

Economic benefits of sport fishing in Los Cabos, Mexico: is the relative abundance a determinant?

V. A. Hernández-Trejo¹, G. Ponce-Díaz Germán², D. Lluch-Belda²
& L. F. Beltrán-Morales³

¹*Universidad Autónoma de Baja California Sur, Mexico*

²*Centro Interdisciplinario de Ciencias Marinas, Mexico*

³*Centro de Investigaciones Biológicas del Noroeste, Mexico*

Abstract

Los Cabos is the main tourism destination in Baja California Sur with almost 1.19million visitors in 2009. Its early development is linked to sport fishing practice since 1960, mainly for two reasons. The first one refers to the high likelihood of catching. The second is related to the abundance of sport fishing species (blue, striped and black marlin; sailfish, dolphin fish, yellowfin tuna, wahoo, roosterfish and jack mackerel), which are present and are highly abundant throughout the year. The study aims to estimate the economic benefits of sport fishing in Los Cabos by applying an economic valuation technique known as travel costs. The study has two basic assumptions; first, travel cost method allows estimating more conservative benefits than the preceded studies for this activity. The second assumption is that the relative abundance of sport fishing species is relevant within the demand model for sport fishing trips. The purpose of valuation is to estimate the willingness to pay for access (WTP) the site and subsequently the economic benefit. Count models, like Poisson, are generally used in travel cost method to estimate the WTP to access the site. The models incorporate arguments like cost of the fishing trip, income, other socioeconomic variables and the catch per unit effort (CPUE). CPUE is considered an appropriate index to measure the relative abundance of sport fishing species. Several Poisson models were estimated to calculate the individual WTP, with values from 22.27 to 70.55 dollars. The economic benefits of sport fishing in Los Cabos for the estimated models are between 2.10 and 6.65million dollars. The value of WTP can be used to propose modifications to



the access fees, and the collected amount may be oriented to enforce conservation, protection and management actions.

Keywords: economic valuation, travel cost, sport fishing, Los Cabos, catch per unit effort.

1 Introduction

Sport fishing is a touristic activity that has established with time. This activity is practiced by people from different countries around the world and it is done mostly in the coasts. There are places where there is an increment of fishermen who gather when the abundance of sport fishing species is high for this activity. Places like Cairns, Australia; Bay of Island, New Zeland; Kailua-Kona, Hawaii y Cabo Blanco, Peru.

Chávez-Comparan [1] mention that the practice of recreational fishing in Mexico is one of the leisure activities that offers the greatest natural attractions, because the country has wide variety of species for that activity. In Mexico, sport fishing generates important economic benefits. The National Commission of Aquaculture and Fisheries (CONAPESCA [2]) calculates the benefits of sports fishing in Mexico around two thousand million dollars (MD). The economic flow generated by this activity generates a multiplier effect in three sectors of the economy: i) the tourist (because of the services of hospitality, restaurants, travel agencies and transport), ii) fishing (through the tour operators, supply of materials and port facilities) and, iii) the industrial (because of the manufacture of ships, equipment and accessories, taxidermy and in general the related industry).

In Mexico, sport fishing is practiced in tourist resorts like Acapulco and Ixtapa Zihuatanejo in Guerrero; Puerto Vallarta in Jalisco; Manzanillo at Colima; Mazatlan in Sinaloa and Los Cabos located in Baja California Sur. Among the principal species for sport fishing are billfishes such as sail fish, striped, blue and black marlin. The minor sport fishing species are principally yellow fin tuna, wahoo, roosterfish and jack mackerel. The billfishes species are the most coveted by the sport fisherman because their strength and size (Klett-Traulsen *et al.* [3]). Gerhard and Gulick [4] state that Los Cabos owes its tourist calling principally due to two factors: i) the raise of the sport activity and ii) because of the species destined for this activity is one of the principal attractions that motivate tourists to travel to this destination Pérez-Valencia [5] .

Sport fishing in Baja California Sur (BCS) is concentrated mainly in Los Cabos area for three reasons: i) it has tourism infrastructure and trained personnel to attend this type of demand, ii) minimal seasonal changes in the quantity of different sport fishing species; and iii) the presence of all fishing species along the year (Ponce-Diaz *et al.* [6]). These factors associated the demand for recreational ecosystem services provide for the sport fishing species in a positive with the increase of the activity (Hernandez-Trejo *et al.* [7]). At the end of last century sport fishing has become a strong branch of economic activity in Los Cabos.



In 2010 the Harbor Master of Cabo San Lucas reports 32,166 trips of sport fishing and 94,218 fishermen aboard, however there isn't a report on the catch rate. Catch rate is an important variable to be considered in any study of sport fishing since it is highly related to the number of fishing trips (Ortega-Garcia *et al.* [8]). A (positive or negative) variation in the catch rate of the species meant to sport fishing could affect in two aspects: i) one variation in the sport fishing travel demands in the zone; and ii) one variation in the perceived recreational benefit by the sport fisherman.

To measure the impact that the variation in catch rates has in the welfare of sport fishermen, can be calculated using economic valuation techniques suggested by the environmental economics. The existing value among the natural attributes of a place and the productive activities that take place therein can be expressed in terms of their ecosystem services, because the value of the ecosystem services is its contribution to social welfare. This value can be expressed by the concept of economic value proposed by Tuner *et al.* [9]. To find the economic value of an element or the ecosystem service, it has to be completely identified and then different valuation methods can be used [10, 11].

The present study aims to incorporate the relative abundance of species of sport fishing (measured by catch per unit effort [CPUE]) as a determinant of the demand per sport fishing trips in the area of Los Cabos and prove if they have influenced over the recreational economic benefits generated by the activity.

2 Background: valuation of sport fishing in Los Cabos

The first economic valuation study for sport fishing in Los Cabos is the one of Ditton and his collaborators [12], they used contingent valuation to assess the activity of sport fishing in Los Cabos; the study includes variables such as the willingness to pay (WTP), income, travel cost, years of experience and the fishermen school level; they obtain a recreational value of the activity of about 15.5 (MD). Thereafter the Billfish Foundation [13] conducted a study to estimate the multiplier of the activity and subsequently calculate the economic benefits generated by the sport fishing in Los Cabos, getting a benefit of 1.13 MD.

None of the previous mentioned studies include environmental determinants in their estimations. A study that applied the individual travel cost method (TC) and incorporates the catch rate (CR) is Alberinni's *et al.* [14], when they incorporate the CR in the model is possible to observe how the consumer surplus changes due to a variation in the CR, without changing the prices. It also analyses contingent scenarios about the abundance of sport fishing species, where two situations are handled: i) the status quo and, ii) an increment of the biomass, based in this two scenarios it is possible to visualize the changes in the welfare derived from a proper management program of sport fishing species.

Economic valuation is a tool that can help to design economical instruments capable of changing patterns of production or consumption. It also supports management plans or other instruments for ecosystem services conservation. The assessment is useful for estimating the economic amount of possible damages



about the ecosystem services and/or the benefits of conservation actions (Seenprachawong [15]).

3 Economic valuation methods

Economic valuation plays an important role in decisions concerning the use of natural resources. It allows measuring and comparing -monetarily-, the gain or loss of the welfare that a person will experience, or the society, because of an improvement or environmental damage. It can contribute to determine an approximate amount for the service provision of environmental services or compensations caused by environmental damages. Also contributes to propose economic instruments aimed to modify production or consumption patterns, and strengthens the design and implementation of conservation and management plans of the ecosystem services. The economic valuation can be useful to evaluate the impact or welfare of an environmental policy.

The contribution made by the tradeoffs of ecosystem services to the welfare is where its economic value lies. If not perceived contribution to welfare, the value assigned to ecosystem services will be void. The existing value between the ecosystem services and the productive activities- including the recreational ones- can be expressed in monetary terms through the tradeoffs that exist among them [16, 17]; this tradeoffs can be expressed by means of the concept of economic value proposed by the environmental economics. To find the economic value of an element or service of the ecosystem different valuation methods can be used.

Here are two basic approaches in the context of environmental economy: i) market methods and ii) non market methods. The approach addressed in the study are the methods that asset environmental value through demand curve (market methods), known as expressed and revealed preferences methods. For the expressed preferences methods we have the contingent valuation method; and for the revealed preference methods there are two methods, travel cost and hedonic prices method. All of them measure variations in the welfare by the consumer surplus.

For recreational benefits (direct use values) given by the ecosystem services of the sport fishing species, one method proposed to be able to value them monetarily is the travel cost method (TC). This method is commonly used to calculate the benefits derive from visitors to sites that protect natural resources with recreational use values. TC asks directly to the users or visitor for their travel costs and expenses incurred during their stay in the site.

Harold Hotelling (1947) suggested the use of the TC to estimate entrance fees to national parks in the United States of America (USA), however it can also be used to asses specific characteristics or attributes of the site. The substance of the method is due to the decision of traveling to a place to enjoy its recreational services (Habb and McConnell [18]). Visitors to the site will incur into travel costs, payment of entrances fees, payments made at the site and other expenses related with a given level of visits Azqueta-Oyartzun [19]; so it is considered a model of demand for a recreational site.

4 Travel cost method

TC is based on cost variations of the expenses that cause differences in the quantities demanded, which allows estimate the cost of demand per trip at different cost levels. TC also assumes that individual recognizes his preferences under conditions of complete certainty; but there are elements in those preferences that are unobservable, neither accessible for the modeler. As the unknown elements of the preferences can be assumed to be stochastic and be included in an error component in the models.

Individual TC has five principal assumptions: i) travel and time is proxy variables for the price of a recreational trip; ii) travel time is neutral, providing no utility or disutility; iii) the decision unit is trips of equal length across the site for each household; iv) the trips are single purpose trips, taken to the recreation site for the purpose of recreation and v) the quantity consumed (x_{ij}) is trips the same place for all consumers.

Same authors mention, that the demand curve estimated by TC shows the availability of the individual to accept improvements in the site or how he values damages to the site. This provision is measured by the number or trips that the individual would be willing to make if those changes would occur. The behavior of the individual, about the various changes in the recreational sites, can be obtained by the travel cost, and socioeconomic variables incorporated in the model.

The individual model of demand starts from a time allocation and income given by a function of a generic demand function for a single site. Assumes that the individual i chooses x_{ij} ; where j is the number of trips to the site $\forall j=1,2,\dots,n$. The cost for a round trip is c_{ij} . The individual also consumes a composition of assets associated with travel z_j , also called weak complementary assets [20]. TC assumes that the individual has two restrictions: i) income,

$$y_i \left(\sum_{j=1}^n x_{ij} c_{ij} + z_i \leq y_i \right) \text{ and ii) time } \sum_{j=1}^n x_{ij} + t_{ij} + h_i = T_i \text{ where } t_i \text{ is the travel}$$

time to the site j ; h are the working hours and T is the total available time. And it is assumed that the time devoted in each site visit is the same.

The demand of the individual I for the site j , with explicit arguments is given by $x_{i1} = f_1(c_{i1} + t_{i1}w_i, \dots, c_{in} + t_{in}w_i, q_1 \dots q_n, y_i^f)$, where y_i^f is the full income of the individual ($y_i^f = y_i^0 + w_i T_i$); or the amount of money that someone can make if he works all the time he is available, w_i , the income after taxes, each q_j is the exogenous quality for the j -nth site, and y_i^0 is the adjusted income of the individual i through $y_i^0 = y_i + w_i h_i$ where y_i is the individual income.

Once the general demand model has been defined, the parameters associated to each determinant to the numbers of travels to the site can be estimated. The most common model in the analysis in the TC is the count model Poisson. For

estimates we define the demand curve for the individual site i in a given population as

$$x_i^* = f(\mathbf{z}_i) + \varepsilon_i,$$

where $\mathbf{z}_i = (p_{ij}, j = 1, \dots, n; q_j, j = 1, \dots, n, y_i^f)$ and $p_{ij} = c_{ij} + w_i t_{ij}$.

Poisson models specify the amount, trips, as an integer random, not negative, with an independent mean of exogenous regressors. The functional form of the demand for this model is typically exponential. For single site models, the general count model is written as follows $\Pr(x_i = n) = f(n, \mathbf{z}_i, \beta)$, $n=0,1,2,\dots$, and the probability density function (PDF) is given by $\Pr(x_i = n) = \left(e^{-\lambda_i} \lambda_i^n / n! \right)$; $n = 0, 1, 2, \dots$; where $\lambda_i > 0$ and it is specified as an exponential function $\lambda_i = \exp(\mathbf{z}_i, \beta)$. Once the parameter estimates associates to the vector \mathbf{z} , the willingness to pay to access the site (WTP) for the Poisson model can be calculated by equation (1).

$$WTP(access) = \int_{C^0}^{\infty} e^{\beta_0 + \beta_1 C} dC = \left[\frac{e^{\beta_0 + \beta_1 C}}{\beta_1} \right]_{C=C^0}^{C \rightarrow \infty} = -\frac{x}{\beta_1} \quad (1)$$

Within the general demand model, the CPUE was incorporated by taking the monthly registries of this variable reported by the fishing fleet that operates in the area. About that Hanley *et al.* [21] and Maunder *et al.* [22], mention that the CPUE is used as a suitable index to measure the relative abundance of fisheries stock, which can also be used in the sport fisheries.

5 Data

Stratified random sampling was used considering each sampling month as a stratum, with a confidence level of 95% and an estimation error of 4%. The sample analyzed was 467 individual who travel to Los Cabos to practice sport fishing between August 2010 and September 2011; the response rate of the survey was 81%. The 80% of the sample visitors declare to come from the USA, 9% from Canada and 7% from Mexico, from them 34% live in California; 97% of the people interviewed were male. With an average age of 34 years old, 72% locate their educational level in graduate level (including master and Ph.D.) and report a yearly average income of 137 thousand and 740 dollars.

Related to the activity of sport fishing, 85% states that they didn't participate in fishing tournaments, only 43% of them declared that the reason of their visit is sport fishing and 47% considers it as a very important element in their visit. 56% of the surveyed considered themselves as expert fishermen, 80% rented the boat in which they went fishing, only 13% of the fishermen didn't captured any species in their trip and 66% acquired a fishing license. The average days of fishing was two days, with a total travel cost and an average cost for the fishing trip of 4,783 and 782 dollars respectively.

6 Results

To estimate the benefits of the sport fishing in Los Cabos the individual TC was used. The results show that the demand function is not linear in the price (p) or travel cost (tc), but is linear in the other attributes; income (y) and catch per effort unit ($cpue$).

$$v = c + \beta_1 \frac{1}{p} + \beta_2 y + \beta_3 cpue + \varepsilon \quad (2)$$

Where v is the independent variable representing the number of trips of sport fishing at Los Cabos and ε is the stochastic term. Thus the equation (2) becomes into an econometric model. This model is estimated with the collected data in the survey, including the variables mentioned before and other individual attributes of the fishermen interviewed. (Table 1)

Table 1: Variables in the model estimates.

Variable	Description
<i>invtc</i>	$\frac{1}{tc}$ of the travel cost of fishing of the <i>i</i> -nth individual
<i>cpue</i>	Catch per unit effort reported by the fleet in the area reported for the week of the interview
<i>ly</i>	Natural logarithm of the income of <i>i</i> -nth individual
<i>reason</i>	Principal reason of the visit to Los Cabos: 1: fishing; 2: vacation; 3: other
<i>license</i>	Type of license acquired by the fishermen. 1: daily, 2: weekly, 3: monthly y 4: yearly
<i>skunk</i>	Take the value from 1: if the fisherman didn't catch any fish in their fishing trip, 0: other form
<i>impfish</i>	Take the value from 1: when the sport fishing is very important for the reason of the trip, 0: other form

Problems of heteroskedasticity detected in the estimates were corrected by the reciprocal of the cost (*invtc*), as the correction was made the estimation of the WTP cannot be done by the equation (3). According to Christiernsson [23] to calculate the WTP there are steps to be made: 1) estimate the elasticity of the travel cost (η_{tc}) by $-\beta_{tc} / (T_a \cdot tc_a)$; where β_{tc} is the coefficient of *invtc*, T_a and tc_a are the average of the visits and the travel cost respectively, and 2) calculate de WTP by $-T_i / -\eta_{tc}$; where T_i is the number of travels per individual. The calculated elasticity for the models has an inelastic behaviour.

The critical values (vc) of the Log-likelihood for the corresponding α value to determine the effectiveness of the estimates are: i) if $\alpha=0.05$; then $vc=-3.84$; ii) $\alpha 0.01$; $vc=-6.63$; iii) $\alpha 0.001$; $vc=-10.83$ and iv) $\alpha 0.0001$; $vc=-15.13$ (Rayson

and Garside [24]). Having presented the above it can be said that the estimated models are robust and efficient up to 99% of confidence.

Table 2: Poisson's estimates.

Variable	Model					
	Extended I		Extended II		Extended III	
	Coef.	P>z	Coef.	P>z	Coef.	P>z
<i>invtc</i>	-130.7220	0.0000	-103.3969	0.0000	-50.2207	0.0020
<i>cpue</i>	2.0213	0.0000	2.2925	0.0000	0.6905	0.0570
<i>ly</i>	----	----	-8.7552	0.0000	-9.7620	0.0000
<i>reason</i>	----	----	----	----	-0.3655	0.0000
<i>license</i>	----	----	----	----	0.1380	0.0010
<i>skunk</i>	----	----	----	----	-0.2412	0.0070
<i>impfish</i>	----	----	----	----	0.0094	0.1140
<i>c</i>	-0.7865	0.0290	-1.1855	0.0050	0.3917	0.2670
LL*	-533.52		-391.98		-195.19	
BIC**	1,084.48		806.05		430.09	
Elasticity	-0.087		-0.076		-0.027	
WTP	22.27		25.16		70.55	
EB (MD)	2.10		2.37		6.65	
*Log-likelihood						
**Bayesian information criterion						
**Consumer surplus						
♦Economic benefit						

The Bayesian information criterion (BIC) mentions that given two models, the model with a smaller BIC will be the one that better fits the data of University of California, Los Angeles [25]. Based on this premise, the model with better fitness is the Extended III (BIC=430.09).

The price elasticity estimated in the four models is inelastic; there for a variation in the fishing trip cost would entail a minor variation in the sport fishing trips in Los Cabos. The WTP calculated in the Extended model I and II, don't show a significant variation in their values which are between 20.86 and 25.16 dollars. The value of the WTP in the Extended III model is 70.55 dollars, exhibiting a significant difference with respect to the other models; nevertheless, this model is the one that fits better to the data. The economic benefits for sport fishing in Los Cabos show the same behaviour as the one calculated for WTP in each model.

7 Discussion

To compare the economic benefits of sport fishing obtained two important values are taken as reference on economic terms. The first one is the Gross Domestic Product (GDP) of the primary sector of BCS for the year 2009, which value was 554 MD. The second amount to consider is the value of the fish production of BCS for year 2009, which has the value of 59.4 MD CONAPESCA [26], this value include fish species of a high commercial price such as abalone and lobster; the prices to fisherman was 16.60 and 9.34 dollars/kg respectively (Agroprospecta [27]). The value of the benefits of sport fishing estimated with the study is over the primary GDP and under the value of fish production of BCS. Similarly the estimated benefit here is under the calculated by the Billfish Foundation and over the value estimated by Ditton and collaborators.

The CPUE is statistically significant at 99% in the Extended models I, II and III confirming the assumption that it is an important determinant for the demand model for sport fishing trips in Los Cabos. Its positive symbol indicates that the probability that the individual takes a decision to make a fishing trip will increase if the relative abundance of the fish sport species also increases.

It is important to mention that if the relative abundance of the sport fishing species decrease, then the probability that a fishing trip would take place would reduce as well. So the results found with respect to CPUE should be considered by the resource managers as a significant element to: i) implement management strategies that help maintain the abundance of the species as it is now, ii) promote the activity in the tourist destination, iii) conservation or the sport fishing species by encouraging and promoting the practice of catch and release and, iv) differential charges for fees or permits.

The inelastic nature of demand functions estimate displays the possibility to suggest increments in the charges for fishing permits, visualizing four options. The first, an increment in the sport fishing permit cost, by day, weekly, monthly or yearly. The second option is the possibility to suggest differentiated charging according to the kind of tourism (national, local or foreign). On third place, one differentiated charge can be given by extraction or release; higher cost for extraction permit and lower cost for release permit. Finally, it is possible to establish differential fees in the permits, depending on the season of the year; higher fees when the likelihood of billfish catch is high and vice versa.

The task becomes difficult to try to answer which of the four WTP should be chosen, the answer is not simple. However, based on statistical criteria, the WTP that should be considered is that calculated by the Extended model III, as it is the one that better fits the data. Keep in mind that economic valuation is static and only responds to the situation prevailing at the time. The value obtained is useful when proposing economic instruments that are able to control the demand on the site, changing patterns of production and consumption (such as catch and release) or establish quotas or permits on catches for the sport fishing species.

On fees or permits on catches, the benefits obtained from this can be oriented to strengthen strategies and management and conservation plans of the cultural



and recreational ecosystem services that are given by the sport fishing species in Los Cabos.

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