

WILLINGNESS TO PAY TO CONSERVE THE RECREATIONAL SERVICE OF CONDOR FLIGHT AT COLCA CANYON, PERU

EDELINA COAYLA*

Faculty of Economic Sciences, Universidad Nacional Federico Villarreal, Nicolás de Piérola Avenue, 262, Lima 1, Peru.

*Corresponding author: edelinacoayla@yahoo.es

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Abstract: The aim of this study is to estimate the environmental economic value of conserving condor flight at Colca Canyon, the only tourist experience of its kind in the world. The Andean condor is a land-based bird with the largest wingspan in the South America, yet it is endangered in Peru and vulnerable worldwide. Using the stated preference choice experiment (CE) method and the conditional logit model estimated via SPSS with a Cox regression, a survey was administered to visitors to Colca Canyon to determine their willingness to pay (WTP) for the conservation of recreation services related to condor flight over the canyon. The CE method can estimate the non-use value (existence value), as well as the use value. Of the domestic and foreign visitors surveyed at the Cruz del Cóndor viewpoint, 67% expressed a willingness to pay for condor conservation in the canyon. Domestic tourists who were not willing to pay stated that the Autonomous Authority of Colca should use the proceeds of tourism for conservation. From the Cox regression, we calculated a total willingness to pay of 18.09 soles (US\$4.82) per visitor to conserve the flight of the Andean condor over Colca Canyon. The marginal WTP for the “condor value” and “condor flight over the canyon” attributes were 7.80 soles and 7.21 soles (US\$2.08 and US\$1.92), respectively. The estimated WTP entails the conservation of the Peruvian natural capital and can help policymakers achieve Sustainable Development Goal 15 by curbing the extinction of the condor, while boosting the livelihoods of the inhabitants of Colca Valley through sustainable ecotourism.

Keywords: Willingness to pay, choice experiments, conservation, condor flight, Colca Canyon.

Introduction

Found in Bolivia, Chile, Colombia, Ecuador, Peru, Argentina and Venezuela, the Andean condor (*Vultur gryphus*) is a symbol of South America, whose cultural importance is reflected in its status as the national bird of the first four countries (Wallace *et al.*, 2020). However, the species has already been wiped out in Brazil and Paraguay.

The global population of the Andean condor—currently around 6,700 individuals—is declining rapidly toward extinction, largely because of poisoning and poaching events (Méndez *et al.*, 2021). In 2020, the species was classified as vulnerable by the International Union for Conservation of Nature (IUCN, 2020). To arrest this decline, the Biodiversity Finance Initiative (BIOFIN) is promoting a public project for the recovery of the Andean condor

in Peru (PNUD, 2018). In turn, Peru’s National Forestry and Wildlife Service (Servicio Nacional Forestal y de Fauna Silvestre, SERFOR) will implement a PEN 8.13 million soles (US\$2.17 million) investment project called “Improvement of the Recovery Service for the Andean Condor in Peru” over the period 2021–2023 to disseminate information on the bird’s population and ecological characteristics for effective management throughout the country’s highland and coastal regions (SERFOR, 2021). The conservation of the Andean condor, part of South America’s natural capital and cultural heritage, is crucial.

Surendran and Sekar (2010) have argued that biodiversity is a valuable but nonetheless little-understood natural resource that is rapidly depleting due to human activity. The exploitation of natural resources, consumerism and extremely

high per-capita demand for resources also contribute to biodiversity loss. Nevertheless, people have always been struck by the intrinsic value of wild animals (Hou *et al.*, 2020).

According to SERFOR, as of 2015, the Andean condor can be found in the regions of Amazonas, Arequipa, Puno, Cusco and Apurímac and throughout the coastal regions, except for Tumbes. There are thought to be only around 600 surviving specimens in Peru; in 2022, SERFOR will carry out the first national census of the Andean condor to determine the exact number and their habitats. One function that the condor plays is natural clean-up. According to Wallace *et al.* (2020), an expert workshop held in Lima in May 2015 identified four priority conservation units for the Andean condor in Peru. These are (i) the Southern Peru Priority Condor Preservation Unit (regions of Ica, Arequipa, Moquegua, Apurimac, Cusco, Puno and Ayacucho); (ii) the Pataz Río Abiseo Celendín/Cordillera Blanca-Central Priority Condor Preservation Unit; (iii) Illescas Priority Condor Preservation Unit and (iv) Páramos de Piura/Bosque Seco de Cajamarca Priority Condor Preservation Unit. Also in 2015, Peru approved a national plan for the conservation of the Andean condor, covering the period 2015–2025 (SERFOR, 2015). But despite this appreciation of the importance of conserving the Andean condor, the economic value of doing so has yet to be estimated.

Therefore, this study focuses on the following questions: How much are tourists willing to pay to conserve the recreational service of condor flight at Colca Canyon, Peru? How valuable is the conservation of the Andean condor at Colca Canyon? How does the estimated willingness to pay (WTP) contribute to arresting the decline of the endangered Andean condor?

In this study, WTP is calculated using the conditional logit discrete-choice model, which assumes the independence of irrelevant alternatives (IIA)—that is, it establishes that the probability ratio of choosing between two alternatives does not depend on the attributes of

the other alternatives. Given the IIA assumption, a well-specified conditional logit model is useful (Christiadi & Cushing, 2007).

The present study is justified because the Andean condor is in danger of extinction in Peru; the species is classified as such by way of Supreme Decree No. 004-2014-MINAGRI, which prohibits its hunting, capture, possession, transportation or exportation for commercial purposes. In addition, the market has thus far failed to calculate the real value of the condor—that is, its use value and non-use value. For example, the recreational value of condor flight over a natural fissure as valuable as Colca Canyon—one of the world’s deepest—has not been calculated. This is important because the Andean condor, as noted, is the biggest wild bird in South America; at Colca Canyon, tourists enjoy the flight of this majestic bird at the Cruz del Cóndor viewpoint. In addition, combatting the depletion of the Andean condor contributes to Sustainable Development Goal (SDG) 15, to promote sustainable use of terrestrial ecosystems and halt biodiversity loss.

The study contributes through the use of the conditional logit discrete choice model based on a specific questionnaire administered to direct users of Colca Canyon. Moreover, the WTP identified has implications for the conservation of the endangered Andean condor and sustainable management of wildlife.

The aim of this study is to estimate tourists’ WTP to conserve the recreational service of condor flight at Colca Canyon.

Literature Review

In Ecuador, The Andean condor is classified as critically endangered. Habitat loss poses the greatest threat to population numbers; the population in that country is estimated to be between 94 and 102 individuals, though during a two-day census in 2015, only 93 were recorded (Naveda-Rodríguez *et al.*, 2016).

Ornithological tourism attracts visitors to natural environments to spot and identify local birdlife while experiencing their habitat and

the surroundings (Santolaria & Giné, 2013). Birdwatching is practised by people with an interest in learning about, identifying or simply seeing birds in the wild while in contact with nature (Andrés *et al.*, 2015). Argentina has more than 1,000 observable bird species, including two emblematic species of condor (both of which have wingspans of more than three metres) and the Magellanic woodpecker.

According to Haefele *et al.* (2016), indirect measures of non-market values infer the value of a good by observing consumer behaviour. The value of a recreational experience can be calculated using the estimated cost of a visit (direct expenses plus the value of the journey time) as the price and with a demand curve plotted based on the number of trips made. The direct methods of measuring non-marketable values are known as “stated preferences”, as they involve asking respondents directly what they would pay for their preferred option. Stated preference methods measure the values of passive resource use such as existence and legacy values. The two main stated preference methods are contingent valuation (CV) and choice experiment (CE).

Under the CE method, respondents are asked to choose from a set of alternative scenarios that differ across a range of attributes, one of which is the associated price or cost (Haefele *et al.*, 2016). An advantage of CE over CV is that its options span different levels of attributes, allowing researchers to offer respondents more than the “take it or leave it” options of CV.

Nylander (2016) has noted that the main tourist attractions at Colca Valley include the opportunity to see condors in flight, as well as the trek to Colca Canyon. The Cruz del Cóndor viewpoint is situated in the locality of Pinchollo, Cabanaconde district, Caylloma province, 42 kilometres from the district of Chivay.

According to Radwanek-Bak (2008), Colca Canyon, with a total length of 120 kilometres, plunges to 3,232 metres at its starting point in Pinchollo. In 2005, Polish scientist Andrew Pietowski calculated the canyon’s depth to be

4,160 metres on the north side, in the vicinity of Quillo Orco in the Huambo district and 3,600 metres on the south side; this makes it one of the deepest canyons in the world, surpassed only by the likes of Yarlung Tsangpo in China (5,590 metres) and Kali Gandaki in Nepal (4,375 metres). Pietowski noted that depth readings change over time due to the sinking of the riverbed and the increasing precision of measurement technologies, among other factors. Peru is also home to Cotahuasi Canyon (Arequipa), with a depth of 3,535 metres and Apurímac Canyon, which, according to one measurement (4,691 metres) is deeper than Colca.

Colca Canyon, formed 150 million years ago, owes its vast depth to various phenomena, including the rise of the Andes, deglaciation during the Quaternary (around one million years ago), the erosion of the Colca River and volcanic eruptions—the residues of which trapped the river, forming a natural dam that finally burst after hundreds or thousands of years.

In this study, viewing condors is classed as a recreational service because visitors enjoy watching the species in flight as part of an ecotourism experience. Many rural tourism activities are based on nature or ecotourism (Jaime *et al.*, 2011; Herman *et al.*, 2013; Hou *et al.*, 2020) and involve visits to natural areas to enjoy the landscape, plants and wildlife. Environmental services in rural areas often lack a market; though they can be difficult to quantify, their value can be measured through recreational activities at tourism destinations (Herman *et al.*, 2013). At Colca Valley and Canyon, striking geography converges with a vast legacy of living cultures (Jaime *et al.*, 2011).

As a tourism resource, Colca Valley was assigned Hierarchical Level 4 by way of Vice-Ministerial Resolution N° 005-2021/MINCETUR/VMT (MINCETUR, 2021a) for its exceptional beauty and importance to the international tourism market. Other Hierarchical Level 4 tourism destinations in Peru include the Nazca Lines, Lake Titicaca, Machu Picchu and the Amazon River. In addition, in 2019,

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) recognised “Colca y Volcanes de Andagua” as a global geopark.

Using the CV method to estimate the WTP of coastal communities for the conservation of mangrove ecotourism in Marudu Bay, Sabah (n=400 respondents), Musa *et al.* (2020) applied logistic regression to estimate the mean WTP of three different types of logit models: Model 1, which yielded results of RM12.96 per person per year, Model 2 (the restricted model), at RM16.08 MYR per person per year and Model 3, at RM25.68 per person per year.

For their part, Perez *et al.* (2019) estimated the economic value of the recreational attributes at Galapagos National Park in Ecuador, noting that tourists expressed the greatest WTP for animal protection (US\$26.9) and waste reduction (US\$111.2).

The economic valuation of wetlands, forests, beaches, parks and rivers is carried out around the world as a way of informing policy measures that maximise human well-being. Bhat *et al.* (2020) used the CE method and the augmented conditional logit model to estimate the WTP per visitor for various attributes of the Dachigam National Park in India; the results were 302.07 rupees on protecting endangered species, 121.91 rupees on improvements to the park area and 171.64 rupees on enhancing research and educational opportunities.

Da Costa and Hernandez (2019) applied a stated preference approach—specifically, a discrete choice experiment (DCE)—for the economic valuation of ecosystem services provided by the Taravo River basin. The attributes were directly linked to the services of water quality and outdoor recreation and indirectly to the service of scenic landscapes. The authors found that respondents, on average (n = 106), were willing to pay up to €128 per year to improve the chosen ecosystem services.

Liu and Yang (2019) adapted CEs to estimate tourists’ WTP for recreational wildlife resources at the Black-Faced Spoonbill Reserve

in Taiwan, finding that the promotion of tourism activities at the reserve and the adequate maintenance of tourism and recreational facilities would increase WTP.

Mongare and Gathiaka (2021) observed that railroad construction significantly altered the ecosystem of Kenya’s Nairobi National Park, applying a DCE to a sample of 93 university students. Their multinomial logit regression estimates indicated that park users were willing to pay 500 shillings above the entrance fee for wildlife restoration and 1,000 shillings for the free movement of wildlife and preservation of natural vegetation.

Petcharat *et al.* (2020) used a CE to estimate the preferences and WTP of residents of the Bangkok metropolitan area to improve ecosystem services in the Bang Kachao Green Area, interviewing 200 respondents between July and September 2016. Analysing the results by way of a conditional logit model, they found that local residents were willing to pay US\$42 per year to improve ecosystem services in Bang Kachao.

A CE involves asking individuals to state their preferences for different scenarios (Petcharat *et al.*, 2020). Most environmental assets are composite, formed by a variety of attributes that can be provided at different levels.

In demand theory, a random utility model can provide the theoretical framework. The choice of any option is represented by the differences between a set of options, where each option is in turn represented by an indirect utility function with two components: A deterministic (V_i) and a stochastic term $U_i = V_i + \epsilon_i$.

Based on a plan to improve the management of El Chico National Park in Mexico, Melo *et al.* (2020) used CE methods and a multinomial logit model to survey 184 visitors; the authors observed that the added marginal WTP was 25.75 pesos (US\$1.35), in addition to the current entrance fee per person. Visitors to the park received a higher level of utility given changes to the regulation and ordering of tourist activities.

Again, employing a CE method, Crespo-Cebada *et al.* (2020) analysed the preferences of visitors to Cornalvo Natural Park in Spain, detecting that on average an increase in biodiversity greatly increases visitors' WTP. They also analysed the heterogeneity of preferences based on a mixed logit model to determine WTP based on visitors' individual characteristics.

Materials and Methods

This study attempts to calculate the economic value of the recreational uses of Colca Canyon. The universe comprises the recreational services at Colca Canyon and the sample is the visitors who come to enjoy the recreational service of condors in flight. The materials used are the survey form in two languages (Spanish and English), as well as SERFOR and Ministry of Foreign Trade and Tourism (MINCETUR) statistics. For the data analysis, the SPSS software is employed.

Study Area

Colca Canyon, through which the Colca River flows is located in Caylloma province, northeast Arequipa (Peru). The Colca River plunges to depths of 3,400 metres on both sides and is more than 200 kilometres long. Colca Canyon has a depth of 4,160 metres (Uribe *et al.*, 2012)

on the Canco side (Autocolca, 2020) and is 3,651 metres above sea level (masl). It is 160 kilometres from the city of Arequipa, in the region of the same name and its geographical coordinates are O74°21'5.44" and S13°5'4.09". The Coropuna (6,425 masl), Ampato (6,288 masl) and Sabancaya (5,980 masl) volcanoes, the latter of which is active are all part of the canyon's landscape. Colca Canyon is situated in Colca Valley, which has an expanse of 11,990 square kilometres (Jaime *et al.*, 2011). The Colca basin was inhabited by the pre-Incan Collagua and Cabana civilisations, from whom it takes its name (the portmanteau "Col-Ca"). These peoples engaged in cattle ranching and agricultural activities on farm platforms on the riverbanks and elements of their culture and dress live on through the Wititi folk dance, added to UNESCO's list of Intangible Cultural Heritage of Humanity in 2015. The prodigious Colca Canyon is a natural habitat of the Andean condor, a monogamous species considered to be immortal and mythological by the Inca civilisation.

Since 2019, Colca Canyon and the Andagua Volcanoes have pertained to the International Network of Geoparks given the unique landscapes and natural spaces they contain. In addition, Colca Canyon (Figures 1, A1) was ranked among the 100 best sustainable destinations worldwide by Green Destinations.

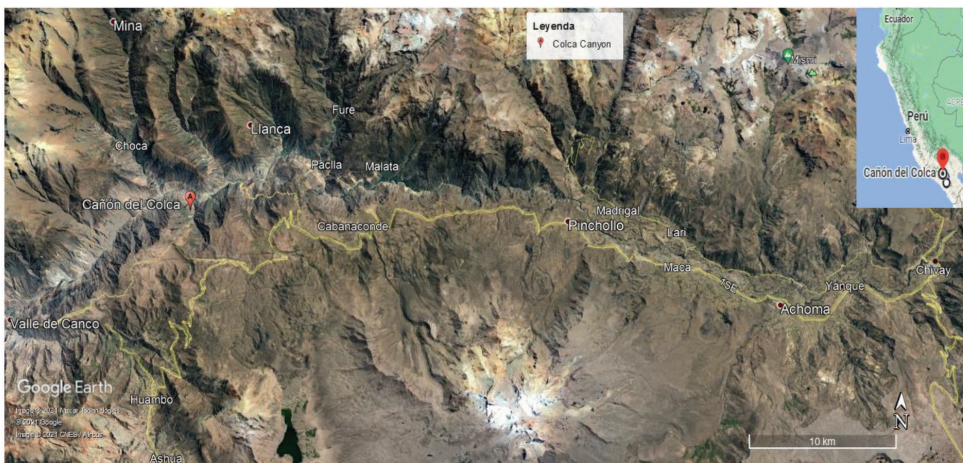


Figure 1: Map of Colca Canyon (Source: Google Earth Pro)

Data Collection

We determined the sample size (n=114) based on an average annual population of visitors to Colca Valley of 276,387 (2017–2018), with a confidence level of 95% and a maximum tolerable error of 2.9%. From September 2017 to March 2018, we administered the survey randomly to visitors at the Cruz del Cóndor viewpoint.

To collect the data, we designed a three-part survey. The first part inquired into each respondent's country of origin, reason for and frequency of visit, length of stay at the canyon, form of travel and total expenditure. The second part included questions concerning the value each tourist placed on the condor's existence, Colca Canyon itself and its uses for tourism and their WTP to conserve condor flight over the canyon. The third part covered respondents' socioeconomic variables, as well as presenting the experiment's valuation options and the attributes and levels of each one. For instance, the price attribute was divided into three levels. The first attribute is the value of the Andean condor, which reflects its non-use value or existence value (Petcharat *et al.*, 2020); the second is condor flight over the canyon—a proxy of use value or recreational service for tourists that includes scenic beauty and aesthetics. The third attribute is uses of the canyon while the fourth is price.

Assuming that the current state of conservation of Colca Canyon is “Level A”—that is, the status quo, without any plans implemented—we presented respondents with two options to improve conservation of condors and the recreational service provided by their flight over the canyon (Options B and C). Each option is comprised of three attributes, which in turn can be categorised as one of three levels; “status quo”, “good” and “very good”.

We initially drafted the survey in the Spanish language only. Then, after completion of the pilot, we improved the draft and translated the final version into English to accommodate the large volume of foreign tourists. The Cronbach's

alpha reliability was 0.737. We administered the survey at random to visitors at the Cruz del Cóndor viewpoint from September 2017 to March 2018 and identified each participant by country of origin.

Choice Experiment Model

In CEs, the selection of environmental characteristics at tourist sites reflects tourists' preferences (Liu & Yang, 2019). Given several possible options, each respondent chooses the selection that results in the highest level of their own utility, based on random choice theory (Cho & Jo, 2015).

A tourist's utility (Bhat *et al.*, 2020) will depend on the characteristics or attributes of the destination (X_j), such as endangered species, location, research and education, one-time payment and each respondent's attitudes and socioeconomic characteristics (Y_i). Education (1) can be estimated using a conditional logit model.

$$U_{ij} = V(X_j, Y_i) + \varepsilon(X_j, Y_i) \quad (1)$$

McFadden's discrete conditional logit choice model (Bhat *et al.*, 2020, Crespo-Cebada *et al.*, 2020) to determine the probabilities of choosing j alternatives, is:

$$P_{ij} = \frac{\exp(v_{ij})}{\sum_{h=1}^J \exp(v_{ih})} \quad (2)$$

A conditional indirect utility function that is generally estimated is presented as follows:

$$V_{ij} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + V_i \quad (3)$$

where β_0 is the alternative-specific constant that captures unobserved information about the tourism options, n is the number of attributes of the destination management strategy employed and the vectors of coefficients 1 to n are attached to the vector of attributes (X). β_0 can be associated with the utility of changing the status quo (Da Costa & Hernandez, 2019).

In stated preference methods, the marginal rate of substitution between the coefficients of each attribute of the destination and the

monetary attribute approximates the WTP for each attribute (Da Costa & Hernandez, 2019). Thus, the WTP for a change in just one managed attribute at the destination (Bhat *et al.*, 2020) is estimated as follows:

$$DAP = -1 \left(\frac{\beta_{park\ attribute}}{\beta_{price}} \right) \tag{4}$$

Therefore, each respondent’s WTP for each attribute is given by the rate of the estimated parameter of each chosen attribute, as well as the monetary attribute.

Moreover, the welfare gains from the conservation of recreational services related to the flight of condors over Colca Canyon can be estimated by way of the compensating surplus (CS) vis-a-vis the status quo, such that:

$$CS = -\frac{1}{\beta_{am}} (V_1 - V_0) \tag{5}$$

where the indirect utilities associated with the status quo V_0 and the alternative scenario V_1 are estimated using the coefficients resulting from econometric regression.

To calculate WTP in this study, we use the conditional logit model in SPSS with a Cox regression (Berendsen, 2015). The conditional partial probability maximised by the Cox regression (in SPSS) is the same as that resulting from the conditional logit regression. The Cox regression can be used for the 1-1 and 1-N matching cases and the output of the Cox equation is exactly the same as in the logit regression (without an intersection).

Results and Discussion

According to the National Forest and Wildlife Inventory (SERFOR, 2020), Peru’s highland ecoregion is home to 240 species of birds, including the emblematic yet “critically endangered” Andean condor.

Requejo (2009: 85-86) estimated the economic value of birdwatching using the formula: $EVBW = AEBW \times NVWB$ (where $EVBW$ = direct use economic value from bird watching; $PGOA$ = average expenditure of bird watchers [local, national and international visitors] on their trip from Moyobamba to Tingana; and $NVWB$ = average yearly number of visitors to watch birds). The authors found that the average daily expenditure was 74.33 soles and that multiplying this figure by the average number of yearly visitors of 30 people (Requejo, 2009: 117) resulted in total expenditure of 2,229.90 soles (US\$696.84). Based on Resquejo’s (2009) technique, our calculation of the direct use economic value of condor flight over Colca Canyon takes into account an average expenditure per tourist of 60.80 soles multiplied by the average annual number of visitors to Colca Valley of 276,387 (2017-2018), resulting in a total expenditure of 182,636,199.20 soles (US\$48,702,986.45). It is also necessary to estimate each user’s WTP for condor flight using the CE preferences approach.

There are 231 species of specially adapted high-mountain vertebrates in the province of Caylloma, in habitats that include ecosystems such as wetlands, polylepis trees and lagoons.

Table 1: Attributes and levels for the choice experiment at Colca Canyon

Attributes Levels	Depth of Colca Canyon	Condors in Flight	Price/Month
A (Status quo)	First place for conservation	No conservation improvements	10 soles
B (good)	Second place (few conservation improvements)	Conservation improvements are prioritized	15 soles
C (Very good)	Very high priority on improving conservation	Very high priority on improving conservation	20 soles

According to the Autonomous Authority of Colca (Autocolca), examples include the Andean condor, the Andean flamingo, the llama, the alpaca, the vicuña, the guanaco, the taruca, the fox, the vizcacha and several species of hummingbird. In addition, Colca has exceptional geoheritage (Pásková *et al.*, 2021).

The Andean condor (Figure 2) measures 1.3 metres in height and has a wingspan of 3.5 metres (SERFOR, 2015). The male weighs 11 to 15 kilograms and the female 8 to 11 kilograms. It is one of the highest-flying birds, using rising warm air masses to soar to 7,000 metres. Tourists come to the Cruz del Cóndor viewpoint to watch condors in flight over Colca Canyon (Figure 3, A2), but by 2017, the number of individuals had decreased from a previous total of 50 to around 25, according to Eloy Cacya, mountain

guide and native of Pinchollo in Cabanaconde (interview conducted on October 7, 2017).

Colca Canyon is an important source of natural capital and a major tourist destination in the region of Arequipa. Its varied territory brings together spectacular geography and an ancient culture that has been developed, transformed and enriched over the centuries. The canyon's 120-kilometre expanse is divided into three main parts: Cruz del Cóndor at 20 kilometres in length, the 45-kilometre long stretch from Sangalle to Canco and Canco to Andamayo, totalling 55 kilometres.

After the pilot, which was administered to 20 respondents, we adjusted the survey by removing some questions given visitors' time constraints (this was primarily because the organised tours to the canyon departing from



Figure 2: The Andean condor (Source: Inforegión, 2021)

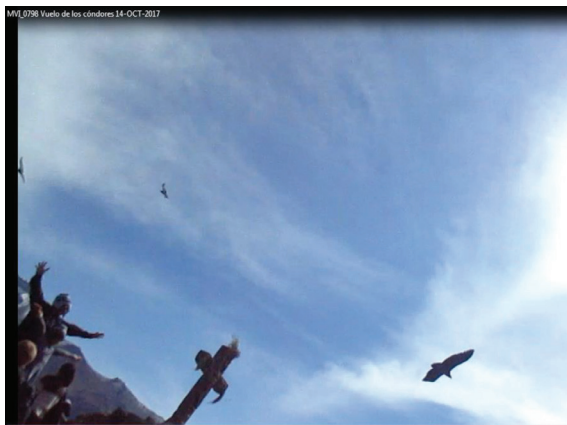


Figure 3: Condors in flight over the Cruz del Cóndor viewpoint, Colca Canyon

Arequipa only spend around one hour at the Cruz del Cóndor viewpoint). Another limitation of the pilot was that foreign tourists who did not speak Spanish could not be surveyed; this informed our decision to translate the questions into English for the final survey.

The final version of the survey (in both the Spanish and English languages) was administered at the Cruz del Cóndor viewpoint at Colca Canyon between September 2017 and March 2018. Complete answers were required for the environmental economic assessment; however, some foreign tourists did not provide data on occupation or age or on monetary considerations, such as total travel expenses, monthly income and WTP to preserve condor flight over Colca Canyon. But in qualitative terms, our results show that domestic and international tourists alike place a high value on the existence of Colca Canyon together with condor flight (see Table 4).

We used the WTP approach and the CE method to measure the existence value (non-use value) as well as the use value of natural capital—specifically, to assess the conservation of recreational services related to condor flight over Colca Canyon. We distributed surveys randomly among a sample of 114 visitors to Cruz del Cóndor (58 foreign and 56 domestic). One limitation is the size of the sample, given that many of the tourists in situ preferred to enjoy the spectacle of condor flight for as long as possible rather than spending their time completing the survey. Therefore, we had to make several trips from Lima (the capital of Peru) to Colca Canyon to administer the survey to the required number of respondents.

The variables we obtained from the survey are as follows:

MaxPrice = Hypothetical price assigned at random to each interviewee, on the basis of which they decide their WTP

Income = Monthly income

Age = Age of interviewee, £ 50 (=1) and > 50 (=0)

Sex = Male (=1), female (=0)

SecWork = Occupation, employed (=1) and self-employed (=0)

Education = Higher (=1), non-higher (=0)

ValueCanyon = Canyon with scenery and condor have a higher value (=1), same value with or without scenery (=0)

ValueCondor = Value of existence of condor at Colca Canyon: High (=1), low (=0)

Price: Level 1 (status quo; PEN 10), Level 2 (PEN 15), Level 3 (PEN 20)

Canyon_condor = Condor flight at the canyon (=1), No condor flight at the canyon (=0)

CanyonUse = Enjoyment of place (=1), sight of condors in flight (=2), enjoyment of canyon and sight of condors in flight (=3), other (s) (=0)

The average travel expenditure of visitors to Colca Canyon was 660.80 soles. They stayed at the viewpoint for 5.6 hours on average (median = 1.5 hours), though most stayed between one hour (40%) and two hours (20%); the period allotted by tour organisers (from Arequipa to the canyon). The average is higher because some respondents remained within the park for 48 hours while others did so for 72 hours in order

Table 2: Visitors to Colca Canyon, 2014–2020

	2014	2015	2016	2017	2018	2019	2020
Total visitors	185,247	205,185	253,920	254,331	298,442	275,623	49,602
Domestic	61,634	72,910	109,504	102,048	128,383	102,409	34,911
Foreign	123,613	132,275	144,416	152,283	170,059	173,214	14,691

Source: MINCETUR (2021b). Peru: Compendium of tourism figures

Note: From April to September 2020, 0 visits were recorded because of the national COVID-19 state of emergency (Supreme Decree No. 044-2020- PCM)

to visit other attractions within Colca Valley. The average age was 36 years. All respondents were over 18 years of age, with the exception of one 16-year-old school student (Table 3) and one 17-year-old university student. In turn, the average monthly income of all respondents was 4,789.80 soles (US\$1,277.28) while that of the domestic visitors was lower (2,481.67 soles or US\$661.78).

For most visitors, both the canyon’s aesthetics and the flight of the condors are valuable (Table 4). However, some expressed a belief that payment for the right to enter Colca

(20 soles for domestic tourists and 70 soles for foreign nationals) is too high.

A total of 95% of respondents place a high value on the existence of the Andean condor at Colca Canyon; none selected the “no value” option. In turn, 88% of the visitors stated that the existence of both the scenery and condor flight at Colca Canyon was what maximised the site’s value (Figure 4).

There is a significant relationship ($\alpha = 1\%$) between WTP and the maximum payment chosen by the visitor. However, WTP and time spent at Colca Canyon are weakly correlated.

Table 3: Quantitative information from respondents

Descriptive Statistics					
	N	Mini- mum	Maxi- mum	Mean	Std. Dev.
6) What is your total expenditure on your trip to Colca Canyon?	84	200	10000.00	660.802	1432.395
7) How long will you stay here? (Cruz del Cóndor, in hours)	95	0.50	75.00	5.605	14.333
11) What is the most you would pay to conserve the flight of the endangered Andean condor over Colca Canyon?	110	0.00	105.00	18.123	30.137
AGE	77	16	72	36.32	13.352
20) What is your average monthly income? (PEN)	65	0.00	33333.33	4789.80	6665.29

Table 4: Results of valuation by visitors to Colca Canyon

		N	Marginal Percentage
10) What value do you place on the existence of the Andean condor at Colca Canyon?	Low	5	4.7%
	High	101	95.3%
8) Would the value of Colca Canyon be the same with or without landscape (fauna, flora, rivers, fresh air and condors in flight)?	Same value with or without scenery	13	11.9%
	More value with scenery	96	88.1%
9) What use(s) does Colca Canyon have to you on your visit?	Enjoyment of place	31	28.4%
	Sight of condors in flight	32	29.4%
	Other(s)	7	6.4%
	Enjoyment of canyon and sight of condors in flight	39	35.8%

There is a significant relationship between visitors' place of origin and their uses of Colca Canyon (Table 6); in comparison to domestic tourists, foreign visitors express greater preference for the option of enjoying the canyon and watching the condors in flight.

Tourists visit Colca Canyon for two main reasons: to observe the condors in flight and to appreciate the canyon itself. Indeed, 29.8% travel to behold the aesthetics and depth of the canyon (Figure 5) while 35.8% of users prefer the recreational service of condor flight (Figure 6).

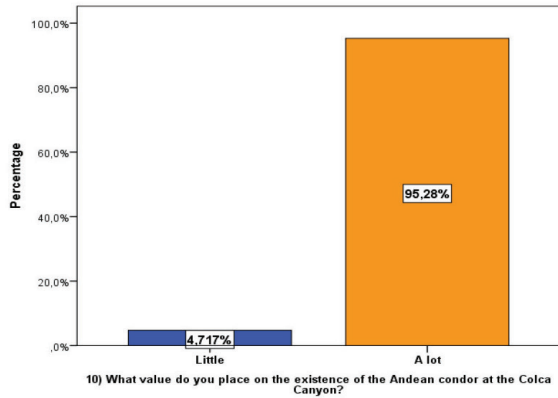
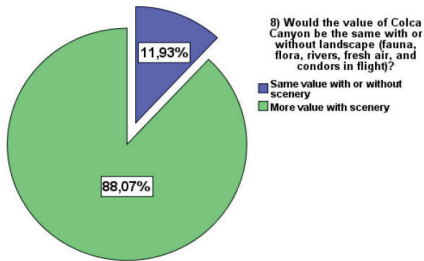


Figure 4: Recreational value of Colca Canyon and condor flight

Table 5: WTP correlations–sociodemographic data

		Willingness to Pay	
	Willingness to pay	Correlation coefficient	1.000
		Sig. (bilateral)	.
		N	111
Cramer's V	11)What is the most you would pay to conserve the flight of the Andean condor (endangered) at Colca Canyon?	Correlation coefficient	0.980**
		Sig. (bilateral)	0.000
		N	110
	7) How long will you stay here? (Cruz del Cóndor)	Correlation coefficient	0.409
		Sig. (bilateral)	0.166
		N	92
	Age1	Correlation coefficient	- 0.187
		Sig. (bilateral)	0.099
		N	78
Phi	Education	Correlation coefficient	- 0.070
		Sig. (bilateral)	0.555
		N	72
	SECTRAB	Correlation coefficient	0.040
		Sig. (bilateral)	0.707
		N	86

**Correlation significant at the 0.01 level (bilateral)

Table 6: Test of independence: Visitor’s place of origin and uses for Colca Canyon

		9) What use(s) does Colca Canyon have to you on your visit?					
		Enjoyment of Place	Sight of Condors in Flight	Canoeing	Other(s)	Enjoyment of Canyon and Sight of Condors in Flight	Total
ORIGIN	Caylloma	1	2	1	2	0	6
	Arequipa	8	10	0	3	8	29
	Rest of Peru	7	10	0	0	4	21
	Foreign	15	10	0	1	27	53
Total		31	32	1	6	39	109

Chi-squared: 42.139 $\alpha=1\%$

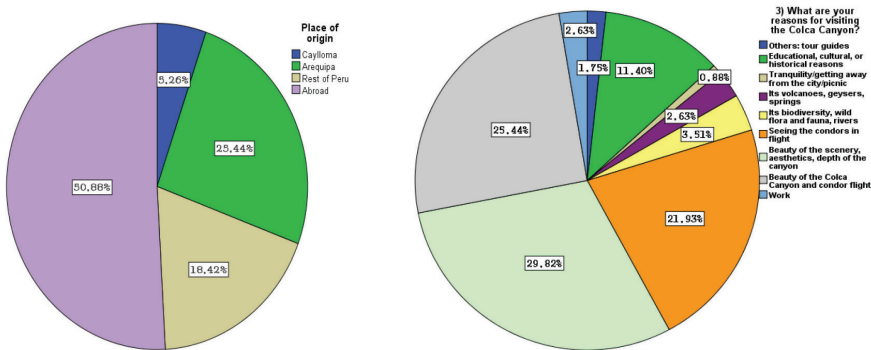


Figure 5: Visitors’ place of origin and reasons for visiting Colca Canyon

Of the 33% of respondents who were not willing to pay for the conservation of condor flight over the canyon, 13% were Peruvian, mostly from Arequipa (8%) and none live in Caylloma, where the canyon is located. Of these respondents, most felt that Autocolca, which manages the canyon, should use the proceeds of tourism for conservation given that entry fees are already high. By contrast, most of the Caylloma residents who were interviewed did express WTP. Of the international tourists, 19% declined to choose a hypothetical price on the grounds that as foreign nationals, they should not have to contribute monetarily to the conservation of a Peruvian natural resource. To avoid possible social desirability bias, respondents answered indirect questions about their WTP, such as how valuable the Andean condor is to them, if the value of Colca Canyon is the same with or without the landscape and condor flight and what each respondent uses the canyon for.

We found that the main uses of Colca Canyon are enjoyment of the location, observation of condors in flight and both of these together (see Figure 6).

The odds ratio (OR) is crucial to the interpretation of the logistic regression. An OR value greater than 1 indicates that as the predictor increases, the probabilities of the result occurring also increase; in contrast, a value of less than 1 indicates that the chances of the outcome occurring decrease as the predictor increases. Under logistic regression, the OR is automatically calculated in the SPSS output and is written as Exp (B) under the Cox regression (Berendsen, 2015).

The OR for the levels of the CE attributes (Table 7), calculated using SPSS, shows that the probability of an option (package) being preferred when the value of the condor is included increases 115-fold (OR 115.788)

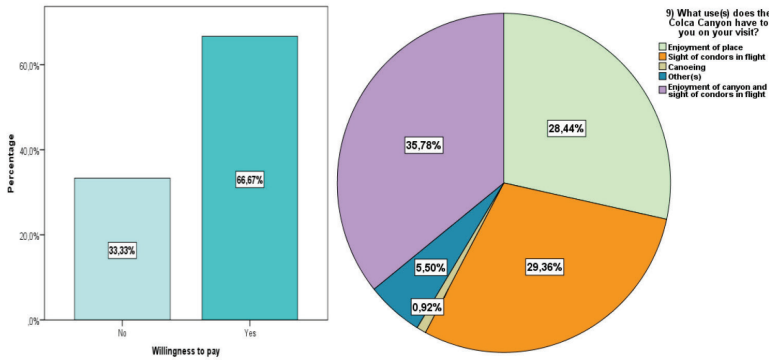


Figure 6: WTP and recreational uses of Colca Canyon

compared with the option with no improvement of condor conservation (status quo). If the option included the conservation of condor flight over the canyon, its probability of selection would be approximately 73 times greater (OR 73.941) than the status quo.

Using the coefficient of the attributes of the conditional logit model estimated using the Cox regression, the marginal willingness to pay (MWTP) according to equation (4) resulted in a MWTP for the existence value of the Andean condor attribute of US\$2.08 per tourist. For the recreational service attribute of condor flight over Colca Canyon, the MWTP was US\$1.92. The uses of Colca Canyon include enjoyment of the location and the depth of the canyon (MWTP of US\$0.82).

The condor flight attribute entails a low level of conservation management under the status quo, which implies that the two attributes of canyon depth and condor flight must be improved in relation to the status quo. The

WTP for change from the status quo to the good and very good scenarios indicates the price that respondents are willing to pay for an improvement in utility by way of this change (Bhat *et al.*, 2020).

The alternative specifications (Models 1–3), which include variables of sex, travel time and travel cost, respectively, were not significant in determining WTP (Table 9).

Hou *et al.* (2020) used 114 valid choice experiment surveys, similar to our sample. Lara-Pulido *et al.* (2021) applied a DCE in situ to direct users of the reefs of Cozumel Island in Southeast Mexico and found a high WTP for the conservation attributes of underwater visibility and biodiversity. In line with this approach, in the present study, we surveyed the viewers of condor flight over Colca Canyon in situ.

In the study by Hadker *et al.* (1997) on the Borivli National Park in India, age was found not to have a significant effect on WTP. In our

Table 7: Result of conditional logit model with Cox regression

	Variables in the Equation						95.0% IC for Exp(B)	
	B	ET	Wald	df	Sig.	Exp(B)	Lower	Higher
Price	-0.609**	0.283	4.627	1	0.031	0.544	0.312	0.947
ValueCondor	4.752***	1.333	12.715	1	0.000	115.788	8.499	1577.501
Canyon_condor	4.303**	2.015	4.560	1	0.033	73.941	1.424	3839.076
CanyonUse	1.839**	0.722	6.491	1	0.011	6.287	1.528	25.864

***1% level of significance, **5% level of significance

study, age was likewise not significant. The authors of the Indian study obtained an average age of 37 years, while in the present case, the average was a similar at 36 years.

As to education level, 81% of our respondents were educated to higher level; this is similar to the sample in Liu and Yang (2019), of whom 75.5% possessed ordinary or graduate degrees. In our study, 67% of respondents stated that they would be willing to make a hypothetical payment. Villena and Lafuente (2013) found that the independent variable of payment offered was statistically significant at 5%; in our case, this variable was likewise significant.

The preferences expressed by visitors to Colca Canyon for improvements to conservation of the Andean condor are consistent with Crespo-Cebada *et al.* (2020), who detected a high preference and a high WTP for an increase in biodiversity.

Tourists' income does not significantly affect their choice of conservation options for the Andean condor at Colca Canyon; this is in line with the study by Petcharat *et al.* (2020), in which income did not influence ecosystem service preferences in Bang Kachao in Thailand. Sex was also not significant in determining WTP, coinciding with the finding by Petcharat *et al.* (2020).

As noted by Liu and Yang (2019), the main recreational resource at the Black-Faced Spoonbill Reserve in Taiwan is the eponymous bird; even though the park also hosts other migratory and resident birds, the number of black-faced spoonbills that tourists observe

will affect their degree of satisfaction and WTP. By comparison, at Colca Canyon, the main recreational resource is the wild Andean condor. The authors found that the average WTP of visitors to the Black-Faced Spoonbill Reserve was 52.4 New Taiwan dollars (US\$1.90); in our case, tourists' WTP for the conservation of condor flight over Colca Canyon was US\$4.82 per month.

Bhat *et al.* (2020) detected a MWTP of 302.07 rupees (US\$4.16) to boost the numbers of endangered species in India. Similarly, in the present case, the willingness to pay for the condor value and condor flight value attributes amounted to a MWTP of US\$4 (Table 8).

Conclusion

Colca Canyon is a unique example of natural capital, as one of the world's deepest chasms and the habitat of the endangered Andean condor, the flight of which provides the site with invaluable recreational and environmental services. In addition, Colca Valley is made up of volcanoes, rivers, biodiversity and living culture. Attracting a large influx of domestic and international visitors (around 276,000 tourists a year), it is one of Peru's most-visited tourist destinations after Machu Picchu. In this study, we used a choice experiment to estimate the conservation value of the Andean condor at Colca canyon. Tourists at the Cruz del Cóndor viewpoint greatly appreciate the sight of condors in flight over the canyon, as well as its general beauty as a geopark. We found that 67% of the visitors were willing to pay for the conservation of the

Table 8: Marginal willingness to pay (MWTP)

Attributes	$WTP = -\frac{\beta_{at}}{\beta_{price}}$	
	PEN	USD
Condor value	7.80	2.08
Condor flight over the canyon	7.21	1.92
Uses of Colca Canyon	3.08	0.82
Total WTP	18.09	4.82

Table 9: Results of alternative conditional logit models via Cox regression and WTP

Variables		Model 1	Model 2	Model 3
Price	B	-0.616*	-0.572**	-0.598*
	Wald	3.711	4.165	3.432
ValueCondor	B	4.749***	4.381***	4.606***
	Wald	12.784	12.236	11.560
Canyon_condor	B	4.318**	4.074**	4.257**
	Wald	4.468	4.385	4.312
CanyonUse	B	1.866**	1.811**	1.811*
	Wald	4.157	6.719	3.805
Sex	B	-0.084		-0.066
	Wald	0.003		0.001
Travel Time	B			0.003
	Wald			0.051
Travel Cost	B		0.000	
	Wald		0.219	
Total WTP (USD)		4.69	4.59	4.73

***1% level of significance, **5% level of significance, *10% level of significance

service of condor flight over the canyon. In turn, 13% of Peruvian tourists, (a key exception being the inhabitants of Caylloma, where the canyon is situated) were not willing to pay, arguing that Autocolca, the park’s administration body, should use the income generated by tourism to this end. Of the international tourists surveyed, 19% did not choose a hypothetical payment price. From this, it might be inferred that they would not be willing to contribute monetarily to the conservation of a Peruvian natural resource. Applying the conditional logit model by way of Cox regression, we found that the total WTP per visitor to conserve the flight of the Andean condor over the canyon was 18.09 soles (US\$4.82) per month. The WTP value obtained contributes to the conservation of natural capital at the national level, acting as an input for policymakers to achieve SDG 15 by preventing the extinction of the Andean condor, while promoting the local development of Colca Valley settlers through sustainable ecotourism. Future research should focus on estimating the economic value of the Andean condor population using the information from

the first national census of the Andean condor in 2022, as well as the damage cost arising from illegal hunting, poisoning and intoxication of the endangered condor.

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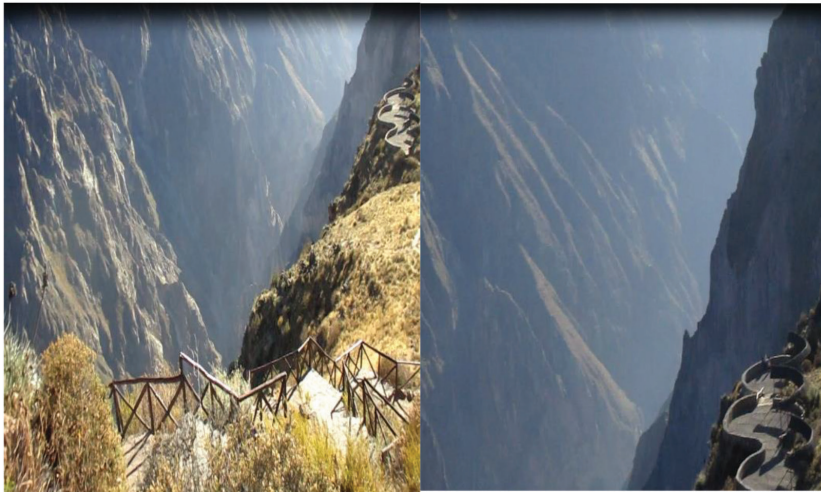
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Appendix



a) b)
Figure A1 (a-b): Colca Canyon, Cruz del Cóndor viewpoint



Figure A2: Tourists watching condor flight over Colca Canyon