VALUING THE WATERVILLE FISHERY:
A travel cost analysis of anglers' recreational use-values

[1]Patrick R. Gillespie*, [2]Stephen Hynes, and [3]Paul O'Reilly

[1]Rural Economy and Development Programme, Teagasc
[2]National University of Ireland, Galway, Socio-Economic Marine Research Unit
[3] Inland Fisheries Ireland

Contributed Paper prepared for presentation at the 90th Annual Conference of the Agricultural Economics Society, University of Warwick, England

4 - 6 April 2016

*Patrick R. Gillespie. Rural Economy and Development Programme, Teagasc, Athenry, Ireland.
Email:patrick.gillespie@teagasc.ie

Acknowledgements: The authors acknowledge project funding from Inland Fisheries Ireland.

Abstract

The Waterville fishery provides angling and other recreation amenities to the public at a nominal cost. However, the use-value which this site provides is not completely captured by market transactions. Benefits which must be consumed in situ make the Travel Cost Method (TCM) the most appropriate choice of revealed preference technique for estimating their value. Data for this analysis was sourced from an online survey, but many respondents were first approached on-site, and links to the survey questionnaire were also advertised on a local conservation website, so self-selection bias was expected. A negative binomial model with a correction for endogenous stratification was estimated, and it outperformed both the standard Negative Binomial and Poisson models. The resulting estimate of per trip consumer surplus was €300. Furthermore, there was a lack of any evidence to support the idea that the site's benefits are inferior goods. In light of this, and of the high use-values associated with the site, the conclusion drawn from the analysis is that future development plans should prioritise the health of the local ecosystem before other quality improving measures.

Keywords coastal, fishery, benefit cost, consumer surplus, TCM, travel cost

JEL code Q220, Q260

1. Introduction

The Waterville fishery is unusual in that it includes both inland—i.e. freshwater—and sea fishing. The town of Waterville is located on the west coast of Ireland in county Kerry. It borders on Ballinaskelligs Bay, and two inland river systems lead into Lake Currane to the east. Both the bay itself and the surrounding wetlands are designated as a Special Areas of Conservation due to a variety of seabirds and plant life which are present there. The fishery—which operates from 17th January through 30th September—supports a variety of fish species. Some of the more commonly targeted species include salmon, sea trout, brown trout, bass, mackerel, and pollock.

The local economy of Waterville is dependent on tourism. The town is located on the "Ring of Kerry" driving route which is a well-known tourist attraction, and this generates an annual influx of patrons during the tourist season. There are a number of hotels, Bed & Breakfast establishments, and camping facilities in the area. These support local entertainment and amenity related businesses, e.g. the Waterville Links golf course.

Several of the local attractions are based on the natural setting in which Waterville is located. A system of hiking and walking trails called "The Kerry Way" cross the landscape. Furthermore, recent accreditation as a Dark-Sky Gold Tier reserve signals that the location is ideal for star gazing. The revenue generated by these activities represents a component of the value inherent in the local environment. Angling also depends on the local ecosystem, and this activity is the main focus of this report.

Places such as Waterville have a more obvious need to properly balance the pressure for economic development and the imperative to protect the local environment. This tension has instigated a survey which has been funded by Inland Fisheries Ireland and the Waterville Lakes and Rivers Trust to assess the value which the fishery itself provides to anglers that use it. This figure requires the use of revealed preference methods of non-market valuation, of which the Travel Cost Method (TCM) is an example. This standard method of analysis will be conducted in this report.

The estimated value obtained from the TCM will be a subset of the total economic value presented by this natural resource; it excludes other types of non-market values, as well as the market values associated with the fishery. However, the results of this analysis are an important component of the overall estimate of total economic value, and this report represents the first attempt at estimating the value of this particular fishery.

The report is timely as well; Irish agriculture is dominated by bovine production systems, and with the recent abolition of milk marketing quotas in 2015, Ireland is projected to undergo an expansion in terms of milk production. Competition for land may put protected areas at risk from agricultural runoff and other negative externalities associated with agricultural intensification. This underscores the need for valuation studies such as this one to guide public policy concerning environmental protection and land use.

The remainder of this report is organised as follows. Section 2 gives the theoretical framework which underpins the estimated value of the fishery. Section 3 provides some detail on the econometric methods used to obtain the estimates. Section 4 discusses the sampling methodology used to obtain the dataset, as well as the practical consequences for model specification. Descriptive statistics are also provided here. Section 5 presents the results of three models, and compares them before arriving at value figures for the fishery. The final section concludes the report with a discussion of implications of the analysis, as well as any qualifications which must be kept in mind when interpreting the results.

2. Theoretical framework

Waterville provides a host of activities and services, but most of these attractions have either an incomplete market or no formal market at all. The absence of such markets makes it difficult to take full account of the benefits provided by the fishery to the user. Furthermore, such benefits may be large relative to the costs of individual development projects, pollution abatement programmes, or the potential benefits from a competing land use. Therefore, it is necessary to monetize and tally such benefits for use in any Benefit-Cost Analysis (BCA) which the national or local government may commission in the future.

One may employ a TCM to estimate consumer surplus (CS) resulting from the services provided from the recreational site. These services have use-values for site visitors, and use-values can be measured through revealed preference techniques. A benefit of this indirect measurement is that it is based on observed data for well-understood market goods, i.e. fuel, car hire, etc. This is sometimes seen as more reliable than directly eliciting hypothetical values from users; respondents may strategically bias their responses, or they may find assigning a value to site benefits very difficult. The TCM is due to Hotelling (1947), and it is one of first revealed preference methods employed by economists (Shecter, 1995, p. 185). It is now a standard technique in the environmental valuation literature. It is most appropriate for situations when the services from some natural resource must be consumed *in situ*, and when entrance fees don't exist or are set low to keep the resource accessible to the general public, e.g. the enjoyment of a national park (ibid., p. 186). The public good provided by the Waterville fishery matches this description very well, so a TCM is an appropriate choice of modelling framework for this analysis.

As the name implies, the TCM uses the costs of travel to and from the site to estimate the CS associated with a given visit to the recreational site. One of the implicit assumptions in this sort of model is that users of a site treat travel costs as a kind of price, or as an additional fee to be added to an explicit entrance fee if one exists. In either case, consumers should respond to increases in travel cost just as they would for an increase in any other price, i.e. the downward-slope of the demand curve implies that increases in the price should decrease the quantity demanded.[1] In this context, a decrease in quantity demanded is equivalent to a reduced number of trips to the site.

Shrestha et al. (2002) describe the theoretical framework for the TCM in terms of Marshallian demand and indirect utility functions. According to the authors, consumer demand can be represented by the indirect utility function

$$\max_{x,z} u(x, z | \boldsymbol{a}, \boldsymbol{s}) \text{ subject to } px + \boldsymbol{q}z = y \tag{2.1}$$

where x is quantity demanded of the recreational activity, z is the quantity of all other goods consumed, $\boldsymbol{a}$ is the vector of exogenous attributes of the activity or site, $\boldsymbol{s}$ is the vector of socioeconomic characteristics, p is the travel cost of the trip, $\boldsymbol{q}$ is the vector of prices of other goods and services, and y is income. The Marshallian demand for recreational fishing is derived as

$$x = f(p, \boldsymbol{q}, \boldsymbol{a}, \boldsymbol{s}, y) = -v_p(p, \boldsymbol{q}, \boldsymbol{a}, \boldsymbol{s}, y)/v_y(p, \boldsymbol{q}, \boldsymbol{a}, \boldsymbol{s}, y)\,. \tag{2.2}$$

[1] That is, a leftward movement along the same demand curve.

A modified form of this model can be applied to the data obtained from the Waterville survey. Observations of variables capturing number of trips (x), travel cost (p), age ($\boldsymbol{s}$), and income (y) exist in the dataset, so the demand function $x = f(p, \boldsymbol{s}, y)$ may be estimated, and demand elasticities for both p and y will be available. This allows for the testing of hypotheses concerning the nature of the public goods presented by the Waterville site.

$$H_1(\text{ Normal goods}): \quad \epsilon_p < 0 \; and \; \epsilon_y > 0$$

$$H_2(\text{Inferior goods}): \quad \epsilon_p < 0 \; and \; \epsilon_y < 0$$

$$H_3 \text{ (Giffen goods)}: \quad \epsilon_p > 0 \; and \; \epsilon_y < 0$$

$$H_4 \text{ (Luxury goods)}: \quad \epsilon_p > 0 \; and \; \epsilon_y > 0$$

where ϵ_p and ϵ_y represent the demand elasticity of travel cost and income respectively.

Normal goods behave as one might expect; quantity demanded decreases with a higher price and increases with larger incomes. Inferior goods also have a downward sloping demand curve, but as income increases less of the good is demanded because consumers switch to higher quality substitutes as their budget constraints loosen.

Giffen goods and luxury goods are unusual in that they both have upward sloping demand curves; quantity demanded increases as the price increases. However, the reasons for the upward slopes are very different. Luxury goods are associated with social status, and the more expensive the good is the more exclusive is the class of individuals which can afford them, hence they provide more utility merely by being less affordable than alternatives. On the other hand, Giffen goods have an upward-sloping demand curve because of particularly strong income effects; as the price of the good increases the consumer has less income available for more expensive alternatives, hence they substitute towards the original good at an increased price level.

Evidence of the benefits of the site behaving as inferior goods or Giffen goods would support the notion that the site is somehow of low quality. Reasons for this may be inadequate infrastructure, lack of support services, declining catch rates due to fish stock collapse, or it may also be a general signal of an unhealthy ecosystem spoiling the natural setting.

Finally, the calculation of CS per trip may be recovered from the estimated coefficient for p via its negative inverse $(-1/\hat{\beta})$ as discussed in Creel & Loomis (1990). Given a reasonable population estimate of the total number of trips to the site per year—which would have to be sourced exogenously—it would also be possible to use this number to arrive at a figure for total annual social welfare arising from the continued existence of the Waterville site as it is today.

3. Methodology

The econometrics of the TCM approach are determined by the data types involved in the regressions. The typical situation faced in the application of a TCM is a dichotomous dependent variable (number of trips) which is left skewed, i.e. count data which has a high incidence of low numbers. Martínez-Espiñeira & Amoako-Tuffour (2008, p.1322) explain the practical consequence of this as the necessity to deviate from the typical Ordinary Least Squares (OLS) regression method; the data will be non-normal and intrinsically heteroscedastic. The same paper gives a good description of the econometric techniques used in this analysis (ibid.). This is summarized as follows; a basic alternative to OLS is to use a Poisson regression (PO)

$$\Pr[Y = y] = \frac{e^{-\mu}\mu^{y}}{y!}, \qquad y = 0,1,2,..., \tag{3.1}$$

where μ is a rate parameter, and y is the count variable on the left-hand side. An exponential function is used to parameterize μ

$$\mu_i = \exp(\boldsymbol{x}'\boldsymbol{\beta}), \quad i = 1, ..., n, \tag{3.2}$$

where $\boldsymbol{x}$ is the matrix of explanatorexplanatory variables and $\boldsymbol{\beta}$ is the conformable matrix of coefficients. If the observations of y_i are independent (once conditioned on the explanatory variables), then the model can be estimated by maximum likelihood.

The probability distribution which underlies the Poisson regression has the property of equidispersion, i.e. that the variance and the mean of the distribution are equal. However, in many contexts the variance of the distribution of the count data (y) is greater than the mean (overdispersion). A properly specified PO model will still be consistent, but it will suffer from standard errors which will be too low, thus making confidence intervals too narrow and giving spurious indications of statistical significance.

Estimation can proceed using a negative binomial (NB) model in this situation. This procedure adds a nuisance parameter (α) to the Poisson regression equation, which can then be tested against a value of 0 to justify the model choice. In particular, if μ from (3.1) is replaced with λ which is random and is defined as $\lambda = \mu v$, with μ defined as in (3.2), and v being distributed as a function $g(v|\alpha)$, then the component v of λ will be the unobserved heterogeneity not captured by the PO model. If the assumption is made that$v \sim \Gamma(1, \alpha)$, where $\Gamma(\cdot)$ is the gamma function, then the negative binomial density function is:

$$\mathrm{h}(\mathrm{y}|\mu, \alpha) = \frac{\Gamma(\alpha^{-1} + y)}{\Gamma(\alpha^{-1})\Gamma(y+1)}\left(\frac{\alpha^{-1}}{\alpha^{-1} + \mu}\right)^{\alpha^{-1}}\left(\frac{\mu}{\mu + \alpha^{-1}}\right)^{y}, \quad \alpha > 0. \tag{3.3}$$

Count data in TCM-based models also frequently suffer from truncation at 0 because trips not taken are not captured by the data. In this case the Poisson model is biased, and a corrected form of the NB must be used instead. That density function is given by

$$\Pr[\mathrm{Y} = \mathrm{y}|\mathrm{Y} > 0] = \frac{\Gamma(\alpha^{-1}+y)}{\Gamma(\alpha^{-1})\Gamma(y+1)}(\alpha\mu)^{y}(1+\alpha\mu)^{-(y+\alpha^{-1})} \times \left[\frac{1}{1-(1+\alpha\mu)^{-\alpha^{-1}}}\right] \tag{3.4}$$

which can then be further adjusted to allow for endogenous stratification (self-selection)

$$\Pr[Y = y|Y > 0] = y_i \frac{\Gamma(\alpha_i^{-1} + y_i)}{\Gamma(\alpha_i^{-1})\Gamma(y_i + 1)} \times \alpha_i^{y_i}\mu_i^{y_i-1}(1 + \alpha_i\mu_i)^{-(y_i+\alpha_i^{-1})}. \tag{3.5}$$

The final equation (3.5) is important for this application, as the data were sourced from an online survey which was linked to from a conservation website associated with the local area of the Waterville fishery. Furthermore, many respondents may have been approached on-site and directed to the online survey that way. This being the case, it is likely that the sample suffers from a non-trivial degree of self-selection bias, just as in the usual case where a survey is fully conducted on-site. Therefore the final model is expected to perform best, but all three models described above were estimated for the purpose of testing and comparison. The models were all estimated in Stata using commands which have been available since version 9.1.[2]

4. Data

This survey of the recreational users of the Waterville fishery was conducted by the website SurveyMonkey™ on behalf of Waterville Lakes and Rivers Trust and Inland Fisheries Ireland (IFI). The analysis of this survey and the writing of this report were undertaken as a project by SEMRU, which is a collaborative research unit jointly administered by the Marine Institute and the National University of Ireland, Galway.

Patrons of the fishery were approached while on-site in various locations. They were directed to the web service, with the online survey completed at their convenience. The survey was also advertised on several angling websites, as well as the Waterville Lakes and Rivers Trust website. Responses were collected over 97 days between 26th February and 2nd June of 2015. It was possible to complete the survey over multiple days, but all respondents completed the survey in one sitting.

The survey included questions to allow identification of individuals, but these have been stripped from the cleaned dataset. An anonymised identification variable is retained, as were any descriptors which would not inadvertently reveal the identity of any individual respondent.

Several questions regarding angling and non-angling related expenses were included. Respondents were presented with options from list of possible amounts and then asked to choose the figure which was nearest to their actual expenditure. Hence, this measure is recorded as a discrete variable which will entail a certain

[2] The official Stata commands POISSON and NBREG were used for the PO and NB models respectively, while the user-created command NBSTRAT (Hilbe and Martínez- Espiñeira, 2005) was used for the NB model corrected for zero-truncation and endogenous stratification.

loss of precision. However, the cut points of these expenditure levels are sufficiently close together that the variable may be viewed as essentially accurate. More troublesome is the open-ended nature of the highest level (greatest spend), which merely indicates that a respondent spent at least some certain amount, which complicates the calculation of statistics. Fortunately, there were few such responses, so removing them is an acceptable solution to this problem.

Open-ended responses were an issue for several other questions as well, but there were few such responses in all cases, and the approach is always to remove these observations, i.e. the entire row of data. There were relatively few variables which could be considered as continuous measures in the resulting data.

The survey was a cross-section of the users of the fishery, i.e. there are no repeated measures in the data. The specified models are then necessarily cross-sectional. Confounding variables are chiefly controlled for through the specification of a corrected negative binomial model (TNB) and the inclusion of a visit rate variable intended as a proxy for respondents' innate propensity to take a trip. It is hoped that this will capture most of any existing unobserved variable bias.

Although no specific effort was made to stratify the sample, the sample will not be representative of the general population of Waterville. The appropriate population for whom the assumption of simple random sampling (SRS) may said to be reasonable is for current users of the fishery, and this may be viewed as the typical user throughout the tourist season if one is willing to accept that there is no systemic difference amongst the users at various points throughout the season. This is the view taken in this report, so statistical inference is restricted to this population.

It may also be possible to view this analysis as a case study for fisheries around the world which have similar characteristics. In this case, these results may suggest further works in those specific areas as appropriate, but will not be definitive in and of themselves.

The survey was completed by 265 respondents. However, only a portion of these observations were retained after the sample was checked for consistency across responses, ambiguity in responses to key questions, and after those respondents that did not engage in angling were removed. Furthermore, the sample includes data on respondents that did not make a trip within the last 12 months. Including these respondents would reduce or eliminate the need to correct for endogenous stratification; this was initially attempted, but the models would not estimate, so only those respondents that took a trip within the last 12 months have been kept in the final sample. After all this sample selection, the final sample stood at 92 observations, which are described in the table below.

The table gives the first indication that the PO model will not be an appropriate choice, as the variance of 9 (standard deviation squared) is substantially higher than the mean number of trips at 3.53. The dependent variable appears to exhibit clear overdispersion.

The travel cost variable appears next. It too has a large degree of variability relative to its mean. The travel cost variable was calculated from responses to expenditure on fuel and car hire. Expenses related to fares for sea or air travel were excluded, as it is doubtful that these expenses were solely associated with the site visit, i.e. the visit took place in the context of a larger trip to Ireland more generally. This is a necessary step, as the TCM implicitly assumes that travel costs are incurred for site access only. Several respondents indicated that they paid for other members of their party as well, so in these instances the cost figures were normalized to expense-per-person to facilitate the analysis.

Table 4.1: **Descriptive statistics of model variables**

Variable	Mean	S.D.	Min	Max
trips (dependent)	3.53	3	1	10
travel cost	89.11	90.29	0	501
visit rate	1.33	0.82	0.18	6
	Freq.	%	Cum. %	
Age				
18 to 24	1	1.09	1.09	
25 to 34	6	6.52	7.61	
35 to 44	14	15.22	22.83	
45 to 54	23	25.00	47.83	
55 to 64	29	31.52	79.35	
65 to 74	18	19.57	98.91	
75 or older	1	1.09	100.00	
Income				
I WOULD RATHER NOT SAY	30	32.61	32.61	
Up to €20,000	4	4.35	36.96	
€20,001 - €30,000	9	9.78	46.74	
€30,001 - €40,000	9	9.78	56.52	
€40,001 - €50,000	7	7.61	64.13	
€50,001 - €60,000	11	11.96	76.09	
€60,001 - €70,000	8	8.70	84.79	
€70,001 - €100,000	4	4.35	89.14	
More than €100,000	10	10.87	100.00	

$n = 92$

The visit rate was calculated as the number of visits the respondent made to the site prior to the last 12 months, and this was divided by the number of years visiting the site less one. Respondents that visited the site very regularly in years prior would be expected to have a higher number of visits in the last 12 months than those that did not visit often. There are many potential reasons for this, some of which would be confounding variables in this analysis if not properly accounted for via this proxy variable. In addition, the variable has a fairly tight distribution with a low standard deviation relative to its mean, so it is likely to have high explanatory power.

The age and income variables capture responses via membership in fairly broad levels, i.e. mostly 10-year increments in the case of age, and mostly €10,000 increments in the case of income. These levels are course measurements, and the numbers of respondents in each bin are too low to make reliable inferences for any individual age or income category. Nonetheless, the variables are important to retain for theoretical and methodological reasons, and the main variable of interest—travel cost—retains a healthy enough sample size at 92 observations to be usable. Therefore the model will still yield results, although the interpretation of the age and income variable comes with a health warning.

5. Results

The results of the TCM models are presented in below in Table 5.1. All three models are jointly statistically significant. The TNB model has a Wald statistic of 38.74 with 16 degrees of freedom; hence it is statistically significant at the 0.01 level. The NB model has a likelihood ratio of 40.01 with 16 degrees of freedom, so it too is statistically significant, but at the 0.001 level (99.9% confidence level). The PO model has a likelihood ratio of 75.12 with 16 degrees of freedom, so it is statistically significant at the highest confidence level, but as mentioned above, the truncated nature of the data will produce standard errors which are too low in the PO model. This is visible by scanning each row of the table and comparing the standard errors for each variable from each model. For example, the standard errors for “Visits per year” are 0.14, 0.09, and 0.07 for the TNB, NB, and PO models respectively.

Table 5.1 TCM model results

	TNB		NB		PO	
	b/se		b/se		b/se	
Travel cost	-0.003**	(0.00)	-0.002*	(0.00)	-0.002**	(0.00)
Up to €20,000	-0.705*	(0.32)	-0.501	(0.38)	-0.561	(0.32)
€20,001- €30,000	-0.022	(0.44)	-0.037	(0.26)	-0.050	(0.20)
€30,001- €40,000	-1.735***	(0.37)	-1.107***	(0.31)	-1.138***	(0.27)
€40,001- €50,000	-0.824*	(0.38)	-0.527	(0.30)	-0.490*	(0.24)
€50,001- €60,000	-1.136**	(0.36)	-0.716**	(0.26)	-0.687**	(0.21)
€60,001- €70,000	-1.572***	(0.42)	-0.945**	(0.35)	-0.961**	(0.30)
€70,001- €100,000	-0.203	(0.35)	-0.185	(0.33)	-0.235	(0.26)
More than €100,000	-0.389	(0.38)	-0.235	(0.25)	-0.212	(0.19)
25 to 34	1.971***	(0.43)	1.366	(0.87)	1.391	(0.75)
35 to 44	1.628**	(0.50)	1.019	(0.85)	0.988	(0.74)
45 to 54	2.047***	(0.48)	1.335	(0.85)	1.321	(0.74)
55 to 64	1.645***	(0.43)	1.073	(0.85)	1.060	(0.74)
65 to 74	1.635**	(0.51)	1.047	(0.85)	1.014	(0.74)
75 or older	2.066***	(0.55)	1.261	(1.21)	1.244	(1.06)
Visits per year	0.520***	(0.14)	0.358***	(0.09)	0.335***	(0.07)
Constant	-1.772*	(0.69)	0.102	(0.86)	0.161	(0.75)
$\ln(\alpha)$	0.354	(0.72)	-1.913***	(0.41)		
$Log\ L$	-175.64		-190.17		-195.81	

$n = 92$
* p<0.05, ** p<0.01, *** p<0.001

Despite the lower standard errors, the PO yields fewer statistically significant results than the TNB model. The reason for this lies in the bias of the PO coefficients which result from the truncated nature of the data; the magnitudes of the coefficients increase for all but two of the regressors. The TNB model also outperforms the NB model which attributes too much of the model's variability to the overdispersion parameter (α), and therefore less variability is assigned to the model's regressors. This is a consequence of ignoring the endogenous stratification of the data which resulted from the sampling method. Since the TNB model accounts for this, as well as the truncation of the data, it outperforms the other models. Further evidence of this superiority is given by the log likelihoods of each model; these worsen (become more negative) as read from left to right in the table, i.e. as the models become more basic.

The NB and TNB models both provide hypothesis tests of no overdispersion in the data. This is just the p-value for the $\ln(\alpha)$ parameter, and statistical significance rejects the notion that the data are equidispersed as the PO model assumes. The NB model does reject the hypothesis of equidispersion, while the TNB fails to reject, so the results are mixed here. However, the apparent bias in the PO model estimates discussed above rule it out in any case.

The model specification is a parsimonious one. Travel cost is included, and this is followed by income and age variables, as well as a variable capturing the yearly visit rate reported by the respondent in years preceding the most recent year. In all three models the travel cost variable has the expected negative sign and is statistically significant. This narrows the hypotheses from section 2 down to the site benefits behaving as either normal goods, or potentially Giffen goods.

Self-reported income categories are also included as factor variables. The base level for this variable (which is omitted to avoid perfect collinearity) was the response "I WOULD RATHER NOT SAY". There are many reasons which may explain why a respondent would refrain from answering this question, but it is plausible to assume that both low and high earners may be more likely to give this response. Given that income is expected to have a positive correlation with the number of trips taken, the negative sign on the income levels may be an indication that more of these respondents actually earn high levels of income. The fact that the coefficients for the levels of income do not uniformly increase (become less negative) for each progressively higher income class suggests some non-linear or possibly even non-monotonic relationship between income and trips, but given the relatively course level of measurement in this variable and the low number of respondents in the categories it must be said that statistical inference for these control variables is not possible. There is effectively no reliable evidence of a generalizable relationship for the income variable in this model, hence there is no empirical evidence that the income effect operates any differently than theory would predict for this sample. Without evidence to the contrary, the hypothesis of the site benefits behaving as normal goods is the most appropriate.

The age category of the respondent is also captured in the model. Like the income variables, age is represented by factor variables for different levels of age. The age variables are the chief beneficiaries of moving from the NB to the TNB model, as all levels become statistically significant. The base level against which each level is compared is the youngest category, i.e. 18 to 24 years old. All levels of age have a positive coefficient relative to this base level, suggesting that 18-24 year olds are least likely to take a trip amongst the age categories. Just as it was with the income variables, the coefficients for the age variables suggest a non-linear and possibly a non-monotonic relationship between age and trips to the fishery, although it is likewise impossible to get confirmation on this point due to the coarseness of these variables and small numbers of respondents in the individual categories.

The visit rate is the last variable specified. This report maintains that this ratio is a measure of any particular respondent's innate propensity to visit the site, hence it may be used to proxy for unobserved variables, thereby reducing bias to the estimates of the specified variables. It is statistically significant in all three models, and its coefficient is moderately large.

It is noteworthy that the constant term becomes statistically significant and is much larger for the TNB model relative to the other two. This is consistent with the motivation of the model; the endogenous stratification of the sample implies a higher base level of trips amongst the sample, and this is reflected in the larger constant term estimated by the model.

The variable which is of direct interest is the travel cost variable because it allows estimates of angler's CS, i.e. the measure of recreation use-value. Following Srestha et al (2002) the estimate of CS can be obtained by taking the negative reciprocal of the coefficient of the travel cost variable$\left(-1/\hat{\beta}\right)$. This yields estimates of per trip use-values of €300, €461, and €444 for the TNB, NB, and PO models respectively. Like Srestha et al (2002), the models estimated here show considerable variation for CS estimates, but as noted in the previous section, and as borne out in the model comparisons in this section, the TNB estimate is the most reliable given the data at hand.

One can use the estimates of CS to construct estimates of site users' willingness to pay (WTP). To calculate an average WTP, one may add the CS figure to a sample mean value for total trip expenditure per person. Trip expenditure should include all items which relate to the trip, but which do not result in an asset which can add value to subsequent trips as these should be considered as investments. Therefore, any expenditure on gear or licenses was excluded from total trip cost. The cost items which were included were: holiday package deals; fares; car hire; fuel; accommodation; dining; grocery shopping; gifts; other trip related expenses; hiring a ghille; boat hire; bait purchases; and other angling relate expenditure.

An analysis of expenditure patterns was carried out using the definition described above. An initial outlier analysis of total expenditure found three outliers which were excluded from the tables below, and this resulted in a sample size of 89 respondents. The sample data allows an examination of the values which different groups of visitors place on the fishery.

A first question to ask is "Do foreign and domestic visitors have similar levels of spending?" This data gives a strong indication that foreign visitors spend a good deal more. The table below shows the mean levels of overall spending and travel related expenditure for visitors from Ireland and Northern Ireland versus those coming from elsewhere. The latter group was almost exclusively composed of visitors from Great Britain, but visitors from mainland Europe and other locations were included as well because they were too few to analyse separately. Trip expense is over €1,000 larger for visitors from elsewhere, but travel cost is only €100 for this group. Further analysis revealed that foreign visitors spend more in every category.

Table 5.2: **Expenditure patterns (€) – visitor origin**

	Per person trip expense	Per person travel cost	*n*
Ireland/N. Ire.	544	52	64
Elsewhere	1606	171	25
p-value	0.000	0.000	

Source: Author's calculations

The survey contained a question which allowed respondents to identify their main influence in the decision to visit the Waterville fishery. The responses allowed the categorisation of respondent into two groups; there were those that said that their primary motivation was that they were a habitual visitor to the site, and there were those that named some other influence. Returning visitors may value the site's amenities more. The next table breaks down trip expense and travel cost along these lines, and although repeat visitors do have a higher mean in this sample, the failure to reject the null hypothesis means that one cannot infer any difference between the mean trip expenses for their underlying populations.

Table 5.3: **Expenditure patterns (€) – main influence**

	Per person trip expense	Per person travel cost	*n*
New visitor	730	80	23
Repeat visitor	881	87	66
p-value	0.606	0.447	

Source: Author's calculations

Whether or not certain types of fishing trips encourage more spending was examined next. Respondents were able to classify their trips into categories regarding where they predominantly fished. These were grouped into inland-based versus sea-based fishing activities. As can be seen in the table, those visitors engaged in sea fishing tended to spend more than those that primarily used the rivers and lakes for their fishing activities.

Table 5.4: **Expenditure patterns (€) – type of fishing**

	Per person trip expense	Per person travel cost	*n*
Inland fishing	702	72	44
Sea fishing	1120	107	38
p-value	0.003	0.022	

Source: Author's calculations

The age of the respondent may factor into the ability to spend more. Table 5.5 bears this out; respondents that were aged 55 and older had an average expenditure per person in excess of 25 per cent higher than those younger than 55.

Table 5.5: **Expenditure patterns (€) – over/under 54**

	Per person trip expense	Per person travel cost	*n*
54 and younger	743	76	43
55 and older	935	94	46
p-value	0.042	0.637	

Source: Author's calculations

Finally, an analysis of the size of the party was undertaken. Parties were categorised into groups of one or two, three or four, and five or more. The final table shows the mean values for the different groups. As one might expect, the larger the group the lower the average per person cost. However, the null hypothesis (no difference between group means) cannot be rejected for overall trip expense due to the similarity of means for groups of 3 to 4 and for groups of greater than 5. Statistical significance is established for travel costs, however.

Table 5.6: **Expenditure patterns (€) – size of party**

	Per person trip expense	Per person travel cost	*n*
1-2 people	1004	105	35
3-4 people	752	85	28
5 or more	722	59	26
p-value (F-test)	0.427	0.029	

Source: Author's calculations

The sample average for the total per person trip expense stood at €842. Adding this figure to the estimate of CS from the TNB model one arrives at an estimate of average WTP of €1,142 per person per trip. Multiplying this figure by the total number of visitors engaged in fishing would yield an estimate of the total recreation use value of the fishery.

6. Conclusions

The Waterville fishery is unusual not only in its ability to accommodate both fresh-water and sea angling activities, but also in the high state of environmental quality which it currently displays. An indication of this environmental quality can be given by the fact that the fisheries Pearl Mussel population is one of the healthiest in the country (WFD Ireland, 2010, p. 41), a fact which led the authors to the following conclusion,

> 'Therefore, the Cummeragh River has one of the most important pearl mussel populations in the country, and every effort needs to be given to removing the causes of eutrophication that could quickly impair the juvenile habitat into the future.' (ibid)

This is an encouraging example of how careful stewardship can yield results in the pursuit of a cleaner environment. Sites such as these are a relatively rare resource in highly-industrialised Western Europe.

However, Waterville is in a spatially remote corner of Ireland which—as a nation—is characterised by a relative lack of heavy industry as compared to other parts of Europe. In this part of the world the threats to places like the Waterville fishery generally come from agriculture, aquaculture, and residential or tourism development. This gives the primary motivation for conducting this analysis on this place and at this point in time.

Some threats don't have an obvious connection to the fishery itself. Just like other milk producing regions of Europe, Ireland is likely to undergo a period of tremendous change in its agriculture sector in the wake of the abolition of milk quotas. Dairy cows are large animals, with large impacts on the local environment. Regions of Ireland have already secured derogation from Europe's chief policy mechanism for the protection of her water sources, i.e. the Water Framework Directive. This essentially allows dairy farms in this region to maintain higher stocking rates than would be allowed in other parts of Europe. If dairying intensity increases in the catchment of the fishery it could have negative consequences. Therefore, the CS estimated in this report should be taken into consideration when decisions are made with regard to land use within the fishery's catchment.

Given that the fishery also includes parts of the Ballinaskelligs bay, the value of the fishery to anglers should also be considered in relation to the use of the bay for the purposes of aquaculture. The Waterville Fisheries

Development Group—i.e. the precursor to the Waterville Lakes and Rivers Trust—give their reasons for concern about salmon farming in the bay,

> ‘The operation of the salmon farm at Deenish Island poses a very serious threat to the viability of the Waterville fishery. This is especially so because of the fact that Waterville is the most important sea trout fishery in Ireland and sea trout are much more susceptible to the effects of sea lice proliferation from salmon cages than wild salmon.’ (Waterville Fisheries Development Group, 2013)

Since aquaculture can overwhelm local habitats and introduce disease and parasites to wild stocks, the economic benefits of such industry must also be weighed against the recreation use-value estimated here.

A final class of threat comes from local development. Some infrastructure has obvious consequences for marine life, e.g. hydro-electric dams, but almost any development which entails construction and soil disturbance carries with it the potential for damage to local watercourses. Those concerned with the quality of the Waterville fishery in terms of its tourism potential will be comforted to read that this report found no evidence that the benefits provided by the fishery behaved as inferior goods. That is to say, there’s no evidence to suggest that visitors to the site come because they can’t afford a better alternative. If the quality of accommodation, or site infrastructure were a problem, one would expect that this would be borne out by the data, but this sample gives no indication of such problems. In light of this, and of the high value which anglers put on the site in its current state, it stands to reason that future development should seek first to limit potential damage to the ecosystem which gives the site its fundamental value.

References

Creel, M.D., Loomis, J.B., 1990. Theoretical and empirical advantages of truncated count estimators for analysis of deer hunting in California. American Journal of Agricultural Economics 72, 434–441.

Englin, J.E., Shonkwiler, J.S., 1995. Estimating social welfare using count data models: an application to long-run recreation demand under conditions of endogenous stratification and truncation. The Review of Economics and Statistics 77, 104–112.

Hilbe, J.M., Martínez-Espiñeira, R. (2005). NBSTRAT: Stata module to estimate negative binomial with endogenous stratification. Statistical Software Components, Boston College Department of Economics, available online at hhttp://econpapers.repec.org/software/bocbocode/ s456414.htmi.

Hotelling, H. (1947). Letter to the national park service. An Economic Study of the Monetary Evaluation of Recreation in the National Parks (US Department of the Interior, National Park Service and Recreational Planning Division, 1949).

Hynes, S., N. Hanley, and C. O'Donoghue (2004). Measuring the opportunity cost of time in recreation demand modelling: An application to a random utility model of whitewater kayaking in Ireland. Working Paper No. 0087, Economics, National University of Galway.

Martínez-Espiñeira, R., & Amoako-Tuffour, J. (2008). Recreation demand analysis under truncation, overdispersion, and endogenous stratification: an application to Gros Morne National Park. *Journal of Environmental Management*, *88*(4), 1320–32. doi:10.1016/j.jenvman.2007.07.006

Shechter, M. (1995). Valuing the environment. In H. Folmer, H. L. Gabel, & H. Opschoor (Eds.), *Principles of Environmental and Resource Economics* (pp. 177–200). Cheltenham, UK: Edward Elgar.

Shrestha, R., Seidl, A., & Moraes, A. (2002). Value of recreational fishing in the Brazilian Pantanal: a travel cost analysis using count data models. *Ecological Economics*, *42*, 289–299. Retrieved from http://www.sciencedirect.com/science/article/pii/S0921800902001064

Water Framework Directive Ireland (2010). Freshwater Pearl Mussel: Currane Sub-Basin Management Plan, Second Draft. Online at http://www.wfdireland.ie/docs/5_FreshwaterPearlMusselPlans/Freshwater%20Pearl%20Mussel%20Plans%20March%202010/Second%20Draft%20of%20Currane%20Sub-Plan%20March.2010.pdf

Waterville Fisheries Development Group (2013). Online at http://www.loughcurrane.com/environmentalfund.html