# Valuing Coral Reef Preservation in a Caribbean Marine Protected Area. Economic Impact of Scuba Diving in Corals of Rosario and San Bernardo National Natural Park, Colombia*

Cómo citar este artículo: Trujillo, J., Navas, & E., Vargas, D. (2017). Valuing Coral Reef Preservation in a Caribbean Marine Protected Area. Economic Impact of Scuba Diving in Corals of Rosario and San Bernardo National Natural Park, Colombia. *Cuadernos de Desarrollo Rural*, 14(79), 1-14. https://doi.org/10.11144/Javeriana.cdr14-79.vcrp

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DOI: https://doi.org/10.11144/Javeriana.cdr14-79.vcrp
Received: 2017-01-24 ❙ Accepted: 2017-04-02 ❙ Published: 2017-06-30

## Abstract:

This study estimates the financial benefits of scuba diving services in the coral reefs of Rosario and San Bernardo National Natural Park, in Colombia. Although this park attracts a high number of divers, the dredging of an adjacent channel threatens the sustainability of its reefs system. Adopting the travel charge approach, we apply abridged count data simulations to estimate demand for scuba diving services. We estimate the annual benefit of diving services and consumer surplus for both domestic and foreign divers. The estimates obtained can be used to inform further assessments of the value of recreational scuba diving in these coral reefs.

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Keywords: coral reefs, ecosystem ser vices, environmental valuation, scuba diving

## Valorar la preservación de los arrecifes de coral en un área marina protegida del Caribe. Impacto económico del buceo en los corales de Rosario y el Parque Nacional Natural San Bernardo, Colombia

## Resumen:

Este estudio estima los beneficios financieros de los servicios de buceo en los arrecifes de coral del Parque Nacional Natural Rosario y San Bernardo, en Colombia. Aunque este parque atrae a un gran número de buceadores, el dragado de un canal adyacente amenaza la sostenibilidad de su sistema de arrecifes. Adoptando el enfoque de cargo de viaje, aplicamos simulaciones de datos de recuento abreviados para estimar la demanda de servicios de buceo. Estimamos el beneficio anual de los servicios de buceo y el excedente del consumidor para buceadores nacionales y extranjeros. Las estimaciones obtenidas se pueden utilizar para informar evaluaciones adicionales del valor del buceo recreativo en estos arrecifes de coral.

Palabras clave: los arrecifes de coral, servicios de ecosistema, valoración ambiental, submarinismo.

# Introduction

Marine protected areas (MPAs) provide numerous social and environmental benefits. Their ecosystems perform some vital ecological tasks, for instance detoxification as well as decomposition of waste, purifying water and air, regenerating soil fertility, and maintaining biodiversity (Daily, Matson, & Vitousek, 1997). Additionally, authorities have designated MPAs as a primary means of conserving coral reef ecosystems (McClanahan, Marnane, Cinner, & Kiene, 2006), another resource that contains great value for nature and humanity at large. These coral reef biomes are hotspots, which serve as the habitation environment for more than one million marine species and further serve as a significant source of income (Wilkinson, 2008; Speers, Besedin, Palardy, & Moore, 2016). In fact, the goods and services associated with coral reefs yield, in yearly net profits, approximately USD 30 billion for the global economy, including income from tourism and fishing (Cesar, Burke, & Pet-Soede, 2003). However, on a global scale, coral reefs are now being significantly degraded because of anthropogenic and natural causes, including climate change and coastal development (Micheli et al., 2014). This degradation is mostly very obvious in the Caribbean Sea. Coral reefs in the Caribbean have suffered an approximately 80 % reduction in their coral cover due to temperature increases and acidification (Doney et al., 2012). Caribbean coral reefs are also threatened by increasing pollution from human activities. This holds true for Colombia's Coral Reefs in Rosario and San Bernardo National Natural Park. These park features include some subaquatic ecosystems, largely composed of coral reefs, and serves as habitat for endangered marine species, making it a highly prominent MPA located in the Caribbean (Garzón-Ferreira & Díaz, 2003; IUCN, 1982; National Oceanic and Atmospheric Administration, 2008; Zarza-González, 2011). Among Colombia's protected areas, it sees the largest

influx of tourists. In 2013, the park reported 443.458 ecotourism visitors, representing approximately 52 % of the total visits to Colombia's reserved locations (Parques Nacionales Naturales de Colombia, 2013).

Although ecological indexes of coral reefs classify Colombia's Coral Reefs in Rosario and San Bernardo National Natural Park as "moderately low" risk, the human impact index raises ecological risk to "moderately high" (Zarza-González, 2011). In that sense, the coral reefs of Rosario and San Bernardo National Natural Park are exposed to a high risk of irreversible damage to their natural recovery capacity. In fact, the park's live coral reefs have been reduced to as little as 33 % of their original bulk (Barrios, 2000; Díaz et al., 2000). Rosario and San Bernardo National Natural Park's shallow reefs have suffered progressive deterioration, and most corals within five meters of the surface are dead (Garzón-Ferreira et al., 2004; Navas et al., 2010).

Various forms of anthropogenic factors are affecting the coral reefs situated in the reserve; however, sedimentation poses a greater risk for coral reefs located in the area (Zarza-González, 2011). The removal of the curves together with the dredging of nearby Canal del Dique further improved the flowing speed of the Magdalena River, which has dangerously made the sedimentation levels higher and has left light material on the water's surface. The Canal del Dique water current deposits this onto the coral reefs, which clouds water surface and thus obscures sunlight. Additionally, other factors, such as dynamite fishing and dumping of wastewater, further increase the degradation of coral reefs (Sánchez Cadena, Grajales, & Porto, 2006). Given this dramatic decline in the health of Rosario and San Bernardo National Natural Park's corals, significant international research has focused on the regeneration through cropping. For instance, the Coral Restoration Foundation (CRF) and the Fundación Corales Vivos enacted an experimental coral restoration program in 2010. These efforts reinforce the importance of the private sector in the recovery of the Caribbean Sea's coral reefs (Zarza-González, Bargas, Londoño, Pacheco, & Duque, 2014).

In the light of the growing concern regarding worldwide coral reef reduction, some research has been carried out to estimate their economic value (Ong & Musa, 2012; Parsons & Thur, 2008). Most of these studies use scuba diving as the economic activity for the valuation of coral reefs. In fact, one of the fastest rising tourist activities in the world presently is scuba diving, and it is considered an activity that carries low environmental impact. Globally, the places with higher rates of tourist visits for this activity are the Caribbean Sea, the Red Sea, and Australia's Great Barrier Reef (Giglio, Luiz, & Schiavetti, 2015; Tratalos & Austin, 2001). For instance, Carr and Mendelsohn (2003), using the cost of travel method, determined the economic benefit of recreational diving activity for Australia's Great Barrier Reef. On the other hand, Jiddawi, Ngazy, & Cesar (2005) estimated, using the contingent valuation methodology, the economic benefit of recreational diving in the Zanzibar islands. In the Caribbean Basin, Parsons & Thur (2008) determined the economic value of recreational diving in the Bonaire National Marine Park, using the contingent valuation method.

Consequently, this paper estimates the economic benefit of scuba diving as a recreational activity aimed at quantifying use values of the coral reefs located in Rosario and San Bernardo National Natural Park. Estimating the monetary value of coral reefs helps to understand their importance and allows their incorporation in policy-making decisions. To achieve this, we devise a demand function for scuba diving recreational services in the coral reefs and estimate the diver–customer excess by applying the travel cost strategy, in order to calculate the economic value of coral reefs. Through this methodology, we deduce robust estimates that provide useful information to environmental policymakers trying to assess damage to MPAs' coral reef ecosystems.

This paper has the following structure. First, we describe the case study site; then, the approach, survey design, data collection methods, and analytical methodologies, including the statistical strategy, are explained; next, we present the results of the estimations and address a series of key issues; and finally, we present the main study conclusions.

# The Case Study Site: Corals of Rosario and San Bernardo National Natural Park

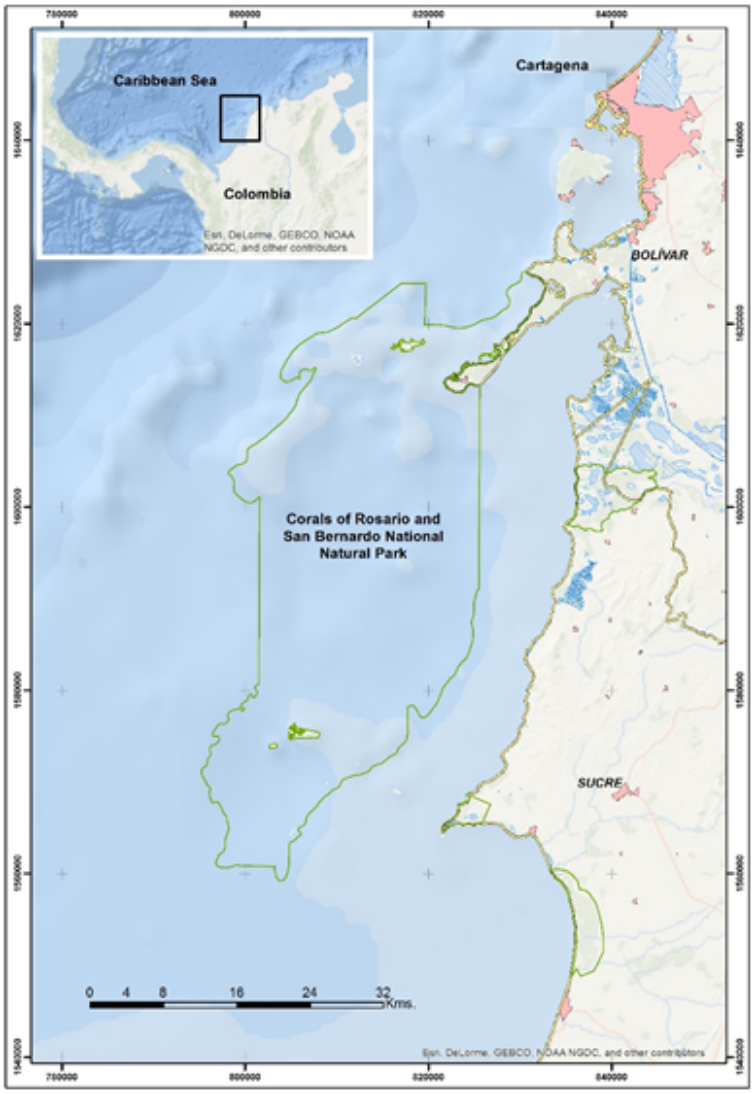


FIGURE 1
Corals of Rosario and San Bernardo National Natural Park, Colombia
Source: own work

Colombia's Caribbean coast is the location site of the Coral Reefs in Rosario and San Bernardo National Natural Park, which is located about 23 km south of Cartagena (figure 1). 43 islands make up the archipelago, which spans an area of about 1.200 km$^2$. The area has a tropical and generally humid climate. A 27° C in average temperature makes the Rosario and San Bernardo National Natural Park a special reserve for varying marine species and ecosystems (Mendoza, Castro, Herrón, Montaño, & Castro, 2011; Zarza-González, 2011). Its mangroves,

coral reefs, and seagrass beds represent a broad variation and dynamic sets of ecology. In Colombia, this coral reef is the largest in terms of size. Moreover, due to the high variation of coastal and marine topographies in the reserve, it serves as a habitat for numerous endangered marine species. Due to ecosystems and species diversity (which causes extensive biodiversity), many environmental resources, as well as ample recreational opportunities, the Coral Reefs in Rosario and San Bernardo National Natural Park have a high ecological and environmental importance and value.

Typically, the Coral Reefs in Rosario and San Bernardo National Natural Park's busiest tourist season starts in late June up until late August. Visitor population peaks in July and December, corresponding to summer and winter holiday periods. For the busy season duration, the regular number of visiting tourists often exceeds fifty persons daily. From June until August, the environmental conditions are highly encouraging for enjoying scuba diving, with water visibility down to 30 feet deep or more, due to the northwest trade winds. In addition, around this time, many marine species migrate to the park.

# Methodology

## Survey Design and Data Collection

This analysis uses data gathered from June to July of 2013 in situ survey, which corresponds to the period with most divers visiting the park. According to Zarza-González (2011), on average, 4.200 divers visit the park annually. In total, there are four diving schools that provide their services in the park. Schools charge different prices for their services and their boats leave from various ports in search of the best places for diving. For the survey, we had the support of three of these four schools, which was key for the capture of the characteristics of the general diver population within the sample.

We conducted a pilot test of 52 surveys, which were not included in the final sample, but were decisive for the final survey design. The final sample consisted of 493 observations. We conducted all surveys in the ports of the three allied diving schools. We surveyed certified divers of all nationalities, who had positive incomes and paid for their diving trips, while excluding diving instructors and diving school directors. The rationale of these exclusions was to avoid possible sample bias, since reef preservation costs help fund diving schools.

The surveys featured face-to-face interviews at the divers' meeting place, before they started their activity, in order to capture expectations for diving in the area. The questionnaire was divided into three parts. The first part posed inquiries such as those related to the respondents' socioeconomic and demographic characteristics. The second section queried the respondents' expectations of diving site quality, and their motivations for visiting the park. Divided into two parts, per expenditure type, the third section included questions regarding travel expenses. This first subsection provided information about the travel costs (both domestic and international) to the Coral Reefs in Rosario and San Bernardo National Natural Park, while the second posed questions about accommodation, food, and diving expenditures. Out of the 493 surveys administered, 474 responses were valid. All outlying cases were identified and removed from the dataset prior to conducting the regression model. Outliers were identified as cases more extreme than three standard deviations from the mean. We report descriptive figures of the datasets implemented in the model in table 1.

TABLE 1
Descriptive Statistics of Variables Used in the Models by Nationality of Divers

| | Foreign | | | | Colombian | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | Mean | Std. dev. | Min | Max | Mean | Std. dev. | Min | Max |
| Trips | 2.344 | 5.596 | 1 | 90 | 6.516 | 12.292 | 1 | 100 |
| TTC | 1905.4 | 1435.42 | 131.5 | 10511.4 | 416.5 | 271.6 | 127.9 | 2159.9 |
| Income | 4854.722 | 3707.75 | 364.28 | 20082.32 | 2617.97 | 1849.192 | 207.29 | 10329.2 |
| Education | 17.495 | 2.793 | 11 | 26 | 16.550 | 2.203 | 11 | 26 |
| Gender | 0.547 | 0.498 | 0 | 1 | 0.577 | 0.495 | 0 | 1 |
| Age | 33.861 | 9.985 | 14 | 65 | 32.684 | 9.714 | 15 | 57 |
| RBO | 0.495 | 0.500 | 0 | 1 | 0.463 | 0.500 | 0 | 1 |
| BP | 0.569 | 0.495 | 0 | 1 | 0.664 | 0.473 | 0 | 1 |
| Time | 33.643 | 20.264 | 2.6 | 114.9 | 9.688 | 13.648 | 0 | 50 |

Source: own work

Note: table 1 shows the mean, standard deviation, maximum, and minimum values for each variable for the entire sample. In addition, table 1 shows how the elimination of surveys with outliers limits the probability of sample data to show any bias. The average travel cost was USD $1.905.49 for foreign divers and USD $416.5 for Colombians. On average, Colombian divers made 6.5 trips to Coral Reefs in Rosario and San Bernardo National Natural Park over the last five years compared with 2.3 trips by foreign divers. These divers came from Angola, Argentina, Autralia, Belgium, Bolivia, Brazil, Canada, Chile, Costa Rica, Denmark, Equator, El Salvador, France, Fermany, Guatemala, Ireland, Italy, Mexico, Netherlands, Panama, Peru, the Philippines, Singapore, Spain, Sweden, Switzerland, the UK, Uruguay, the USA, and Venezuela.

# The Model

We use the Travel Cost Method (TCM) to calculate the economic advantages of the Coral Reefs in Rosario and San Bernardo National Natural Park's recreational scuba diving resources. This method is based on individual revealed preferences and fits non-market valuation. The economic benefit generated by coral reefs can be estimated through the development of a demand function for recreational diving. Following this argument, our central hypothesis is that divers who visit the park perceive and respond to changes in the cost of their trip (Loomis, 2003). Therefore, we verify the inverse correlation between the cost of the divers' trip and how many times they visited through the expression below:

$$Trips = f(TTC, MST, MST * TTC, Income, Colombian, Income * Colombian, X, \varepsilon)$$

Where, Trips is a vector-reliant factor that denotes the number of trips to the Coral Reefs in Rosario and San Bernardo National Natural Park for scuba diving recreational purposes from 2008 to 2013. Total travel cost (TTC) represents the fee of round-trip travel taken from the respondent's point of habitation or final destination to the diving spot, in addition to the total expenses on registration, food and drink, diving fees, accommodation, and time cost. We calculate the cost of time as:

$$Hwage \times 33\ \% \times Travel\ time$$

Where, Hwage is estimated as the yearly revenue divided by the total hours of work in a year. Moreover, we use 33 % of the salary based on previous TCM studies that consider the value of time for a recreational trip as a third of the salary (Tapsuwan & Asafu-Adjaye, 2008; Blaine, Lichtkoppler, Bader, Hartman, & Lucente, 2015). Travel time is a calculation of the time spent on a round-trip from the starting point to the Coral Reefs in Rosario and San Bernardo National Natural Park. The fact of adding the travel time value can help minimize the omitted-variable bias, as pointed out by Tapsuwan & Asafu-Adjaye (2008).

On the other hand, divers may spend money visiting other places in the park or have expenses aside from diving activity. The decision to address this issue depends on the aggregation level of the site's destiny (Blaine et al., 2015). Considering that the Coral Reefs in Rosario and San Bernardo National Natural Park offers various activities and that our objective is only to exclusively calculate the economic advantages that recreational diving brings, it is necessary to address the possible overestimation of multipurpose trips. We eliminate the effect of multi-purpose trips of TCM by including the dummy Multi-Site-Trip (MST). If the diver was in the Coral Reefs in Rosario and San Bernardo National Natural Park more days than needed for diving activities, this dummy takes the value of 1; it is 0 only if the diver came to the National Natural Park just for diving. To eliminate the overestimation of consumer surplus (CS), we created an interaction of this variable with TTC (Mendelsohn, Hof, Peterson, & Johnson, 1992). Thus, we eliminate the effect of the costs incurred in other recreational activities and a realistic estimate and adjusted CS is obtained (Mwebaze & Bennett, 2012).

In addition, considering the differences between the socioeconomic characteristics of domestic and foreign divers presented in table 1, we include the dummy Colombian that takes the value of 1 in case the visitor is Colombian and 0 otherwise. By doing so, we intend to compare the estimates of domestic and foreign divers, which can be useful for the design of regulatory policies. From equation 1, we have that X is the vector of the diver's socioeconomic characteristics (Income, Education, Gender), in which Income is measured as the total annual income after tax. In addition, we included in the model an interaction between Income and Colombian to determine the role of income between Colombians and foreigners in the model. The variable Education is measured by years of study. Gender represents a dummy variable that takes the value of 1 in case it is a male diver and 0 otherwise. Likewise, we use quality variables of the Coral Reefs in Rosario and San Bernardo National Natural Park like beauty of place (BP) and recommended by others (RBO), aiming to capture the diver's expectations regarding coral reefs. Therefore, if the diver finds that the expectation towards the beauty of the place was a reason for the visit, BP takes the value 1 and 0 otherwise. Similarly, RBO takes the value of 1 if the reason for the site visit was other divers' recommendation and 0 otherwise. Finally, # is the random shock term.

The variable Trips considers a count variable in the model because it only takes integer and positive values. Thus, estimation of the demand function for recreational diving services by ordinary least squares is not appropriate. Additionally, due to the nature of the surveys (in situ), the dependent variable does not take 0 values, insofar as non-tourists are excluded from the sample. For this reason, the model estimation should be performed by truncating the count variable to 0. Another feature of the sample is endogenous stratification. The sample is endogenously stratified because those who come to the park frequently have a higher likelihood of being added to the sample than individuals who visit the park occasionally (Shaw, 1988). Considering these characteristics, we use the truncated stratified negative binomial (TESNB) model and the zero-truncated Poisson (ZTP) model for calculation. These models allow us to estimate equation (1) without considering issues on the nature of the sample data. In fact, recent literature makes extensive use of such models (see Mwebaze & Bennett, 2012; Prayaga, Rolfe, & Stoeckl, 2010; Rolfe & Dyack 2010; Tapsuwan & Asafu-Adjaye 2008; Shrestha, Seidl & Moraes, 2002).

# Results

The truncated count data model regression that falls below the TCM is displayed in table 2. The figures are made in accordance with the economic model as well as the latest research results on recreation demand. Representation remains the same across estimates, proving that the specification of the model is viable. The coefficients show that the correction of issues, for instance, the truncation of the dependent variable with the endogenous stratification, makes the precision of the estimates much better. In contrast, Pearson correlations were conducted between all predictors; high collinearity was not indicated based on these results. Using Durbin-Wu-Hausman chi-squared tests and Wu-Hausman F tests, Endogeneity test was carried out, and these did not reveal endogeneity problems in any of the variables. A series of diagnostics were conducted to determine the most appropriate model for analysis. Initially, descriptive statistics were conducted on the dependent variable, the number of trips, which found a variance approximately 20 times the mean; this suggests the suitability of an undesirable binomial model as opposed to a Poisson model, due to the degree of dispersion present. Hence, only the undesirable binomial model outcomes are presented for discussion.

TABLE 2
Model Estimation Results

| | Truncated Poisson | Truncated Negative Binomial |
|---|---|---|
| TTC | -0.0014607<br>[-0.0001461]*** | -0.001265<br>[-0.000311]*** |
| MST | -2215.418<br>[-0.1454703]*** | -232.299<br>[-0.4028666]*** |
| MST*TTC | 0.0015016<br>[-0.0001495]*** | 0.0012886<br>[-0.0003157]*** |
| Income | -0.0000238<br>[-0.0000146] | -0.00006<br>[-0.0000268]** |
| Colombian | -0.8799183<br>[-0.122442]*** | -0.8941361<br>[-0.3627912]*** |
| Income*Colombian | 0.0002169<br>[-0.0000234]*** | 0.0002325<br>[-0.0000643]*** |
| Education | -0.0349491<br>[-0.0109643]*** | 0.051072<br>[-0.0265755]** |
| RBO | -0.5903869<br>[-0.0592394]*** | -0.688131<br>[-0.1250094]*** |
| BP | 0.4618713<br>[-0.0623145]*** | 0.5111255<br>[-0.1296053]*** |
| Gender | 0.0193491<br>[-0.0543294] | 0.1398497<br>[-0.1238658] |
| Constant | 3.294214<br>[-0.216138] | -15.29018<br>[194.2909] |
| lnalpha | | 16.89922<br>[194.2901] |
| Alpha | | 2.18E+07<br>[4240000000] |
| N | 474 | 474 |

Source: own work
Standard errors in brackets
*p < 0.10; **p < 0.05; ***p < 0.01

# Discussion

The central variable of the model, TTC, whose interaction with MST represents the effect of the travel expense on the number of visits to the Coral Reefs in Rosario and San Bernardo National Natural Park for those divers who did not perform multipurpose trips, turned out to be negative and significant. This means that for visitors who travelled to the National Natural Park exclusively to engage in recreational diving activities, as their travel expense rises, the number of visits to the Coral Reefs in Rosario and San Bernardo National Natural Park tends to decrease. This result is consistent with the results found in studies such as Blaine et al. (2015) and Mwebaze & Bennett (2012). On the other hand, the variable MST, which takes the value of 1 for the people who made multipurpose trips and 0 otherwise, turned out to be negative and numerically relevant. This implies that people who travel to this place exclusively to engage in recreational diving activities make more trips to the Park than those who visit it and do various activities. This result reveals the importance of recreational diving activity in the Coral Reefs in Rosario and San Bernardo National Natural Park. The variable MST*TTC shows the impact of the travel cost on the number of times the park was visited for those who travelled to the park and performed various activities in addition to recreational diving. This variable turned out to be positive and numerically relevant. This result implies that for those visitors who made multi-purpose trips, no opposite correlation exists between the cost of travel and the number of visits made. However, this is not inconvenient to our estimates, since these are based on those divers who visited the park exclusively for recreational diving activities.

Regarding socioeconomic characteristics, the variable Income, which in this case represents the role of income in the number of trips that foreign divers make, had a negative yet significant effect on the model. However, when we observe the result of the interaction of this variable with the dummy Colombian, which represents the effect of income on the model for Colombian divers, this was discovered to be of positive and significant influence on the model. The divergence between the impact of income for local and foreign divers reflects the extensive discussion in the TCM literature on both negative and positive effects of this variable (Loomis, Yorizane, & Larson, 2000; Martínez-Espineira & Amoako-Tuffour, 2008; Mwebaze & Bennett, 2012; Blaine et al., 2015). However, income estimates in TCM models could pose significant risks for policy design and ecological administration of ecosystems (Blaine et al., 2015). For this study, estimates for foreign divers indicate an inverse relationship between income and visits to the Coral Reefs in Rosario and San Bernardo National Natural Park. Therefore, we could indicate that foreign divers might consider the coral reefs at the National Natural Park as an inferior good. The model findings on foreign divers reinforce the environmental problems that have plagued the coralline ecosystems of this MPA. In the case of local divers, there is a positive correlation between the revenue and the number of trips made to the place.

Revenue estimates in this study could be adjusted to address issues raised by Blaine et al. (2015), where tax rates implemented to restrict access to natural resources tend to affect a greater proportion of lower-income visitors, which are usually local tourists. This is because lower income visitors have a reduced number of alternatives for recreation and appreciation of environmental services. As such, a hypothetical implementation of input tax rate for recreational diving in the Coral Reefs in Rosario and San Bernardo National Natural Park would impact mostly local divers. For this reason, the design of future regulatory policies in the National Natural Park should include an analysis of the characteristics of the park's visitors. The variable Education has a positive and important influence on the model, while Gender has no significant impact.

Moreover, the vector of expectations for conducting visits to the park shows that RBO has a negative influence on trips. This indicates that, when the site is recommended by another diver, the probability of visiting the Coral Reefs in Rosario and San Bernardo National Natural Park to practice scuba diving, decreases. This confirms the

problem of sedimentation of coral reefs and their consequent loss of biodiversity. Finally, we find that the variable regarding expectation of beauty (beauty of the place, BP) has a constructive effect on the number of visits. This reveals the importance of quality and conservation regarding the diving site in deciding whether to visit.

We estimate the welfare provided by recreational scuba diving in the Coral Reefs in Rosario and San Bernardo National Natural Park by calculating consumer surplus. The ratio (1/#TTC) represents the consumer surplus in USD per person-visit in 2008-2013. Therefore, we divide the result of the ratio by five to obtain the annual benefit for recreational diving services. The adjusted annual economic benefit is USD 156.75 per diver per year. This result reflects the individual willingness to pay divers to visit the National Natural Park. Additionally, this result is similar to that estimated in other studies, as we had anticipated. For example, Jiddawi et al. (2005) found that the willingness to pay for the Zanzibar Islands is USD $ 84.70 per diver per year. For the Bonaire National Marine Park case, Parsons & Thur (2008) estimated that the diver's willingness to pay was between USD $ 45 and USD $ 192 per year.

We calculated the financial benefits for recreational diving in the Coral Reefs in Rosario and San Bernardo National Natural Park considering the number of divers who visit the park on a yearly basis. Consequently, with 4.200 divers each year (Zarza-González, 2011), the overall annual value of USD 658.359 is derived from recreational diving in the park.

# Conclusions

This study was conducted with the aim of estimating the significant use values of coral reefs located in the Coral Reefs in Rosario and San Bernardo National Natural Park, through the estimation of the different consumer surplus as well as the financial benefit of recreational diving. In contrast, estimates of consumer surplus constitute economic references, which could be useful in applying future taxes to this activity; action that seeks to promote mitigation policies on coral reef issues. Furthermore, estimates of the impact of reef loss in the request for recreational diving services and the level of site quality in the divers' expectations, raises the potential implementation of environmental management measures. One of these measures is policies to mitigate coral reef losses in the Coral Reefs in Rosario and San Bernardo National Natural Park. Such policies must palliate the impacts of dredging and its consequent deposition of sediments and pollution on delicate marine structures. If such policies were designed to ensure the environmental protection of the reefs, the resources obtained by any disincentive to dredging could be used to promote reef conservation projects. Initiatives include the coral regeneration initiative as well as other far-reaching efforts; research on the sustainability of coral reef ecosystems. Likewise, policies aimed at implementing entrance fees for recreational diving services as a source of income for the restoration of coral reefs need to be designed. However, caution must be exercised when designing these types of policies insofar as they could lead to entry fees that disproportionately affect local visitors (as per our findings).

Further studies could attempt to apply adjusted count data models to recreational services provided by other marine protected areas within the Colombian marine platform. We suggest that a thorough inventory should be conducted of both the protected areas and the recreational services they provide within Colombian territory. Additional studies could subsequently assess the economic value of the environmental assets of these areas. Given the country's substantial touristic potential, such information would be highly valuable.

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# Notes

* Artículo de investigación. Volumen 14 N.° 79 (enero-junio) 2017 ISSN en línea: 2215-7727