last twelve months would have changed had the reef's conditions been in its improved state (**Table 1**). Two cards were also used to show respondents the reef's Current and Improved conditions (**Figures 1a** and **1b**).

The issue of potential bias in responses to the (hypothetical) contingent behaviour question was addressed through the inclusion of a consequentiality statement at the beginning of each interview (*Carson and Groves 2007*). Respondents were made aware that the

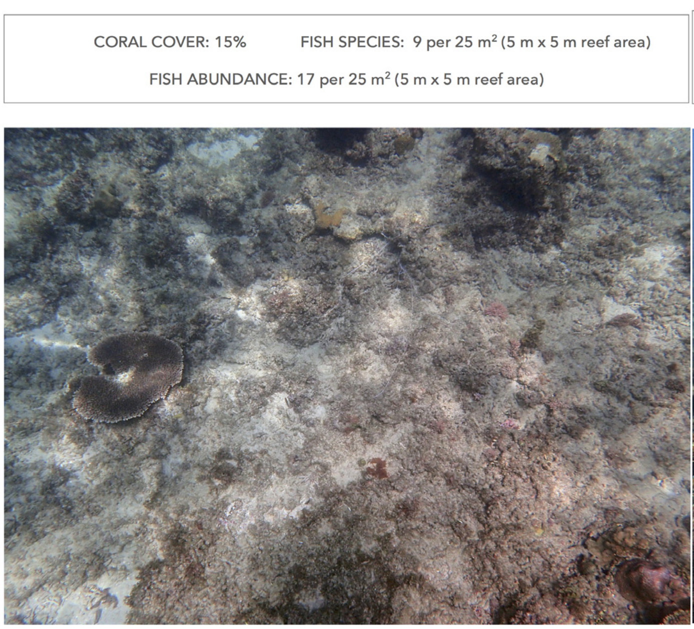

Figure 1a. Current conditions card.

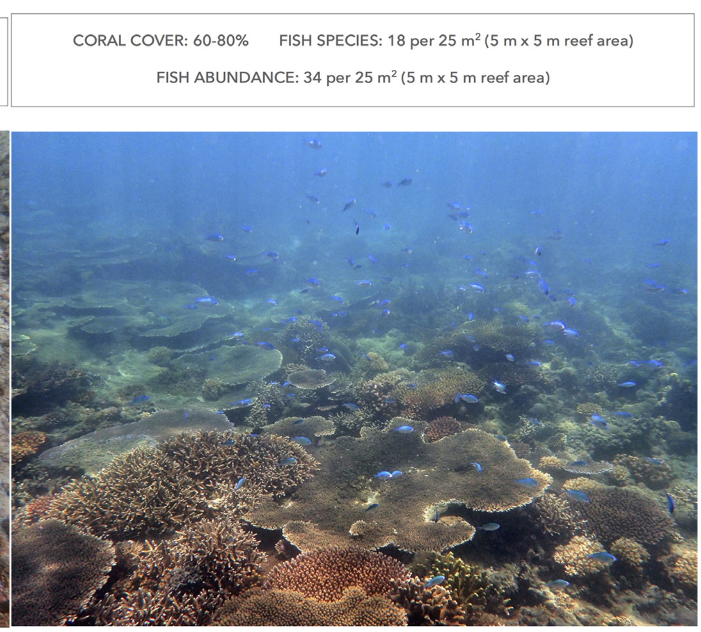

Figure 1b. Improved conditions card.

answers to the survey would be used in guiding the municipality's management decisions for Magsaysay Reef.

The study acknowledged that the photos used in the conditions were not directly comparable as the angle at which the photos were taken are different. However, the top-down view used for the Current Conditions card was necessary to illustrate the low coral cover in the area, as was the case in the Improved Conditions card which showed the broader picture of recovery, including fish life.

The survey was conducted at Tondol White Sand Beach (TWSB) over the two-month summer peak season (mid-March to mid-May) in 2017. Face-to-face interviews of 473 respondents were completed. This sample constituted around 5% of the population of visitors during the peak season (Anda Municipal Tourism Office (MTO) 2015). According to the Anda MTO, the tourist peak season for TWSB is usually between March to May every year. This period coincides with hot weather and important holidays.

Blanket surveying was attempted but some stratification of the sample was used when visitor numbers exceeded interviewer capacity. This stratification broadly followed the Philippine population structure in terms of age and gender in 2016 (retrieved from http://psa.gov.ph). Of the total sample, 50% were residents of Pangasinan province, while 60% had access to private sections of the Beach. Visitation rates varies per season (**Table 2**).

It should be noted however, that the stratification attempt was largely unsuccessful. The differences between the means and the distribution between the Philippine population and the study sample were statistically different. Moreover, the respondents were chosen based on their capacity to influence or make decisions for the with which group they travelled; hence, the sample should not be expected to represent an external population. The results in the next section thus used the respondent as the unit of analysis.

RESULTS AND DISCUSSION

The cost of travel was estimated using the following variables: private or public transportation costs, opportunity cost of travel, and other expenses incurred during and for the trip.

Private transportation costs for each group of visitors ($Trans_v$) were estimated by using distance in terms of kilometers and the resultant fuel and toll fees. That is, $Trans_v$=2*(6.036 * *km* + D(2.67*(*km*-184)), where D is the dummy variable that takes on the value of 1 if the expression in the parentheses is true; otherwise, it takes on the value of 0 and toll costs are omitted.

For fuel costs, the study took the average cost per km of different models of cars (*How much does it cost 2017*), US$0.12 km^{-1} [1], and multiplied by the distance travelled in km. For final toll costs, authors used the rate of US$0.05 km^{-1} (*THE SUBIC-CLARK-TARLAC EXPRESSWAY n.d.*) multiplied by the distance travelled minus 184 km each way (which is the distance between the last toll road exit and TWSB). If the distance travelled one way is less than 184 km, toll cost is excluded from that observation. This is multiplied twice to get the cost of the return trip.

Public transportation costs for the entire group ($Trans_b$) were regressed (OLS) using the distance between the respondents' homes and TWSB (variable: *km*) and the length of their trip (in number of days, variable: *tl*). This was applied to the sample, and multiplied twice to account for the return trip, i.e. $Trans_b$ =2*(301.1761 + 6.1013*km*-200.4143*tl*).

Where a respondent indicated that the reason for their journey to TWSB included activities other than leisure (e.g. company or group outings or visiting relatives), only fifty percent of travel costs were attributed to the recreational value. This method is adopted from *Bennett* (*1995*), where it is assumed that the visit was 'very important' to the respondent, despite the fact that the visit was done for a specific function other than leisure. No adjustment to

[1] *US$1 = Php 49.8603 in May 2017. Retrieved November 3, 2017, from http://www.bsp.gov.ph/statistics/excel/pesodollar.xls*

Table 2. Estimated visitation rates to TWSB by origin and period, 2015.

Period	Pangasinan Residents		Non-Pangasinan Residents		Total	
	Visitors	%	Visitors	%	Visitors	%
Peak	4,025	39.8	4,465	62	8,490	49.2
Non-peak	6,080	60.2	2,670	37.4	8,750	50.8
Annual	10,105	58.6	7,135	41.4	17,240	100

Source: Anda Municipal Tourism Office, 2015 observed travel costs were made if the respondent visited places other than TWSB during their journey from home. The study argued that this was due to the mean length of the entire trip and the mean length of stay in TWSB were not significantly different from each other. This indicated that the trips observed in the survey were predominantly single purpose trips with TWSB as the focus.

Other costs include entrance and incidental fees. The travel cost questions asked in the survey were focused on the expenses of the respondent's whole group. Hence, the 'group travel cost' was divided by the number of persons in the respective groups to calculate the return travel cost per visitor.

Data on a range of other variables were also collected during the survey interviews. These variables, along with the visitation variables and the travel cost variables is set along with their codings (**Table 3**).

Two trip generation functions were estimated, using the current visit rate (VC_n) and the improved reef visit rate (VI_n) as the two dependent variables. The Negative Binomial model was chosen over the Poisson model due to the presence of over-dispersion in the models (**Table 4**). A Zero-Truncated Negative Binomial model was also estimated; however, the maximum likelihood estimators failed to converge. The significance level of the log likelihood functions for both models indicates their explanatory strength.

As expected, higher travel costs decrease visitation rates for both models (highly significant at the 1% level). Those travelling with children and those whose activities are reef-related were less likely to visit in both current and improved conditions.

Gender is significant in the current conditions model, with women less likely to visit in the past twelve months compared to men. This difference between the sexes becomes insignificant in the contingent visitation model. Age has an insignificant coefficient in the current levels; however, it is significant and negative in the improved conditions model. This suggests that, after reef restoration, younger tourists are more likely to visit the site more frequently.

Table 3. Variable Coding and Descriptive Statistics.

Variable	Description	Descriptive Statistics (n=473)
Dependent Variable		
Current Visits VC_n Mean (SD)	Number of visits per person (n) in the past 12 months	4.03 (16.42)
Improved Visits VI_n Mean (SD)	Contingent number of visits per person (n) in the past 12 months upon hypothetical improvement of asset (reef) conditions	6.91 (32.02)
Independent Variables		
TC_n Mean (SD)	Average return travel cost per person (n)	685.93 (1247.44)
Group Size Mean (SD)	Number of persons in a group	14.08 (13.92)
Place of sampling Frequency of 1 (% of total)	0=public beach; 1=private beach	263 (55.37%)
Travelled with Child Frequency of 1 (% of total)	0 = no child; 1 = travelled with child	375 (79.28%)
Gender Frequency of 1 (% of total)	0= male, 1= female	277 (58.56%)
Age Mean (SD)	age of respondent in years	38.54 (14.03)
Member of environmental club Frequency of 1 (% of total)	0= not a member; 1 = member	90 (19.03%)
Experience working for an environmental or tourism firm Frequency of 1 (% of total)	0 = no work experience; 1 = has work experience	21 (4.44%)
Education Frequency of 1 (% of total)	0 = not a high school graduate; 1 = at least a high school graduate	336 (70.74%)
Household Income Mean (SD)	Midpoint of Philippine Family Income and Expenditure Survey annual income bracket	US$2,071.11 (79125.77)
Awareness of the Reef Frequency of 1 (% of total)	0 = not aware that there is a reef nearby; 1 = aware that there is a reef nearby	128 (27.06%)
Experience of Snorkelling in the Area Frequency of 1 (% of total)	0 = has not snorkelled in the area; 1 = has snorkelled in the area	63 (13.32%)
Reef-related Frequency of 1 (% of total)	0 = recreational activities undertaken during the trip are not reef-related, 1 = recreational activities during the trip are reef-related	40 (8.49%)

Table 4. Trip Generation Functions.

Log of VC_n	Current (VC_n)	Improved (VI_n)
Travel Cost per Person	-0.0003***	-0.0002***
Gender	-0.5247***	-0.0337
Age	0.0047	-0.0333***
Member of environmental club	-0.4852***	0.7127***
Household Income	-2.77 x 10-6***	7.48 x 10-7
Travelled with Child	-0.6630***	-0.5485***
Awareness of the Reef	0.2701**	0.5581***
Activities are Reef-related	-0.4748***	-0.8032***
Location of Interview	-0.1726	-0.2258**
Constant	2.6536***	3.3615***
LL function	-1048.7115	-1212.1712
Significance level	0	0
McFadden's Pseudo R-squared	0.0738	0.1002
Obs.	471	471
NB alpha	0.8975	0.9225

**** significant at the 1% level; ** significant at the 5% level*

If a respondent is a member of an environmental club, they would visit less frequently than non-members given the current state of the Reef. However, an improvement in the reef's condition would make an environmental club member visit more frequently than a non-member. This result suggested that the reef restoration may stimulate use by more environmentally-conscious visitors. Furthermore, awareness of the reef has a positive and significant effect on visitation rates for both current and improved conditions.

The negative and significant coefficient on income implies that the site is an inferior good, given current conditions. With improved site conditions, household income became positive but was insignificant for this sample. Estimating a model of the difference between current and improved visitation rates as the dependent variable using and income, gender, education, and household income as the independent variables reveals that none of these socio-economic variables significantly impact the change in visitation rates, with the exception of age (negative, $p<0.001$). However, little can be presumed about the behavior and income elasticity of potential new visitors who would be motivated to go to the site once its reef has been restored.

Variables that were insignificant as explanatory of visitation rates in both models were omitted from the final models. These include the dummy variables: education, experience in working for an environmental or tourism firm, and experience of snorkeling in the area.

Consumer surplus estimates

Consumer surpluses per visit per individual were estimated using Equation 2. Given current site conditions and by using Equation 3, the average consumer surplus of a single visit per tourist is US$63.37 with a 95% confidence interval of US$47.12 to US$96.74.

The average consumer surplus under improved reef conditions is US$113.18 per visit per person with a 95% confidence interval of US$73.88 to US$241.86 (**Table 4**).

Table 5. Average Consumer Surpluses and marginal benefits (per person per visit)*.

	Current	Improved	Marginal benefit
βTC	-0.0003	-0.0002	
Std. Err.	5.57×10^{-5}	4.81×10^{-5}	
Consumer Surplus (Mean)	US$ 63.37	US$ 113.18	US$ 49.81
Consumer Surplus (Lower 95% CI)	US$ 47.12	US$ 73.88	US$ 26.76
Consumer Surplus (Upper 95% CI)	US$ 96.74	US$ 241.86	US$ 145.12
Annual Visits	17,240	20,688	3,448
Mean Economic Value of Annual Visits	US$ 1,092,467.84	US$ 2,341,530.95	US$ 1,249,063.11
Economic Value of Annual Visits (Lower 95% CI)	US$ 812,282.86	US$ 1,528,382.93	US$ 716,100.07
Economic Value of Annual Visits (Upper 95% CI)	US$ 1,667,724.91	US$ 5,003,609.14	US$ 3,335,884.23

**significant at the 1% level*

CONCLUSIONS AND RECOMMENDATION

An improvement in the conditions of Magsaysay Reef adjacent to Tondol White Sand Beach (TWSB) was estimated to provide mean annual marginal benefits of US$1.25 M with a 95% confidence interval between US$0.72 M and US$3.34 M. However, it is important to note a few caveats from this conclusion.

The sample is not expected to represent the population of the Philippines. Thus, the results are only internally valid for the current users of TWSB, and not to the entire population of tourists in the Philippines. Moreover, sampling was conducted only during the peak season for tourism, and not throughout the year. Hence, this study acknowledges that there may be a time-dependent sampling bias.

The consumer surplus for current site conditions includes the value of the beach and all its amenities, not solely that of the reef. On the other hand, the change in this value from current to improved includes only the improvement of the reef. Moreover, potential new visitors who may be enticed to visit with the restoration of the reef are not taken into consideration.

Lastly, projections for the reef's improved condition may vary, as the technology for mass larval reseeding is currently being field-tested and improved. As such, the contingent value of an improvement in coral reef conditions are also subject to change as this technology evolves.

REFERENCES

Bann, C. 1998. The economic valuation of tropical forest land use options: a manual for researchers. Singapore: Economy and Environmental Program for Southeast Asia.

Barton, J. A., Willis, B.L. & Hutson, K.S. 2015. Coral propagation: a review of techniques for ornamental trade and reef restoration. Reviews in Aquaculture. doi: 10.1111/raq.12135.

Bases Conversion and Development Authority. (n.d.). THE SUBIC-CLARK-TARLAC EXPRESSWAY. Retrieved September 19, 2017, from http://www.bcda.gov.ph/sctex

Bateman, I. J., and Willis, K. G. 1999. Valuing environmental preferences: theory and practice of the contingent valuation method in the US, EU, and developing countries. Oxford: Oxford University Press.

Bennett, J. 1995. The Travel Cost Method of Estimating the Value of Recreational Use of Natural Areas. Report for the New South Wales NPWS.

Cabaitan, P.C., Gomez, E.D. and Aliño, P.M. 2008. Effects of coral transplantation and giant clam restocking on the structure of fish communities on degraded patch reef. *Journal of Experimental Marine Biology and Ecology,* 257, 85-98.

Carson, R. and Groves, T. 2007. 'Incentive and informational properties of preference questions', *Environmental and Resource Economics*, 37, p. 181–210

CarGuide.PH. 2017, February 14. How Much Does It Cost to Run the 2017 Honda Civic RS Turbo? Retrieved September 19, 2017, from http://www.carguide.ph/2017/02/how-much-does-it-cost-to-run-2017-honda.html

Cruz-Trinidad, A., Geronimo, R., and Aliño, P. 2009. Development trajectories and impacts on coral reef use in Lingayen Gulf, Philippines. *Ocean and Coastal Management*, 52(3-4), 173-180. https://doi.org/10.1016/j.ocecoaman.2008.12.002

Cruz-Trinidad, A., Geronimo, R. C., Cabral, R. B., and Aliño, P. M. 2011. How much are the Bolinao-Anda coral reefs worth? *Ocean and Coastal Management*, 54(9), 696–705. https://doi.org/10.1016/j.ocecoaman.2011.07.002

dela Cruz, D. W., Villanueva, R. D., and Baria, M. V. B. 2014. Community-based, low-tech method of restoring a lost thicket of Acropora corals. ICES *Journal of Marine Science*, doi:10.1093/icesjms/fst228.

dela Cruz, D. W., and Harrison, P. L. 2017. Enhanced larval supply and recruitment can replenish reef corals on degraded reefs. *Scientific Reports*, 7(1). doi:10.1038/s41598-017-14546-y

Edwards, A. 2010 (Ed.). Reef Rehabilitation Manual. Coral Reef Targeted Research and Capacity Building for Management Programme, St Lucia, Australia. 166 pp.

Gillespie, R., Collins, D., and Bennett, J. 2017. Adapting the travel cost method to estimate changes in recreation benefits in the Hawkesbury–Nepean River. *Australasian Journal of Environmental Management,* 1–17. https://doi.org/10.1080/14486563.2017.1354236

Harriott, V.J. and Harrison, P.L. 1984. Methods to accelerate the recolonization of corals in damaged reef systems. Final report to the Great Barrier Reef Marine Park Authority, 58 pp.

Harrison, P.L., Babcock, R.C., Bull, G.D., Oliver, J.K., Wallace, C.C. and Willis, B.L. 1984. Mass spawning in tropical reef corals. *Science*, 223: 1186-1189.

Harrison, P.L. 2006. Settlement competency periods and dispersal potential of scleractinian reef coral larvae. Proceedings of the 10th International Coral Reef Symposium, Okinawa 1:78-82.

Harrison, P. L., Villanueva, R., and dela Cruz, D. 2016. Final Report for FIS/2011/031: Coral Reef Restoration using Mass Coral Larval Reseeding (Report No. FR2016 -15). Retrieved from [Australian Centre for International Agricultural Research http://aciar.gov.au/publication/fr2016-15].

Licuanan, A.M., Reyes, M. Z., Luzon, K. S., Chan, M. A., Licuanan, W. Y. 2017. Initial Findings of the Nationwide Assessment of Philippines Coral Reefs. *Philippine Journal of Science*, 146(2), 177-185.

Mwebaze, P., and Bennett, J. 2012. Valuing Australian botanic collections: a combined travel-cost and contingent valuation study. *Australian Journal of Agricultural and Resource Economics*, 56(null), 498.

Raymundo, L., Maypa, A., Gomez, E. D., and Cadiz, P. 2007. Can dynamite-blasted reefs recover? A novel, low-tech approach to stimulating natural recovery in fish and coral populations. *Marine Pollution Bulletin*, 54: 1009–1019.

Rinkevich, B. 2005. Conservation of coral reefs through active restoration measures: recent approaches and last decade progress. *Environmental Science and Technology*, 39: 4333–4342.

Shaish, L., Levy, G., Katzir, G. and Rinkevich, B. 2010. Coral reef restoration (Bolinao, Philippines) in the face of frequent natural catastrophes. *Restoration Ecology* 18: 285-299.

van Oppen, M.J.H., Oliver, J.K., Putnam, H.M and Gates, R.D. 2015. Building coral reef resilience through assisted evolution. Proceedings of the National Academy of Sciences of the United States of America, 112: 2307–2313.

Villanueva, R. D., Baria, M.V. & dela Cruz D. W. 2012. Growth and survivorship of juvenile corals outplanted to degraded reef areas in Bolinao-Anda Reef Complex, Philippines, *Marine Biology Research*, 8:9, 877-884

Wooldridge, J. M. 2012. Introductory econometrics: a modern approach (5th ed.). Boston: Cengage Learning.

ACKNOWLEDGMENT

The authors would like to acknowledge the contributions of Peter Harrison, Dexter dela Cruz, and Charlon Ligson for their valuable insights and projections on site conditions, as well as to Cielo Magno for her guidance in data analysis. The data gathering would also not have been possible without the participation of the laboratory of Patrick Cabaitan and the Anda local government. In particular, authors would like to thank the Municipal Agriculture Office under Elizabeth Torino-Tomas for the logistical assistance, and the Office of the Mayor for providing tourism data. Many thanks to the enumerators: Mildred Fronda, Marilyn Toledo, Elsa Shela Carolino, Liezel, Christine Biocarles, Monica Celeste, Lanie Caole, Noli Caspe, Elizabeth Gomez, Jake Ramos, Benny Canta, Edraline Alfonso, and Larry Delmonte. The authors are also grateful for the funding support of the Australian Centre for International Agricultural Research.