The worth of a chough: Contingent valuation of *P Pyrrhocorax* in Cornwall and the connections to Cornish identity

El valor de un chough: Evaluación contingente de *P Pyrrhocorax* en Cornualles y las conexiones con la identidad de Cornish

Recibido: enero 17 de 2020 | Revisado: abril 12 de 2020 | Aceptado: junio 11 de 2020

Jhon Tredinnick-Rowe[1]
Jeremy Anbleyth-Evans[2]

Abstract

The aim of this paper is to determine how people value species for conservation and apply it to policymaking. This paper is the first attempt to value one of the UK´s rarest birds specifically; the red-billed chough (Pyrrhocorax pyrrhocorax). Classical economic theory struggles to assign value to resources that are not a product of markets, such as endangered wildlife. The contingent valuation method will be used to gauge how P pyrrhocorax is valued in Cornwall via a questionnaire method, eliciting responses to how much individuals are willing to pay to preserve this rare species. The methodology requires diligent questionnaire design, implementation and regression analysis. It was found that the average willingness to pay was £23.60 to mitigate habitat damage to this endangered and iconic bird. Economic valuation has a large role to play in determining policy for species conservation. However, there are other more complex and non-orthodox forms of valuation occurring such as aesthetic, intrinsic bequest and relational values that cannot be accounted for by direct valuation.

Key words: Economics, Health economics, Red-billed Chough

Resumen

Este documento tiene como objetivo determinar cómo las personas valoran las especies para su conservación y aplicar esta valoración a la formulación de políticas. Este documento es el primer intento de valorar una de las más raras especies de aves en el Reino Unido, el Chova piquirroja o Chova pico rojo (Pyrrhocorax pyrrhocorax). A la teoría clásica de economía se le dificulta el asignar un valor a los recursos que no son productos de mercado como, por ejemplo, las especies silvestres en peligro de extinción. El método de valoración contingente se usará para evaluar como el P.Pyrrhocorax es valorado en Cornualles (Cornwall) a través de cuestionarios, obteniendo respuestas de cuánto está dispuesto a pagar cada individuo (WTP por sus siglas en inglés) para la preservación de esta rara especie. La metodología requiere de diseños especializados de cuestionarios, implementación y análisis de regresión de los mismos. Se encontró que, en promedio, cada individuo está dispuesto a pagar £ 23.60 libras esterlinas para mitigar el daño al hábitat de esta icónica especie de ave en peligro. La evaluación económica tiene un rol muy grande que jugar en determinar las políticas para la conservación de las especies; sin embargo, existen otras formas de valoraciones más complejas y no ortodoxas como los valores estéticos, intrínsecos, de legado y relacionales que no se pueden tener en cuenta mediante la valoración directa.

Palabras clave: Ciencias económicas, Economía ambiental, Chova de pico rojo

1 European Centre for Environment and Human Health, University of Exeter Medical School, Knowledge Spa, Royal Cornwall Hospital, Truro, Cornwall, United Kingdom. j.tredinnick-rowe@exeter.ac.uk

2 CEDER - Centro de Estudios del Desarrollo Regional y de Políticas Públicas, Carrera de Geografía Humana, Campus Osorno, Universidad de Los Lagos, Chile.

https://doi.org/10.24265/campus.2020.v25n30.02

Introduction

In the UK, governmental and judicial processes are under pressure to shift towards a more ecologically conscious form in response to changing societal values. How to meet this need has become a pressing issue with policymakers for multiple decades. Two central areas determine how governments protect the environment and biodiversity, (1) economic and (2) socio-cultural concerns. Due to finite economic resources and budgetary constraints (recessions and austerity), the level of environmental protection is often matched against the current state of a nation's economy, and its population's attitude towards conservation (existing legal basis). The utilitarian or neo-classical school of economics would state that policymakers have to determine what level of environmental degradation can be tolerated in a resource at the expense of financial gain, i.e. commercial logging involves cutting down trees. However, more recently, there has been a move towards natural capital valuation, by valuing ecosystem services, which are based on ethical rather than cost considerations. For example, the EU habitat directive and Birds Directive emerged from civil society and NGO pressure over the years.

Borgström, and Kistenkas (2014) highlight that the losses of ecosystem services such as water circulation and purification and the subsequent provision of technical mechanisms are more expensive than providing space for a network of functioning habitats for species, or green infrastructure.

Since the Millennium Ecosystem Services Assessment and its subsequent reiterations, the valuation of species and habitats has begun to change in the mainstream, such as the connection to wellbeing (MEA, 2005). This has seen the ecosystem services/natural capital approach emerge as part of DEFRA (Department for Environment, Fisheries and Rural Affairs) policy. This apparently includes an attempt to include wildlife to ensure better decision-making by valuing our 'natural capital'. This is an instrumental valuation, to determine how much it is worth to the market. It is worth mentioning that there is increasing interest in non-instrumental values and the relational turn in the literature, emphasising a deeper focus on relational values to nature, in addition to instrumental and intrinsic values (Chan et al. 2016; Muraca et al. 2018; Klain et al. 2017).

The Natural Capital Approach of DEFRA is part of an attempt to internalize the externalities' or to modify market valuation to give more consideration to ecosystems. Perhaps what is needed is reverse; to view the contributions of the economy within the ecosystem, after all humans are internal to it (Odum and Odum, 2000). Nevertheless, current calculations of GDP ignore the throughput – the metabolic flow of useful matter and energy from environmental sources, through the economic subsystem (production and consumption), and back to environmental sinks as waste (Jackson and Senker, 2011). A way to do this as theorised by Odum and Odum, (2000) to use one kind of energy as the common denominator.

A method of valuation was developed based on the total amount of energy of one kind used directly and indirectly

(and by all pathways) necessary to make something. For example, everything in an ecosystem can be expressed in the solar energy used to make each item by various direct and indirect pathways. Thus, fish have higher values per joule than phytoplankton.

However, economists of the 1970s such as Shabman and Batie (1978) objected to the energetic approach. They argued that value and price were determined by people's "willingness to pay" and not by the amount of energy required to produce a product or service.

This fits with the Cost-benefit analysis (CBA)) approach, which in accordance to mainstream market values assigns a monetary value to all public goods and their benefits (Mitchell and Carson 1993, 1). This approach is not an end in itself but offers greater insight into the value associated with different courses of action, aiding decisions on environmental policy and protection. It rooted in classical economic theory.

The Chough and its connections to Cornish identity politics

Red-billed Cornish Choughs (*Pyrrhocorax pyrrhocorax*) are a medium-sized red-billed, red-legged member of the corvid family. They feast on soil invertebrates and are rarely found more than 1km inland from the coast. The chough is listed in Annexe 1 of European Union Directive (EC/79/409) on the Conservation of Wild Birds; further information can be found in (Reid et al. 2003, Robertson, Jarvis, and Day 1995). This paper looks to apply economic modelling for public goods to the conservation of this species.

Figure 1. A Chough in flight, credit: By Andrew - originally posted to Flickr as chough, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=7204919

Beyond its conservation value in economic terms, the red-billed chough also holds significant cultural importance for the Cornish national minority in the UK (McKillop 1998, 78). The red-billed Chough is a heraldic symbol, which features on governmental, civic and monarchic insignia of Cornwall, as well as in its folklore (Carter et al. 2003). King Arthur was reputedly transformed into a Red-billed Chough when he died (Penhallurick 1979). Absent since the late 1940s, the Chough returned to recolonize Cornwall's Lizard peninsula in 2001, a symbol of the areas cultural rebirth. Circa 2019, there were 12 breeding pairs of Choughs in Cornwall (Bird Guides 2019).

Project Aim

1. To evaluate the economic worth placed upon conservation of *Pyrrhocorax pyrrhocorax* in Cornwall through a Contingent Valuation economic survey.
2. Produce information that can be utilized in implementing environmental policy to facilitate species conservation.

Economic Evaluation and the Contingent Valuation Method

To understand species valuation, according to the strictures of Contingent Valuation is it essential to comprehend four different types of resources, non-use resources, private goods, public goods and common goods. In classical economic theory, value is based around the interaction of products in a market place, which determines the price of the goods. From this positon, public goods do not have a financial value, as they are non-excludable. For example, a view from a nature reserve cannot be valued because it is open to all visitors. Resources which cannot be valued in markets are termed *non-use resources*. This covers goods that we would classically call common, i.e. water or air.

Whereas private goods are traded in regulated markets, have a market-defined price and associated property rights. The consumer preference for private goods is readily identifiable. There are numerous examples of private goods from food to clothing; they typically represent a tangible quantity (Mitchell and Carson 1993, 55).

Public goods are distinguished by their collective property rights; public goods typically cannot be traded in any market form; hence, an individual in a collective cannot sell their rights to the property. Property rights are non-transferable (ibid, 56). A classic example being air, no one can sell his or her rights to access to air, nor can it be traded on any form of market. However, it must be noted; there are exceptions such as the commodification of urban air rights in the Taipei Metropolitan Area.

Open access resources are free to all persons at no cost. However, this issue generates problems with protecting these resources, as they have no singular ownership. With the absence of property rights, it becomes harder to attribute blame for damage or misuse. In some cases, perceived property rights may be just as important as legal ones. The classical economic model states that only if resources can be shown to have a monetary value, would they be worth protecting through legislation. This is the reason for using cost-benefit analysis techniques to demonstrate the value of a resource to inform policymakers of the level of protection needed.

There are numerous methodologies for environmental valuation based on extracting a preference for a particular type of goods from the public. Consumers preferences are expressed directly by respondents in some form of surveys, or preferences are revealed in an indirect manner examining consumer-spending patterns. For example, two houses of identical design are in different locations; one has a sea view the other does not. The revealed preference infers the value of the sea view to a consumer, expressed indirectly in the difference between the two house prices.

The method we have chosen to value to the conservation of red-billed Choughs is the contingent valuation method (CVM). The contingent valuation method is a form of normative economics (based on value judgements) associated with social welfare and consequently, the environment. It uses the revealed preference technique. A large proportion of which is concerned with creating more equitable and sustainable arrangements between producers and consumers. This is illustrated in Figure 2.

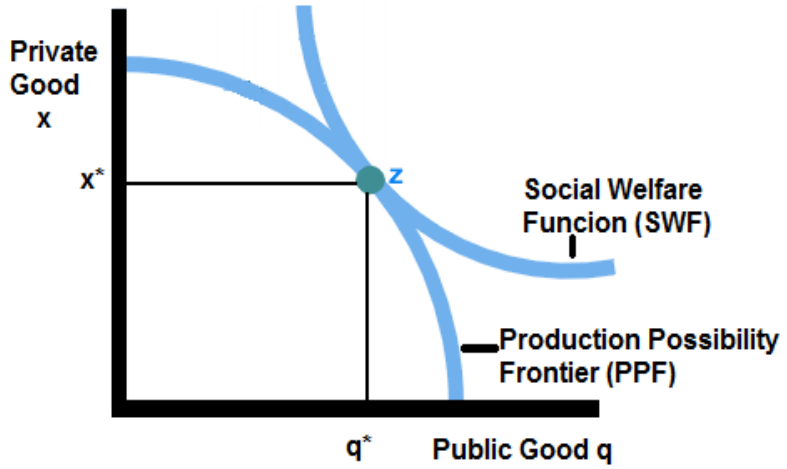

Figure 2. Point of optimal production for social welfare function

Figure 2 illustrates a utilitarian approach to finding a trade-off between public and private goods in a market. The tangent at point Z indicates the optimal point where the use of public goods q* corresponds to the use of private goods x*. This could be, for example, the point at which logging in a forest neither causes excessive harm to the resource nor damages the enjoyment of the resource for the public (Mitchell and Carson 1993, 18).

In the case of the contingent valuation, however, the position of Z on the curve is dependent upon the opinions of the public surveyed and may not represent such a sustainable solution but will be transposed towards the goods which are preferred, i.e. in the example either of timber or continued preservation of forests. Contingent valuation presents a hypothetical market for goods to operate in, as there are no markets for non-use goods. The technique sets out a hypothetical market where other scenarios are presented, representing the alternative sources of action for the respondent. Hence, the valuation of preserving choughs is consciously weighed against other opportunity costs, e.g. protecting other bird species in Cornwall or historical monuments and other substitute commodities in the area.

Markets are used to understand the demand for one course of action over another; hence, they indicate the preference of the consumers in a supply-demand relationship. This gives the policy-maker vital information on which course of action the public values most. Moreover, where to allocate protection, given the finite nature of the policy maker's resources. The goods that are valued most highly, however, are not necessarily the most useful or those from which we can derive the most benefit. For example, the protection of giant pandas generates much higher revenues than other species such as bees that play a key role in biodiversity and the continuation of human life on the planet. The contingent valuation method elicits the value placed on the resource in terms of consumer preference, not the intrinsic value to humanity or any wider community. However, the individual respondent may be motivated by wider, more holistic values in their willingness to pay for a resource's protection.

This makes the contingent valuation method distinct in that it accounts for the non-use class of existing benefits. This is not the case with environmental resources where humans tend toward vicarious consumption (Mitchell and Carson 1993, 63). The method is used as a decision-making tool and not an absolute justification for one scenario over another. Only an ardent few take the more stringent approach suggesting that policy should be based exclusively upon a cost-benefit analysis.

The valuation of species occurs for many reasons, economic, social or otherwise (Pearce and Moran 1994); however, these values are not generally quantified in economic terms, i.e. in market terms or policies. Hence they are generally non-use values (Tisdell 1990). There are a number of approaches to valuing ecological resources, with an array of different microeconomic techniques such as hedonic pricing, of which contingent valuation is just one.

The National Oceanic Aviation Administration (NOAA) created a guideline to Contingent Valuation. The directive has since become a benchmark for conducting surveys utilizing the CV method. Alongside methodological guidance in Arrow et al. (1993), it will be used for the basis of the CV method in this paper.

The NOAA report on contingent valuation was commissioned in response to the Exxon-Valdez incident. In the American legal system under the Oil Pollution Act of 1990, NOAA is required to establish regulatory procedures for determining the destruction or injury of natural resources that occur from oil discharge (ibid). This includes the financial reparations of the cost for the damage to non-use resources. Consequently, a panel of economists was required to undertake a critical analysis of the CV method and produce guidelines for its application. These guidelines have become a benchmark in the implementation of the CV method and will be adhered to in the paper.

Method

We have established that the Contingent Valuation Method (CVM) represents a technique, which permits ecological impact to be considered in a cost-benefit analysis system, and environmental damage to be accounted for in an economic system. It is a particular case of choice modelling and is conducted by surveys. The survey is based upon a hypothetical scenario to allocate a price to non-use values. It is designed to assess the respondent's Willingness to Pay (WTP) to obtain or avoid the loss of a certain species or environment (Markandya and Richardson 2017). It can alternatively be used to calculate the Willingness to Accept (WTA) of a group or individual for the same ends. The survey is designed on a contingent market situation (a hypothetical market) which has two fundamental characteristics:

1. A proposal of change to the system.
2. A mechanism or vehicle for implementing change.

WTP surveys are designed to generate the information required to make predictions about the question it sets out to solve, i.e. the economic worth placed upon conservation of *P pyrrhocorax* in Cornwall. They must also

generate predictions that can be subject to scrutiny. We used sample groups to determine what value they would attribute to the suggested change. Our data collection used an opportunistic random sampling method to select members of the public. Our data was a product of on-site sampling - where red-billed chough (P pyrrhocorax) has an established habitat, offsite locations and online questionnaires.

We draw from Farolfi, Mabugu, and Ntshingila (2007) and their application of demographics-based surveying to drive targeted policy and their linear regression techniques. We also used the illustrative examples of questionnaire design and planning for CVM provided in the OCED report by Atkinson et al. (2018).

As WTP forms of the contingent valuation method are most typically preferred in policymaking, we opted for this technique. It offers a robust and concise survey design to allow the results to be meaningfully applied. The CV method can produce information that is applicable to forming government policies based on a purely monetary value.

Biases

Contingent valuation methodologies can suffer from biases due to the nature of questionnaires and how they are written and interpreted by the respondent. The survey was written to minimize these biases. Of particular concern for environmental surveys is the warm glow effect. This effect is also known as the *good cause argument* occurs when the respondent offers a valuation that causes them to feel positive about their view on environmental issues (Rahmatian 2005). However, it may well not represent the real value that they are prepared to pay.

Sampling method

The on-site fieldwork was conducted on the Lizard peninsula, in the Duchy of Cornwall (UK), see Figure 3. This is the only site for breeding pairs of Choughs in the nation. The size of the survey is an important issue. The optimal sample size for Contingent Valuation surveys is fundamentally about the value of information required (Vaughan and Darlin 2000). *As P pyrrhocorax* can be considered a site-specific resource due to its very small population in Cornwall, the questionnaire took two forms. On-site samples were taken from visitors to the peninsula where *P pyrrhocorax* nests. This also made the geographical spread of the data more varied avoiding a bias to one locality. However, the size of the survey was limited by financial, physical and time restraints. Offsite sampling was conducted by using online surveys to create a larger catchment area and to provide information about non-users' WTP of the resource, (Pearce and Moran 1994).

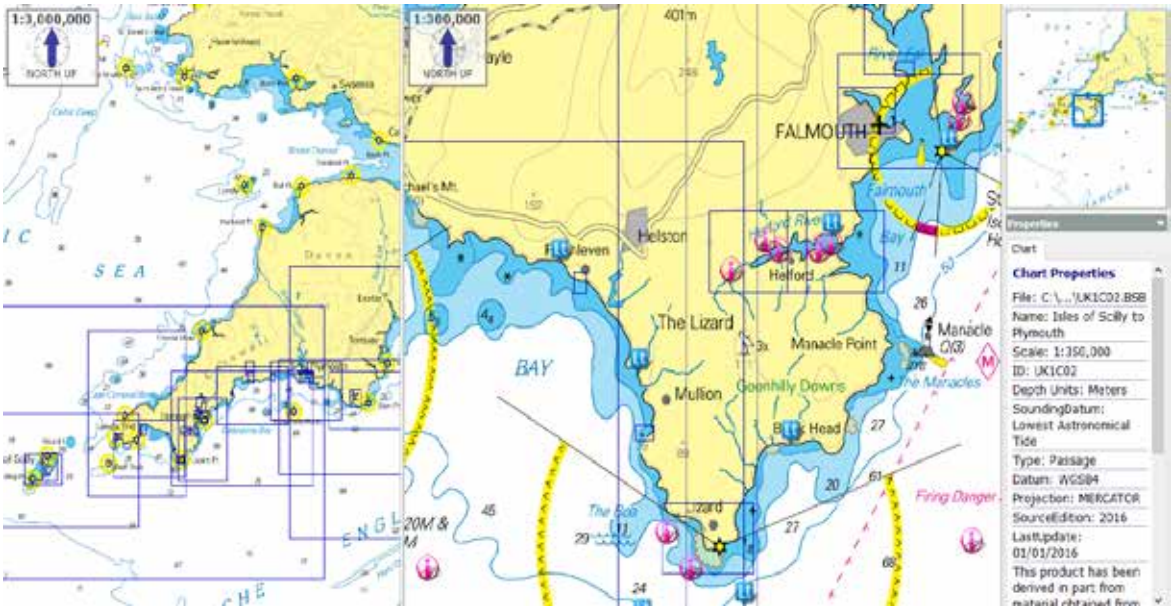

Figure 3. A map detailing the location of the Lizard Peninsula, in the South West United Kingdom, the sole location of *P pyrrhocorax* in Cornwall.

Questionnaire review

The initial questionnaire was prepared according to comments issued by a focus group review. The questionnaire design incorporated the suggestions of the focus group members to ensure it was clear and understandable. This contributed to reducing the non-response rate in the questionnaire making the data collected more valid.

Tabulating Data and Analysis

A logistic regression model based in SPSS was used to determine the WTP. The SSPS logistic regression technique is based on standard models and equations. Basic descriptive statistical methods were used to evaluate the WTP of different sections of the respondents. This was linked to the respondents' income to validate WTP findings. The data were assessed to determine if it was normally distributed. Other indicators of a normal distribution, such as skewness and kurtosis were considered.

Results

Willingness to Pay

In total, taking into account both on-site and offsite results, 114 people completed the survey[1]. The average willingness to pay value for preserving Cornish red-billed choughs was **£23.60**. This figure will be used in the binary logistic regression to determine what factors cause respondents to pay above or below the average WTP value. However, first, the distribution of the data must be assessed.

Testing for normal distribution

For the dataset to be normally distributed, it must have a significance greater than 0.05 in the Kolmogorov-Smirnov test and the Shapiro-Wilk test (built-in tests from the SPSS software package). The Kolmogorov-Smirnov test and Shapiro-Wilk tests were used as the sample size was within the limits of 50 replicates, a summary table can be found below.

1 A copy of the survey is available from the corresponding author upon request.

Table 1
Test for Normality of WTP Data

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
WTP £	.351	113	.000	.355	113	.000

a. Lilliefors Significance Correction

As can be seen from both the Shapiro-Wilk test and the Kolmogorov-Smirnov test, the significance is lower than 0.05; as such, the data is not normally distributed. This is displayed graphically in a Q-Q plot of the data against a normally distributed curve.

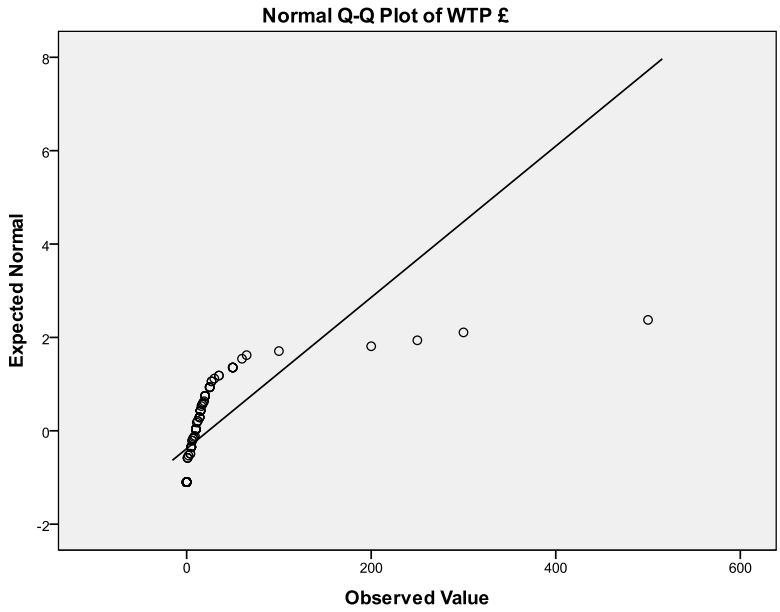

Figure 4. Q-Q plot of WTP data against an expected normal distribution

The observed values (in circular points) do not obey the normally distributed line set out in the Q-Q plot, which is indicated by the straight line. Other indicators of the nature of the data considered include skewness and kurtosis. These measures do not give conclusive proof whether the data set is normalized or not but serve as additional proof and reliable indicators. Both also indicated a non-normal distribution. The non-normally data distribution was taken into account for the logistic regression method chosen.

Backwards Stepwise Binary Logistic Regression

A nonparametric method of regression was chosen to analyze the results. Binary logistic regression was conducted to identify the significant parameters in the questionnaire that determine the WTP values of respondents. This method evaluates the responses of each question in the survey and indicates if a parameter is statistically significant for predicting the WTP value. It starts by analyzing all

parameters, i.e. respondent's answer to questions and iteratively works down to the only parameters that affect the WTP within a 95% confidence interval.

Binary logistic regression treats WTP values as a binary set of data. In this case, the average WTP value was taken (£23.60), and all values below this average were designated 0, and all values above the average were designated 1. The regression analysis can identify the factors that determine if a parameter's influence upon the WTP value is a 1 or a 0; i.e. above or below the average.

The method gives the coefficients for a regression equation from which the variables identified can be used to determine if the respondent will pay over or under the average WTP value. A summary of the results can be found in Table 2.

Table 2
Regression Analysis Coefficients and Significances

Variables in the Equation		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1 [a]	Respondent	-.008	.01 0	.611	1	.434	.992
	DistanceTravelled.Miles	-.010	.008	1.279	1	.258	.990
	Age	-.003	.022	.017	1	.897	.997
	Income£	.074	.032	5.550	1	.018	1.077
	FrequencyDays	.003	.002	2.505	1	.113	1.003
	Gender	1.145	.695	2.715	1	.099	3.143
	interest_envir	-1.066	1.183	.812	1	.367	.344
	Ornithology	.846	.832	1.032	1	.310	2.329
	know_choughs	-2.735	1.313	4.343	1	.037	.065
	protected_yn	.527	.884	.355	1	.552	1.693
	Important	-20.614	11211.515	.000	1	.999	.000
	Possible	-.381	.769	.246	1	.620	.683
	Constant	18.95 9	11211.515	.000	1	.999	1.713E8
Step 11 [a]	Income£	.055	.022	5.994	1	.014	1.056
	know_choughs	-3.068	1.275	5.791	1	.016	.047
	Constant	.813	1.234	.435	1	.510	2.256

a. Variable(s) entered on step 1: Respondent, DistanceTravelled.Miles, Age, Income£, Frequency Days, Gender, interest_envir, Ornithology, know_choughs, protected_yn, important, possible.

The nomenclature of the table is such that B is a logistic regression constant, S.E. stands for Standard Error, Df stands for Degrees of Freedom, Sig stands for Significance, and Exp (B) is an exponential regression coefficient. For the data set to be statistically significant, it must have a significance value greater than 0.05. After the 11th iteration, the only variables that influence a respondent's WTP to within a 95% confidence level are the respondent's *income per annum* and their *knowledge* that Choughs nest on the Lizard peninsula. These values and their regression coefficients can be substituted into the following regression equation to determine if a respondent's income and knowledge that Choughs location will determine if they are willing to pay over or under the average £23.60 WTP value.

$$P_i = \frac{1}{1 + e^{-\sum_{i=1}^{n} \alpha + \beta_i x_i}}$$

Where Pi stands for probability; however, in this case as it is binary regression, the probability outcome is either 0 for below the WTP average or 1 for above the WTP average. Alpha and beta are regression coefficients given in table 2 of the different parameters, i.e. income and know choughs. The reliability of the model can be demonstrated by contrasting the predicted binary WTP values and the actual values taken. The model showed that it could predict if a respondent will pay over or under the average in 96.5 % of 113 respondents.

Gender

The genders of the respondents were approximately equal, 55.3 % male and 42.1 % female, and 2.6% declined to answer. Female respondents were on average willing to pay £7.77 more than their male counter parts. This demonstrates a WTP to preserve Choughs that is a third higher for Women.

Table 3

Respondent's Gender Divide and Their WTP

Gender	Frequency	WTP Average £
Male	63	20.13
Female	48	27.90
No Answer	3	10.00

Age

The most prevalent age groups amongst the respondents were 19-30 years old, representing 33.3%, followed by 31-49 years (28.9%), and 50-69 years (23.7%). The highest WTP of any of the age groups was 50-69 years old. The non-respondent rate to this question was 1.8% (Table 4).

Table 4

Summary of WTP and Income per Annum by Age Group

Age	Frequency	WTP Average £	Average Income £
<18	6	17.00	£15,000.00
19-30	38	14.82	£20,026.32
31-49	33	28.27	£24,060.61
50-69	27	40.33	£28,666.67
70+	8	9.38	£14,250.00
No Answer	2	7.50	£0.00

There is a clear correspondence between the age groups with the highest values of WTP and the age groups with the highest incomes.

Income

The most prevalent income groups were those with less than £15,000 per annum, representing 37.7%. The non-respondent rate to this question was 5.3%.

Table 5
Respondent's Income and their WTP

Income /£1000	Frequency	WTP Average £
<15	43	24.67
15-20	31	18.14
>20-40	25	32.33
>40-60	4	32.50
>60-80	3	17.33
80+	2	17.00
No Answer	6	17.60

Interest in Environmental Issues

When asked if they had an interest in environmental issues, 78% of respondents answered yes, 21.1% answered no, and 0.9% did not answer. The most common environmental interest amongst the respondents was conservation representing 29.8 %. The non-respondent rate to this question was 0.9%.

Table 6
Respondent's Interest in Environmental Issues and their WTP

Options	Frequency	WTP Average £
Yes	89	28.08
No	24	7.00
Conservation	34	36.47
Energy	15	47.33
Waste Management	15	45.47
Geology	5	108.60
Agriculture	9	65.00
Other	18	12.56
None	1	14.00
No Answer	1	0.00

Knowledge of Choughs Nesting on the Lizard Peninsula

When asked if they knew that Choughs nested on the Lizard peninsula, 65.8% of the respondents answered yes, 32.4% answered no. The non-respondent rate to this question was 1.8%.

Table 7
R*espondent's Knowledge of Choughs Nesting on the Lizard Peninsula and their WTP*

Options	Frequency	WTP Average £
Yes	75	31.68
No	37	7.86
Unsure	0	0.00
No Answer	2	0.00

Respondent's Frequency of Visitation

The most frequent type of visit to the Lizard peninsula was once a year 43.8%, and 17.5% of respondents visited on a monthly basis, 9.6% daily, 4.4% weekly, 21.9% of the respondents had never visited the Lizard peninsula. The non-respondent rate to this question was 2.6%.

Table 8

Respondent's Frequency of Visitation to the Lizard Village and Their WTP

Options	Frequency	WTP Average £
Daily	11	13.00
Weekly	5	13.80
Monthly	20	30.70
Yearly	50	34.36
Never	25	3.76
No Answer	3	5.00

Non-response Rate

A good indicator of the success of a questionnaire is the non-response rate. A low non-response rate shows that respondents were willing to engage with the researcher. It also helps to reduce the non-response bias, which could prejudice particular question's responses due to lack of participation. The average non-response rate for the questionnaire was 1.65%; this low non-response rate adds validity to the approach and suggests that the survey was understandable and that the format was adequate to hold the respondent's interest.

Discussion

Demographics and Income

The gender of the respondents was well balanced, with 55.3% of the respondents being male, 42.1 % female and 2.6% declining to answer. On average women were willing to pay £7.77 more to conserve choughs than men, with both groups having approximately equal average annual incomes. From this, we can assume both sexes had approximately the same disposable incomes. Indicating a difference in willingness to pay to preserve Choughs between men and women.

The WTP values amongst the different age groups varied considerably, with a range of ±£30.95. The highest WTP of any age group was 50-69 years old, followed in descending order by 31-49 years old, less than 18 years old, 19-30 years and 70+, which had the lowest WTP of any group. Again, this must be matched against each group's ability to pay by assessing their annual income (Table 9).

Table 9
WTP Summary and Income per Annum by Age Group

Age	Frequency	WTP Average £	Average Income £
<18	6	17.00	£15,000.00
19-30	38	14.82	£20,026.32
31-49	33	28.27	£24,060.61
50-69	27	40.33	£28,666.67
70+	8	9.38	£14,250.00
No Answer	2	7.50	£0.00

The WTP values (except <18 years of age) match the descending order of average income values, i.e. those age groups with higher incomes are willing to pay higher amounts to conserve Choughs. Those who are 50-69 years old would feel the loss of this public resource more strongly. This may be because generally, as people age and their children become financially independent, their mortgages are paid, the volume of disposable income and leisure time increases. As such, up to the point of retirement, an individual's peak income and leisure time will occur between the ages of 50 and 69, affording them more time to enjoy public goods and more money to protect them.

Regression Analysis

The regression analysis showed that the only variables that influence a respondent's WTP to within a 95% confidence-level are income per annum and their knowledge that Choughs nest on the Lizard peninsula. The parameters that affect the WTP value of respondents with any degree of statistical accuracy are few. The low power of the model to predict exact WTP values could be due to an insufficient number of responses. It would seem, however, that the reasons that people value nature might not be well predictable within the standard economic framework of public goods.

From the responses gained, it may be the case that people primarily value nature for its bequest value and its inherent value rather than any form of use or even access to it. If this is the case, it makes quantifying the valuation much harder as has been demonstrated by the low degree of power of the regression analysis model.

In regard to *P pyrrhocorax* there may be a significant degree of associated bequest or inherent valuation by respondents due to its place in Cornish mythology and as a heraldic symbol. This may account for some of the unpredictability in the WTP values of species. In the supporting comments of the question concerning whether the conservation of Choughs was necessary, many respondents who assented added that it was because of the Cornish identity associated with Choughs more than just a concern for nature.

Conclusions and Methods Criticism

The contingent analysis style is based on free-market principles and tries to expand them into matters concerning non-use public goods in ecosystems. This raises the issue of whether liberalized forms of neoclassical economics are the best approach

to valuations of a non-use resource. It remains debatable if amoral market systems should be utilized to provide judgement in monetary terms. Furthermore, all scenarios in the hypothetical market (representing different environmental resources) are equally weighted in importance, whereas this may not be the case in a real-life situation.

The methodology of contingent valuation assumes somewhat naïvely respondents does not possess uncertainty about whether they will value the use of a resource in the future. Uncertainty is a significant factor in some public goods, and this approach represents a risk to policymakers' decisions using the contingent valuation method (Mitchell and Carson 1993, 70). Some economists in the early development of the CV method were highly critical of its approach. For example, Anthony Scott once remarked about the technique,

"*Ask a hypothetical question and you get a hypothetical answer*" (Scott 1965, 27)

However, it is equally probable that when questioned on a particular topic of which the respondent has no knowledge or opinion that they will not make an effort to construct elaborate hypothetical answers unless prompted by the questioner. However, supplementing the method with face-to-face interviews allows an attentive interviewer to determine to some extent if a respondent is likely to value the resource in the future.

This being said, contingent valuation is a versatile methodology that allows for the analysis of a diverse range of goods and a wide range of benefits. It cannot be guaranteed that respondents will answer a contingent valuation survey truthfully; however, it is sufficiently accurate enough to have some meaning and be used to gain inferences. Given this, is it always necessary to make assumptions in the process to reach a precise value for the welfare of an environmental resource or species. There is a need for the method to incorporate qualitative and more contextual forms of valuation to truly understand people's motivation to preserve (or not) nature. Moving towards a mixed-methods approach that is less anchored to purely neoclassical economics theory.

The question remains, how to protect the red-billed Chough? Even if the exact reasons for its valuation cannot be determined entirely. A non-means tested indirect levy or form of taxation to protect Choughs would be regressive as it disproportionally targets the less well off. As such, indirect, standard means of payment such as entry fees to the areas where Choughs should be discouraged unless they are set at levels payable by all. Given the income data, a fairer and more progressive method would be a means-tested ecological tax. Whatever the method selected to fund conservation of Choughs it should be noted that the WTP values of respondents indicate a complex valuation of the species that goes further than simple use, e.g. increased biodiversity, aesthetic value, cultural significance etc. Any legislative approach should recognize and reflect this in its application.

Acknowledgements

I would like to thank Dr Bruce Forrest, Dr Bryan Mills and all the participants in the project survey. I would also like to thank my family and Dr Loveday Jenkin for their help and encouragement.

References

Arrow, Kenneth., Robert. Solow, Paul. Portney, Edward. Leamer, Roy. Radner, and Howard. Schuman. 1993. *Report of the NOAA panel on Contingent Valuation*, *Federal Register 58*. Silver Spring, Maryland: National Oceanic and Atmospheric Administration.

Atkinson, Giles., Axel Nils. Braathen, Ben. Groom, and Susana. Mourato. 2018. *Cost benefit analysis and the environment: further developments and policy use* Paris: Organization for Economic Co-operation and Development

Bird Guides. 2019. "Record breeding season for Cornish Choughs." Last Modified 20/07/2019, accessed 24/03/2020. https://www.birdguides.com/news/record-breeding-season-for-cornish-choughs/.

Borgström, S., & Kistenkas, F. H. (2014). The compatibility of the Habitats Directive with the novel EU Green Infrastructure policy. European Energy and Environmental Law Review, 23(2), 36-44.

Carter, Ian., Andrew. Brown, Leigh. Lock, Simon Wotton, and Stuart. Croft. 2003. "The restoration of the Red-billed Chough in Cornwall." *British Bird* 96:23-29.

Farolfi, S., R. E. Mabugu, and S. N. Ntshingila. 2007. "Domestic Water Use and Values in Swaziland: A Contingent Valuation Analysis." *Agrekon* 46 (1):157-170. doi: 10.1080/03031853.2007.9523766.

Hung-Ying Chen (2020) Cashing in on the sky: financialization and urban air rights in the Taipei Metropolitan Area, Regional Studies, 54:2, 198-208, DOI: 10.1080/00343404.2019.1599104

Markandya, Anil. , and Julie. Richardson. 2017. *The Earthscan Reader in Environmental Economics*. Oxford: Routledge.

McKillop, James. 1998. *Dictionary of Celtic Mythology*. Oxford: Oxford University Press.

Millennium Ecosystem Assessment (MA). 2005. Ecosystems and human well-being: Synthesis, 160 pp. Washington, D.C.: Island Press

Mitchell, Robert., and Richard. Carson. 1993. *Using Surveys to Value Public Goods the contingent valuation method*. Washington, D.C.: Resources for the Future.

Pearce, D. W. , and D. Moran. 1994. *The Economic Value of Biodiversity*. London: Earthscan Publications Ltd.

Penhallurick, R.D. 1979. *The Birds Of Cornwall And The Isles Of Scilly*. Penzance: Headland.

Rahmatian, Morteza. 2005. Contingent Valuation Method. Fullerton, CA: California State University, Fullerton.

Reid, J. M., E. M. Bignal, S. Bignal, D. I. McCracken, and P. Monaghan. 2003. "Environmental Variability, Life-History Covariation and Cohort Effects in the Red-Billed Chough Pyrrhocorax pyrrhocorax." *Journal of Animal Ecology* 72 (1):36-46.

Robertson, A., A. M. Jarvis, and K. R. Day. 1995. "Habitat Selection and Foraging Behaviour of Breeding Choughs Pyrrhocorax pyrrhocorax L. In County Donegal." *Biology and Environment: Proceedings of the Royal Irish Academy* 95B (1):69-74.

Scott, Anthony 1965. "The Valuation of Game Resources: Some Theoretical Aspects." *Canadian Fisheries Report* 4:27-47.

Shabman LA, Batie SS. 1978. Economic value of natural coastal wetlands: a critique. Coastal Zone Manage J 4(3):231–247.

Tisdell, Clem. 1990. "Economics and the debate about preservation of species, crop varieties and genetic diversity." *Ecological Economics* 2 (1):77-90. doi: https://doi.org/10.1016/0921-8009(90)90014-L.

Vaughan, William J., and Arthur H. Darlin. 2000. *The Optimal Sample Size for Contingent Valuation Surveys: Applications to Project Analysis*, *Sustainable Development Department Technical Papers Series*. Washington, D.C.: Inter-American Development Bank.