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# Establishing an Evaluation Framework for Endangered Species Conservation Preferences for the Eurasian Otter

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**Abstract:** Wildlife conservation and management are critical issues that attract substantial attention. To develop a sustainable conservation project for the Kinmen Eurasian otter, the present study established a wildlife conservation framework and constructed a management program suitable for Kinmen Eurasian otter conservation based on the preferences of tourists and residents. The results of this study show that residents and tourists were not satisfied with the current status of Eurasian otter conservation in Kinmen and were willing to pay to change the status quo. Respondents preferred to maintain and artificially construct otter habitats, increase the otter population, limit traffic speed and establish underpasses, Kinmen Eurasian otter products, and educational parks. The findings of the market segmentation analysis divided respondents into two groups, passive conservationists and active conservationists. Both groups preferred protecting the Kinmen Eurasian otter to some extent. Passive conservationists, which included mostly residents and individuals with lower levels of education, lacked awareness of the Kinmen Eurasian otter and preferred to establish Kinmen Eurasian otter products and educational parks. Active conservationists were primarily tourists with higher levels of education who were familiar with the Kinmen Eurasian otter and had previously participated in Kinmen Eurasian otter conservation activities. These tourists preferred all conservation attributes and levels. Both groups of conservationists disliked the decline in the number of Eurasian otters in Kinmen. In addition to understanding respondents' preferences for conservation strategies, these findings reveal the importance of promoting education about the Kinmen Eurasian otter.

**Keywords:** choice experiments; conservation values; ecosystems; endangered species; Kinmen Eurasian otter; multiple attributes



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## 1. Introduction

Maintaining a proper balance between wildlife conservation and economic development attracted significant attention in recent decades [1,2]. Due to human demands or choices, this development is unavoidably intertwined with the existence of wild species in fisheries, agriculture, and forests, which contribute substantially to human society and economic development [1,2]. Human overexploitation and the destruction of natural ecology exerted great pressure on the survival of wild species. Species are increasingly being destroyed in their native habitats due to soil, air, and water pollution, a lack of food sources, excessive human hunting, and the indiscriminate destruction of wild species [3]. Human attitudes can determine the success of biodiversity conservation initiatives [4,5]. The involvement of human dimensions of conservation and environmental management is indispensable for the production of robust and effective conservation plans, practices and outcomes [6–8]. Therefore, understanding human dimensions is conducive to environmental conservation, and a deeper understanding of human preferences and expectations for biodiversity supports the implementation of the overarching goal of conservation.

Take the Eurasian otter as an example. Eurasian otters are primarily nocturnal and not easily seen during the day. Eurasian otters open their eyes at approximately 15–41 days. Their average life expectancy is 4–5 years in the wild, but Eurasian otters survive 12–14 years in captivity [9]. They are generally active at night, mysterious, and difficult to observe, and therefore, very difficult to catch and mark [10–12]. Due to habitat destruction, particularly in forests, environmental pollution, and excessive mining, Eurasian otters were classified as endangered species in the second half of the 20th century [13,14]. Eurasian otters are listed as endangered species in several European countries, such as Italy and Denmark, and even became extinct in some countries, such as the Netherlands and Switzerland [13,14]. Kinmen Island is the only place with traces of the Eurasian otter in Taiwan [10]. According to the survey report of Lee [10], the topography, landform, vegetation, aquatic environment, etc., of the island and coast underwent substantial changes due to the development and construction of Kinmen Island. Otters no longer appeared in areas where they were active in the past, including reservoirs, lakes, ponds, rivers, and channels, after the construction or human disturbance, which showed that the habitat of Kinmen Eurasian otters was extensively destroyed. Some originally connected waters were blocked, which forced otters to move across roads, causing further killing and resulting in a rapid reduction in the Kinmen Eurasian otter population [10].

Few studies of wildlife conservation policies used the utility model to explore public support for Eurasian otter conservation [15,16]. Therefore, the present study constructed a conservation preferences utility model for the Kinmen Eurasian otter based on the demands of residents and tourists. Following the literature survey, the five attributes of "Habitat maintenance", "Number of Eurasian otters", "Developing a friendly environment", "Kinmen Eurasian otter products and educational park", and "Eurasian otter conservation fund" were included in the model, and these studies are discussed in the third part of study. The combinations of alternatives derived from the five attributes of conservation preferences provide respondents with choices for their preferences. The heterogeneous preferences of respondents for Eurasian otter conservation support and their marginal willingness to pay (MWTP) for conservation preferences were not estimated [17]. Therefore, this study used the random parameters logit (RPL) model in the Kinmen Eurasian otter conservation preferences utility function to understand the differences between residents and tourists in various attributes and to estimate their WTP for each attribute. Tekalign et al. [18] stated that tourists supported sustainable tourism development through community participation in tourism and infrastructure changes, but they did not prefer most activities organized by the community, which showed that perceptions may differ between residents and tourists. Therefore, the present study further used the latent class model (LCM) to assess whether heterogeneous preferences existed between different categories of respondent groups based on their socioeconomic background, their awareness of otters, their attitudes and perceptions of otter conservation, and whether they joined a conservation organization. Taiwanese conservation authorities can plan corresponding management strategies based on the preferences of each group obtained from the present study.

This research is divided into 5 parts. The first part is comprised of the introduction. The second part introduces the research area and the empirical model for Eurasian otter conservation. The third part explains how to design the attributes and levels for the Eurasian otter conservation plan and presents the various combinations of attributes and levels of multiple conservation management strategies. The fourth part estimates the preferences of various conservation strategies using the RPL model, uses the LCM model to distinguish between the preferences of each group, and estimates the MWTP of Eurasian otter management strategies. Finally, this study presents recommendations and implications for a Eurasian otter conservation strategy.

## 2. Kinmen Eurasian Otter and Literature Review

### *2.1. Impacts on the Kinmen Eurasian Ootter*

Kinmen County in Taiwan is comprised of 12 islands, including Kinmen, Leiyu, and other small islands, with a total area of approximately 150 square kilometers. Kinmen has a subtropical maritime climate with annual rainfall from April to September. The terrain is mostly flat and has natural small and shallow streams. There are seven and two small streams in Kinmen and Leiyu, respectively. Most of the land is agricultural. The main peak in Kinmen is Taiwu Mountain (253 m), and the highest point in Leiyu is Chi-lin Mountain (116 m). The strata are dominated by granitic gneiss [19,20]. The geographical locations of Kinmen, Taiwan and mainland China are shown in Figure 1.


**Figure 1.** Location of Taiwan, Kinmen and the archipelago of Xiamen from Google Maps.

Several centuries ago, the vegetation cover of Kinmen Island flourished, but the natural forests of Kinmen were depleted, and the land suffered from erosion and dust storms from approximately 200 years ago. It was not until 60 to 70 years ago that the forests were rebuilt with a tremendous amount of effort invested in developing these plantations [19]. Kinmen is the only place in Taiwan that maintains a stable otter population [21]. The Eurasian otter is listed as an endangered species in Taiwan. According to the Council of Agriculture, Executive Yuan, and the Environmental Information Center, Taiwan, there were fewer than 200 Eurasian otters in Kinmen in 2018. Over the past decades, the habitat of Eurasian otters devolved to its current poor situation in the southwestern region of Kinmen, and no traces of Eurasian otters were identified in some regions for a long time. Traffic also poses a great threat to Eurasian otter survival in Kinmen. Birds and reptiles are also killed by traffic accidents in Kinmen [10,12,22]. To maintain the habitat of otters, the Kinmen government protects wetlands and some streets from development [23].

### *2.2. Integrating Theories on Preferences for Endangered Species Conservation*

#### 2.2.1. Negative Impacts on Endangered Species

Kearney et al. [24] suggested that quantification of the mitigation factors of endangered species was important for the conservation of threatened species, and their results show that damage to the habitat of threatened species results in serious threats to their survival. There was evidence that the populations of wildcats, pine marten, and polecats showed signs of restoration in the 1970s [25–28]. However, otters were experiencing a catastrophic decline, which was attributed to exposure to organochlorine pesticides [25–28]. The destruction of wildlife habitats seriously impacted the survival of otters [29].

Forests are frequently a central part of discussions on endangered species conservation and biodiversity because approximately two-thirds of species habitats are in forests [30]. Because forests possess ecological diversity and species richness, forest loss inevitably leads to potential species extinction [30]. For example, due to improvements in forest development, habitat restoration, legal protection, and civic awareness in South Korea, the habitat of the Eurasian otter increased significantly, and these otters are found throughout the

country [31,32]. Forests in the Chienpu stream basin and Nanju lake region in Kinmen are the primary habitats and active areas of Kinmen Eurasian otters on the east peninsula of Kinmen. Therefore, the present study proposes that maintaining current and constructing artificial afforestation and otter habitats will provide a better environment for their survival.

Since the deregulation in Kinmen, development and construction were performed on a massive scale, which damaged and disturbed the habitat of the Kinmen Eurasian otter [10]. Research on the current status of Kinmen Eurasian otters revealed that habitat fragmentation and water extraction were major threats [33]. Previous researchers found that good vegetation cover around water, stone piles, floating wood piles, dikes, and culverts provide better habitats for Eurasian otter survival [10–12,27,34,35]. If conservation activities are performed legally in protected areas, the threat of habitat reduction may be effectively reduced [24]. Therefore, habitat maintenance is also important in the conservation of the Kinmen Eurasian otter.

A decrease in endangered species generally attracts public attention. However, the results from different studies are quite intriguing [36,37]. Steven, Smart, Morrison, and Castley [36] noted that greater numbers of endangered species increase the public WTP for wild animal conservation. However, Lehtonen, Kuuluvainen, Pouta, Rekola, and Li [37] found that a single increase in the number of endangered species reduced people's WTP by 0.3 Euros. Fewer than 200 Eurasian otters remain in Kinmen. Consistent with the Wildlife Conservation Act in Taiwan, the Eurasian otter is protected wildlife and an endangered species. The use of conservation policies to increase the number of Kinmen Eurasian otters and continue breeding will also increase the welfare of tourists and residents. Human welfare in otter conservation may be derived from the economic value of ecotourism centered around the Kinmen Eurasian otter or the aesthetic value of maintaining or artificially constructing otter habitats [38,39].Therefore, the number of Kinmen Eurasian otters is an important factor that affects people's preference for species conservation and may be incorporated as an attribute to evaluate people's willingness for a conservation program for the Kinmen Eurasian otter.

Körbel [40] and Grilo et al. [41] believed that traffic accidents were a major cause of animal deaths, and these accidents caused serious potential threats and reduced the survivability of animals. These authors recommended the construction of drainage culverts or small trade access paths beneath roads. For example, culverts and underpasses are very common constructions in Portugal that reduce the risk of otter death. Yoxon and Yoxon [33] reviewed the current status of Eurasian otters and identified roadkill as a major threat. These studies emphasize the importance of a friendly environment for Eurasian otters. The development of a wildlife-friendly environment is the goal of all countries, and the development of a friendly environment may be used as an assessment attribute in the Kinmen Eurasian otter conservation program.

#### 2.2.2. Public Preference for Kinmen Eurasian Otter Conservation

The public's attention and preferences are beneficial to the conservation of endangered species. Therefore, it is important to increase the public's understanding and comprehension of endangered species to promote their awareness of wildlife conservation [42]. Previous research showed that habitat was one of the most important factors for the conservation of Eurasian otters. Eurasian otters often appear in large-area, interconnected habitats that are not blocked by factors, such as roads, upstream fills, gates, basins, and water pipes. Water quality and water level stability are also important factors for Eurasian otters because these factors provide a good habitat for fish, aquatic insects, and other food sources [10–12,27,34].

Because Eurasian otters frequently prey on fish, scholars defined Eurasian otters as potential predators [43,44]. Eurasian otters require well-developed vegetation cover around waters, and the presence of natural or artificial stone piles, floating wood piles, dikes, culverts, etc., which may be used for hiding and resting [11,12,27]. Areas with no or low levels of human disturbance, such as human activities, lighting, and noise, are suitable habitats

for Eurasian otters [11,12,27]. However, habitats suitable for the survival of Eurasian otters experienced significant damage due to human activities, agriculture, industrial pollution, and the construction of real estate. Over the past 10 years, Aoun [45] observed the wildlife ecology of developing countries and showed that an excessive consumption of natural resources occurred in Lebanon due to human activities, such as overhunting, overharvesting, and overgrazing. Due to the imbalance in these ecosystems, rare animals and plants in Lebanon are on the verge of extinction [45].

Another important attribute in conservation efforts is the number of endangered species [36]. The extinction of species is quite serious in ecosystems [46]. Colléony, Clayton, Couvet, Saint Jalme, and Prévot [42] claimed that the public widely recognized the rapid reduction in biodiversity. The study also quoted IUCN data (2015), which indicates that the International Conservation Union Endangered Red List saw the number of critically endangered mammalian species increase from 168 species to 209 species between 1996 and 2005. The number of Eurasian otters decreased sharply to near extinction in the United Kingdom (UK) in 1950–1980. The main cause was the use of organochlorine pesticides, which killed the otters when the chemicals penetrated their food chain through the waterways [27]. Pollution by mercury, petroleum, and polychlorinated biphenyls also harmed otter populations in other countries [47]. The UK paid attention to issues related to the conservation of Eurasian otters in the past decades. The use of organochlorine chemicals was ultimately banned, and the number of otters recovered slowly [27]. Kontoleon and Swanson [48] indicated that people paid special attention to indicator species. Previous studies show that people had a special preference for indicator species compared to unknown species [49–51]. Therefore, the presentation of a protected animal to the public using a brand image will have a greater effect and a higher WTP [51,52].

## 3. Conceptual Framework

### *3.1. The Aapplication of Choice Experiments to Evaluate Wildlife Conservation Values*

Many studies used the choice experiment (CE) model to evaluate the economic value of conservation and environmental preferences. For example, Kubo and Shoji [53] applied the CE model to estimate the preferences of residents near conservation areas in Japan for brown bear conservation. Their results show that respondents supported coexistence with bears, and there was a heterogeneous preference for the conservation area. Residents preferred to perform bear conservation in the conservation area but opposed conservation in residential areas, which means that when people's residences were closer to the bear habitat, their attitude toward conservation was more negative. The main reason was that these residents were engaged in agriculture and fisheries, and bear conservation would affect their livelihood. Therefore, their study recommended subregional management to promote the conservation of wildlife [53]. Moro et al. [54] also applied the CE model to explore issues related to the Western Serengeti's reduction in illegal hunting because illegal hunting was one of the most serious threats to the conservation of many species in Africa. Their research used the CE model to investigate the role of illegal hunting in the livelihood strategies of residents in western Serengeti to determine the trade-offs between illegal hunting and other sources of income. The study found that attributes, such as increasing microcredit, increasing wages, increasing the number of herds, limiting hunting for a week, and increasing marketing opportunities, produced higher WTP for respondents and helped reduce the problem of illegal hunting. Roberts et al. [55] used the CE model to explore the WTP of eco-users for improving the ecosystem quality of coral reefs because coral reefs are vulnerable to terrestrial runoff. The study examined whether divers were willing to pay for biodiversity conservation and found that most divers were willing to pay the relevant fees to improve the quality of coral reefs. The study divided respondents into three categories, and each category's characteristics and WTP for improving the quality of coral reefs were depicted. Steven, Smart, Morrison, and Castley [36] also used the CE model to estimate the WTP of birdwatchers who watched special birds and found that they had a WTP of USD 45 for a high-level endangered species and USD 31 for a mid-level species.

### 3.2. Research Method

Eurasian otters are listed as endangered species in the "Wildlife Conservation Act" in Taiwan [10]. Eurasian otters are primarily distributed on the mainland and many coastal islands. Their staple foods are aquatic animals, such as fish, shrimp, and aquatic insects. Eurasian otters are the most advanced consumers in wetland ecosystems. Therefore, water contamination seriously harms Eurasian otters. Past research on Eurasian otters primarily focused on ecological perspectives, and the conservation value of Eurasian otters and policy management strategies were not addressed [10–12]. The present study proposed that Eurasian otter conservation had no real market value and was regarded as a nonmarket goods issue [17].

The CE model is one of the most commonly used tools in the estimation of nonmarket goods. Hausmann et al. [56] and Steven, Smart, Morrison, and Castley [36] argued that the CE model clearly measured respondents' preferences and assessed the use and nonuse value of goods and services. The CE model was also used to measure respondents' conservation preferences and environmental management [36,57,58].

The CE model was originally developed by Louviere and Hensher [59] and Louviere and Woodworth [60] to address transportation issues [61]. Following the studies of Juutinen et al. [62], Bateman et al. [63], and Barrio and Loureiro [64], the random utility function is shown in Equation (1):

$$U_{ni} = V(X_{ni}) + \varepsilon_{ni} = \beta_n' x_{ni} + \varepsilon_{ni} \quad (1)$$

where $\beta_n$ is the vector of utility coefficients for the nth respondent in this study, and $\beta_n$ refers to each estimated coefficient variable. Juutinen, Mitani, Mäntymaa, Shoji, Siikamäki, and Svento [62] further expanded the study of McFadden [65] and suggested that random utility models may be used to derive conditional logit (CL), RPL, and LCM, which are modeled by utility maximization and demand theory [63,64]. The CL model is the basic model of CE, which assumes that all parameters of the interviewees are constant for preference. It is used to assess the average preference of interviewees. The RPL model considers the preferences of individual respondents and estimates the WTP of each respondent. The LCM model was developed to understand the characteristics of interviewees and categorize interviewees into different groups [62].

The present study assumed that the respondents, i.e., tourists and Kinmen residents, would clearly accumulate their utility function, and this function would also express the observable utility and unobservable random items of the respondent [62]. Train [66] proposed that observable deterministic items were generally defined as linear parameters. Recent research also recommends using the RPL model and the LCM of the CE method to measure respondents' preferences. A characteristic of the RPL model is that it considers unobserved preference heterogeneity as a continuous utility parameter, and the LCM estimates the preference heterogeneity of different category groups [67].

Based on the attribute and level design in Section 2.2, the empirical model of this study is defined as follows:

$$V_1 = ASC + \beta_1 HM^+ + \beta_2 NEO^- + \beta_3 NEO^+ + \beta_4 DFE^+ + \beta_5 EOE^+ + \beta_6 EOCF \quad (2)$$

where $V_1$ is the respondent's utility function for the conservation preference for the Eurasian otter in Kinmen, and $ASC$ represents a dummy variable, which is the specific constant of the choice alternative. A dummy variable of 1 means the status quo. A dummy variable of 0 means otherwise. $\beta_1$ and $HM^+$ represent the estimated coefficients and levels of attributes for reducing excessive human interference, respectively. $\beta_2$ and $NEO^-$ represent the estimated coefficients and levels of attributes for reducing 20% of the number of Eurasian otters, respectively. $\beta_3$ and $NEO^+$ represent the estimated coefficients and levels of attributes for increasing 10% of the number of Eurasian otters. $\beta_4$ and $DFE^+$ represent the estimated coefficients and levels of attributes for the speed limit and setting up underpasses, respectively. $\beta_5$ and $EOE^+$ represent the estimated coefficients and levels of attributes for Eurasian otter products and educational parks, respectively. $\beta_6$ and $EOCF$ represent

the estimated coefficient and attributes for the Eurasian otter fund per person per year, respectively.

After estimating the above parameters, the welfare variable of WTP or compensation for each attribute can be estimated by demand theory, as shown in Equation (2) [68–70].

$$\text{WTP} = \frac{-\beta_C}{\beta_6} \quad (3)$$

where $\beta_C$ is the coefficient of each level of attribute, and $\beta_6$ is the coefficient of the fund parameter.

### *3.3. Research Design*

Based on the above discussion, the integrated conservation program for the Kinmen Eurasian otter was constructed, as shown in Figure 2. Three aspects, including public preference, community preference, and sustainable development, are incorporated into the framework. Five attributes, "habitat maintenance", "number of Eurasian otters", "developing a friendly environment", "Eurasian otter product and educational park", and "Eurasian otter conservation fund", were further used to measure the three purposes of the Kinmen Eurasian otter conservation program. The theoretical framework is shown in Figure 2. According to the literature review, the present study developed a questionnaire to explore respondents' preferences toward the Kinmen Eurasian otter conservation management strategy based on wildlife and Eurasian otter conservation preferences, RPL and LCM. As discussed above, habitat maintenance is very important for Eurasian otter conservation. Therefore, the present study considered "habitat maintenance" an important attribute that affected people's conservation preferences for the Kinmen Eurasian otter. In addition to the current status of "habitat destruction", we proposed "maintain and artificially construct the habitat of the otter" as an additional level.

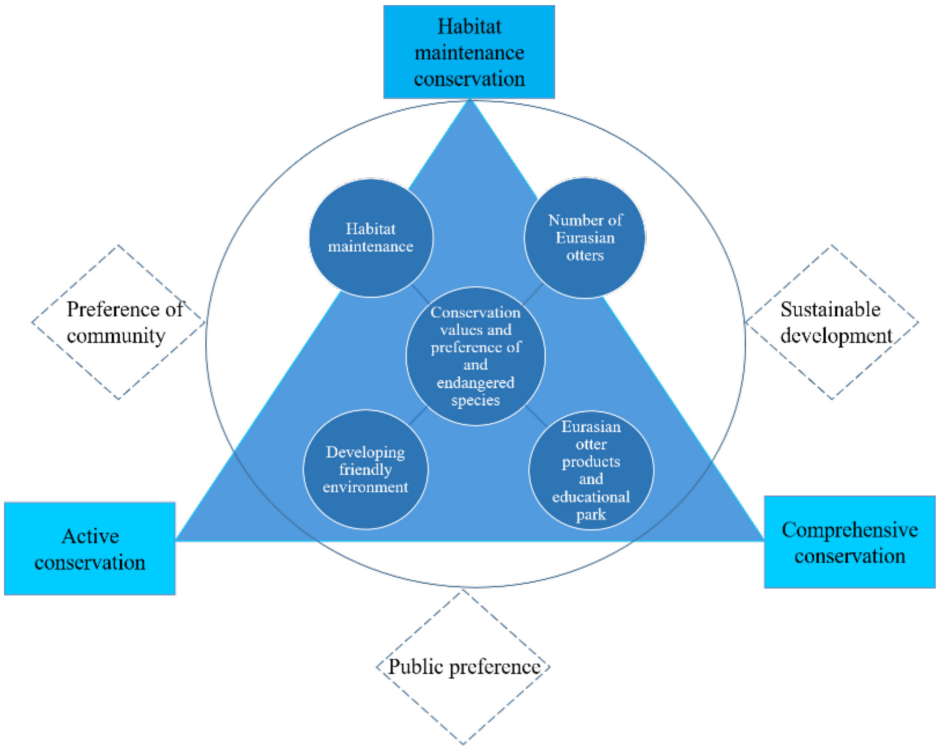


**Figure 2.** The conservation values and evaluation framework of endangered species.

Previous studies found that the number of endangered species affected people's preferences for conservation programs [36,37]. Therefore, the present study assumed that the number of Eurasian otters would also affect the preferences of Kinmen residents and

tourists for conservation alternatives. The "number of Eurasian otters" was included as an attribute to understand respondents' preferences toward the Kinmen Eurasian otter conservation program. The present study set the "reduce by 20%" and "increase by 10%" numbers of Eurasian otters as two additional levels.

A friendly environment is very important for the survival of Eurasian otters. Previous studies showed that the use of organochlorine pesticides and road kill were the main reasons for the decline in the number of otters [10,28]. Therefore, the development of a friendly environment reduces the use of pesticides to promote the conservation of animals and a friendly environment in which animals and humans coexist. "Developing a friendly environment" is one of the most important attributes of Kinmen Eurasian otter conservation alternatives. To investigate residents' and tourists' preferences for Eurasian otter conservation alternatives, we chose an additional level, "speed limit and setting up underpasses".

Previous studies found that people had a special preference for indicator species and paid more attention to these species. Endangered species presented with a brand image have a higher WTP [48–52]. Nadhurou et al. [71] noted that educational activities reduced the negative impact of hunting and illegal activities. Scholars also found that educational activities reduced illegal destruction via conservation behavior. Therefore, the attribute of "Eurasian otter products and educational park" was also a key factor in the construction of the brand image of Kinmen Eurasian otters. The present study used "Eurasian otter products and educational park" as an attribute to create a brand image for the Kinmen Eurasian otter and educate the public and volunteers via an educational park. Therefore, the present study set "establish Kinmen Eurasian otter products and educational park" as an additional level.

When the CE model was used to assess relevant issues in ecological economics, WTP was also a very important attribute [72,73]. The financial factor in the CE method is a key element used to measure respondents' WTP for public goods [62,74,75]. Most people are familiar with the idea of a user charge. Therefore, the "Eurasian otter conservation fund" was a very important attribute and was included in Eurasian otter conservation. For the final CE questionnaire, the present study obtained the opinions of 50 interviewees using open price pretest questionnaires to understand the range of WTP. The formal CE questionnaire in this study was further developed based on pretest questionnaires. Changing the current situation and increasing the level of Kinmen Eurasian otter conservation preferences without paying was quite unreasonable for respondents. Therefore, the present study constructed the Eurasian otter conservation fund using the pretest open-price questionnaire. The levels of the Eurasian otter conservation fund were set to no payment, TWD 1000, TWD 1500, TWD 2000, and TWD 5000 for one year.

Based on past related research, the present study constructed a theory of Eurasian otter conservation preferences to identify the public's demand and establish the best Eurasian otter conservation alternative. The evaluation attributes and levels are shown in Table 1.

### *3.4. Choice Experiment Design for Kinmen Eurasian Otter Conservation*

The study questionnaire had five attributes, with each attribute containing 2–5 levels and 120 sets ($2 \times 3 \times 2 \times 2 \times 5$) of alternatives. Louviere et al. [76] and Birol et al. [77] suggested the use of orthogonal design to find the optimal combination and number of groups via experimental design when there was a large number of management alternatives. Twenty-five sets of alternatives were obtained after orthogonal design in this study, one of which was the current condition. Twelve alternatives were deleted due to unreasonable arrangement. For example, an alternative is better than the current situation, but the respondents did not have to pay. Therefore, a total of 12 alternatives and one current condition in this study were used for residents and visitors. Juutinen, Mitani, Mäntymaa, Shoji, Siikamäki and Svento [62], Lee and Wang [74], Zong et al. [78], and Lee et al. [79] used a choice set that combined two random alternatives with the current condition. Therefore, questionnaires of 22 versions were generated in this study. Each questionnaire was expected

to have three choice sets that contained six combined alternatives and the current status. The design of the questionnaire was based on text and picture descriptions to help the respondents easily understand the questions. One of the versions is shown in Figure 3.

**Table 1.** Attributes and levels of Kinmen Eurasian otter conservation preferences.

| Attitudes | Levels | Variable Name |
|---|---|---|
| Habitat maintenance | 1. Habitat destruction (current status);<br>2. Maintain and artificially construct the habitat of the otter. | $HM_{-}^{+}$<br>$HM^{+}$ |
| Number of Eurasian otters | 1. Fewer than 200 (current status);<br>2. Reduce by 20%;<br>3. Increase by 10% | $NEO_{-}^{+}$<br>$NEO^{-}$<br>$NEO^{+}$ |
| Developing friendly environment | 1. No (current status);<br>2. Speed limit and setting up underpasses. | $DFE_{-}^{+}$<br>$DFE^{+}$ |
| Eurasian otter products and educational park | 1. No (current status);<br>2. Establish Kinmen Eurasian otter products and educational park. | $EOE_{-}^{+}$<br>$EOE^{+}$ |
| Eurasian otter conservation fund | 1.There is currently no source of conservation fund (current status);<br>2. TWD 1000;<br>3. TWD 1500;<br>4. TWD 2000;<br>5. TWD 5000. | $EOCF$ |

Note: The exchange rate between NT and USD is approximately 1:30. The following exchange rates were calculated based on this standard.

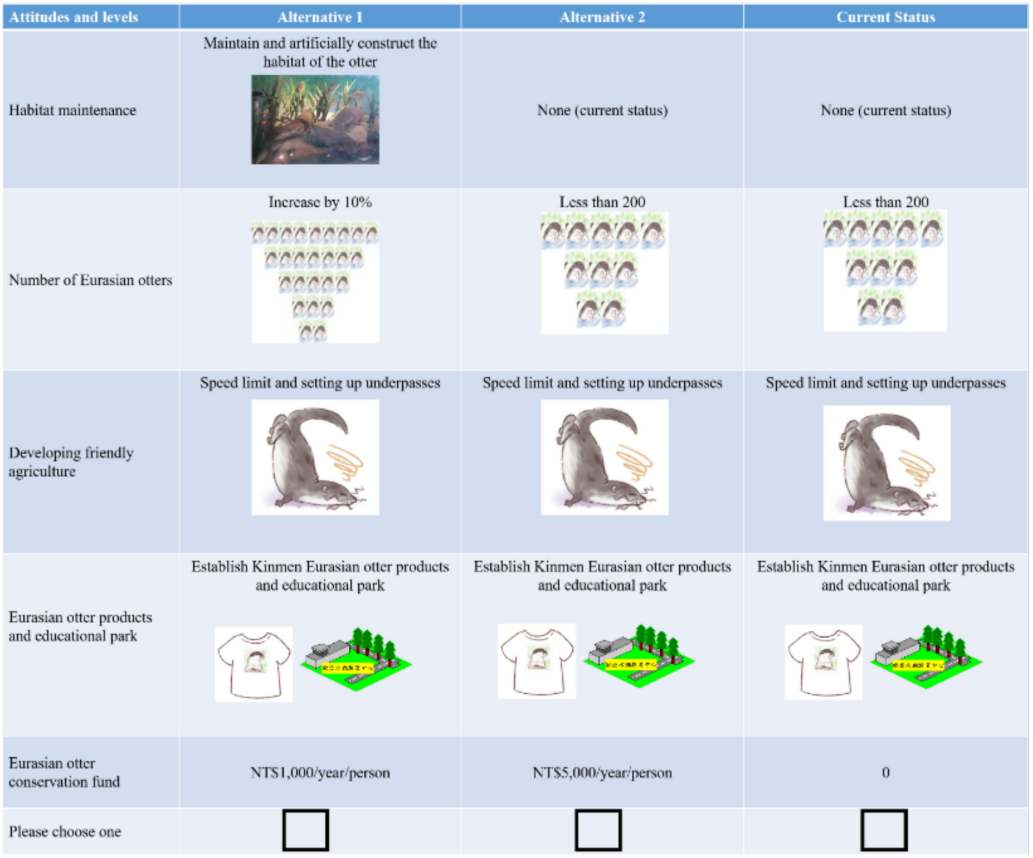


**Figure 3.** An example of a choice set for Kinmen Eurasian otter conservation preferences.

### 3.5. Sampling Design and Sample Data

The present study set 880 samples with a 95% confidence level and an estimation bias of 3.3%. The present study interviewed 880 respondents, including 440 tourists and 440 residents, from June 2020 to October 2020. We performed one-on-one interviews in the Kinmen area and assumed that Kinmen residents and tourists had the same preferences and non-preferences for the conservation of Kinmen Eurasian otters.

For the descriptive statistics of the social background of the respondents, there were 202 male tourists (45.9%), 238 female tourists (54.1%), 213 male residents (48.4%) and 227 female residents (51.6%). There were 223 (50.7%) married tourists and 217 (49.3%) married residents. A total of 200 tourists were younger than 40 years old (45.5%), 105 tourists were over 40 years old (54.5%), 267 residents were younger than 40 years old (60.7%), and 173 residents were over 40 years old (39.3%). There were 134 (30.4%) tourists with a high school diploma or lower, 238 (54.1%) tourists with an undergraduate diploma, and 68 (15.5%) tourists with a graduate degree or above. There were 143 (32.5%) residents with a high school diploma or lower, 268 (60.9%) residents with an undergraduate diploma, and 29 (6.6%) residents with a graduate degree or above. These results are displayed in Table 2.

**Table 2.** Statistical analysis of tourists and residents.

| | | Tourists | Residents |
|---|---|---|---|
| Number | | 440 | 440 |
| Gender | Male | 202 | 213 |
| | Female | 238 | 227 |
| Married | | 223 | 217 |
| Age | Less than 40 years old | 200 | 267 |
| | Over 40 years old | 240 | 173 |
| Income | Less than TWD 40000 | 213 | 248 |
| | More than TWD 40000 | 227 | 192 |
| Education | High school or lower | 134 | 143 |
| | Undergraduate | 238 | 268 |
| | Graduate or above | 68 | 29 |

## 4. Results

### 4.1. Estimating Residents' and Tourists' Preferences for the Eurasian Otter

The RPL model results for tourists and residents are shown in Table 3. As shown in Table 3, we found that six attribute levels were significant at the 5% level and had a positive impact on respondents' preferences, except for $ASC$ and $NEO^{-}$, which had a negative impact on respondents' preferences. This result shows that respondents did not prefer the status quo in the conservation of the Eurasian otter in Kinmen. The respondents preferred "reduce excessive human interference", "increase number of otters", "speed limit and constructing biological corridor", and "establish Kinmen Eurasian otter products and educational park". As expected, respondents had the highest preference for "increase number of otters by 10%", followed by "establish Kinmen Eurasian otter products and educational park", "speed limit and set underpasses", and "reduce excessive human interference". Respondents had a strongly negative preference for "reducing the number of otters by 20%".

**Table 3.** Results of the RPL Model.

| Attributes and Levels | Willingness to Pay | | | | MWTP (TWD) |
|---|---|---|---|---|---|
| | Coefficient | T Value | Coefficient Std. | T Value | |
| *ASC* | −1.19116 | −4.89 *** | 4.28492 | 13.22 *** | −2374 |
| $HM^{+}$ | 0.23878 | 4.73 *** | 0.44080 | 3.75 *** | 478 |
| $NEO^{+}$ | 0.50201 | 6.50 *** | 0.62058 | 5.29 *** | 1001 |
| $NEO^{-}$ | −0.61409 | −7.56 *** | 0.62058 | 5.29 *** | −1234 |
| $DFE^{+}$ | 0.26948 | 4.52 *** | 0.66474 | 5.88 *** | 538 |
| $EOE^{+}$ | 0.44322 | 8.47 *** | 0.22185 | 1.13 | 885 |
| *EOCF* | −0.00050 | −12.05 *** | | | |
| Log-likelihood | −2219.41847 | | | | |
| Chi Squared | 1361.83594 *** | | | | |

*** indicates significance at the 1% level.

### 4.2. Welfare Results for the Conservation of the Eurasian Otter in Kinmen

The MWTP for the conservation of Eurasian otters in Kinmen was calculated based on Equation (3), and the results are shown in Table 4. The results show that the most important attribute for tourists and residents was the number of Eurasian otters. The respondents were willing to pay TWD 1001 to increase the number of Eurasian otters, and they had a strong aversion to reducing the number of Eurasian otters (TWD−1234). Their second priority was to "establish Kinmen Eurasian otter products and educational park", and respondents were willing to pay TWD 885 to achieve this. The respondents were willing to pay TWD 538 for "speed limit and setting up underpasses". For "maintain and artificially construct the habitat of the otter", they were willing to pay TWD 478.

**Table 4.** Market segmentation of Eurasian otter conservation for the two groups.

| Attributes and Levels | Category 1 Conservative Conservationist | | | Category 2 Active Conservationists | | |
|---|---|---|---|---|---|---|
| | Coefficient | T Value | MWTP | Coefficient | T Value | MWTP |
| *ASC* | −0.32041 | −0.71 | −396 | −4.06624 | −0.29 | −19,363 |
| $HM^{+}$ | 0.08408 | 0.96 | 104 | 0.29860 | 4.47 *** | 1422 |
| $NEO^{+}$ | 0.34053 | 1.41 | 420 | 0.27298 | 3.17 *** | 1300 |
| $NEO^{-}$ | −0.68912 | −4.15 *** | −851 | −0.22022 | −2.43 ** | −1049 |
| $DFE^{+}$ | −0.04796 | −0.25 | −59 | 0.40617 | 5.12 *** | 1934 |
| $EOE^{+}$ | 0.35995 | 3.27 *** | 444 | 0.41603 | 6.44 *** | 1981 |
| *EOCF* | −0.00081 | −3.97 *** | | −0.00021 | −4.59 *** | |
| | | 56.6% | | | 43.4% | |
| Category parameter: Category 1 | | | | Coefficient | T Value | |
| Constant | | | | 1.44506 | 2.71 *** | |
| Resident | | | | 0.89517 | 4.63 *** | |
| Knowledge of the Eurasian otter in Kinmen | | | | −0.63151 | −2.92 *** | |
| Knowledge that the Eurasian otter is a protected animal | | | | −1.07183 | −5.75 *** | |
| Had participated in conservation activity for the Eurasian otter before | | | | −1.02117 | −2.98 *** | |
| More than 40 years old | | | | −0.15070 | −1.00 | |
| Undergraduate or over | | | | −0.45270 | −2.73 *** | |
| Monthly income more than TWD 40000 | | | | 0.07334 | 0.55 | |
| Log-likelihood | | | | −2546.14618 | | |
| x2 (22 d.f.) | | | | 708.38052 | | |

*** and ** indicate significance at the 1% and 5% levels, respectively.

### 4.3. Market Segmentation of Eurasian Otter Conservation

Häfner et al. [80] found that individual preference was influenced by social and cultural background, including education, gender, and age. Therefore, this study further used the LCM to analyze the market segmentation of Eurasian otter conservation. The analysis

results of the LCM are shown in Table 4. The results show that the LCM divided respondents into two latent classes. The proportion of latent class 1 was 56.6%. Respondents in this class belonged to the conservative conservationist group. They were primarily residents with a lower education level who did not know that the Eurasian otter existed in Kinmen, did not know that the Eurasian otter was a protected animal, and did not previously participated in conservation activities for the Eurasian otter. At a significance level of 5%, this group disliked the idea of reducing the number of Eurasian otters and preferred to establish Kinmen Eurasian otter products and educational parks. The proportion of latent class 2 was 43.4%. Respondents in this active conservationist group were tourists who had high education, knew that the Eurasian otter existed in Kinmen, knew that the Eurasian otter was a protected animal, and had participated in conservation activities for the Eurasian otter. At a significance level of 5%, respondents in this group preferred the active conservation of Kinmen Eurasian otters. Conservationists in this class preferred to reduce excessive human interference, increase the number of Eurasian otters, limit speed and set up underpasses, and establish Kinmen Eurasian otter products and educational parks. They also did not prefer a reduced number of Eurasian otters.

### 4.4. Welfare Estimation for Conservation Scenarios for the Eurasian Otter

Based on the results in Table 3, we provided three scenarios under various hypothetical conservation policies for the Eurasian otter and estimated their welfare effects. The results are shown in Table 5. The attributes were positively influenced by the respondents' preferences for conserving the Eurasian otter. Scenario I represented the habitat maintenance conservation alternative. Respondents were willing to pay TWD 1016 annually to maintain and artificially construct the habitat of the otter and set speed limits and underpasses. Scenario II was a more active conservation strategy. Respondents were willing to spend TWD 2017 to maintain and artificially construct otter habitats, set speed limits and underpasses, and increase otter numbers by 10%. Scenario III was a comprehensive conservation alternative. Respondents in this scenario preferred all attributes, including "maintain and artificially construct the habitat of the otter", "increase the number of Eurasian otters by 10%", "set up speed limits and underpasses", and "set up Eurasian otter products and educational park". Their MWTP was TWD 2902.

**Table 5.** Hypothetical strategies for the conservation of Eurasian otters.

| Attributes and Levels | Scenarios | | |
|---|---|---|---|
| | **Scenario I** | **Scenario II** | **Scenario III** |
| | **Habitat Maintenance Conservation Alternative** | **Active Conservation Alternative** | **Comprehensive Conservation Alternative** |
| Habitat maintenance | Maintain and artificially construct the habitat of the otter | Maintain and artificially construct the habitat of the otter | Maintain and artificially construct the habitat of the otter |
| Number of Eurasian otters | - | Increase by 10% | Increase by 10% |
| Developing friendly environment | Speed limit and setting up underpasses | Speed limit and setting up underpasses | Speed limit and setting up underpasses |
| Eurasian otter education and cultural creative industry park | - | - | Establish Kinmen Eurasian otter products and educational park |
| Eurasian otter conservation fund | TWD 1016 | TWD 2017 | TWD 2902 |
| CI | 959~1074 | 1933~2103 | 2813~2993 |

## 5. Discussion

The issues of environmental protection, sustainable development, and conservation received considerable attention in recent years [1,2,4–8,81]. People's preferences play an important role in the success of wildlife conservation. Using the Kinmen Eurasian otter as an example, this study constructed a utility model of wildlife conservation preferences based on the economic theory of nonmarket goods. This model contributes to the academic development of sustainability, environmental protection, and conservation in the future. Eurasian otters are listed as first-class protected animals in Taiwan and are now on the verge of extinction. Almost no trace of otters are found on the island of Taiwan, and there are fewer than 200 otters on Kinmen Island. Therefore, the conservation of Kinmen Eurasian otters is a very important issue. To understand the Eurasian otter conservation policy and management strategy, the present study used a combination of approaches to explore the Eurasian otter conservation preferences and attributes of residents and tourists in Kinmen. This study then constructed the Kinmen Eurasian otter conservation preference function and explored respondents' WTP for the conservation of the Kinmen Eurasian otter. Our results show that respondents were very dissatisfied with the current conservation status of Kinmen Eurasian otters.

Based on the theoretical framework developed in this study, we depicted three stages in the construction of conservation objects for endangered species. The first stage was "habit maintenance conservation", the second stage was "active conservation", and the third stage was "comprehensive conservation". For the first stage, "habitat maintenance conservation", previous literature showed that excessive development and habitat destruction substantially threaten endangered species [24]. Therefore, understanding how to actively maintain a wildlife habitat is of great importance, and the successful conservation of endangered species may be determined by public support. Following the end of martial law in Taiwan, Kinmen began to engage in economic development to provide more job opportunities, such as opening for tourism activities [10]. These transformations led to the destruction of the otter habitats. The results of this study show that the public preferred to maintain and artificially construct Eurasian otter habitats. Due to the lack of waterfalls and the destruction of forests in Kinmen, people constructed many ponds to conserve water for daily life and agricultural use. These forests, ponds, and lakes became excellent habitats for Kinmen Eurasian otters. To meet the maintenance demands of otter habitats, the Kinmen government implemented conservation and protection measures for ponds around otter territories.

In addition to the people's willingness to artificially support the maintenance of the original otter habitat, they also supported the establishment of underpasses for otters. Wildlife–vehicle collisions were a major source of wildlife mortality since the 1970s [82,83]. For example, Germany reported over 300 otters road kills from 1985 to 1993, especially after German reunification [40]. Destruction of the main trails established by Eurasian otters in Kinmen forced the otters to traverse the road. Kinmen residents typically drive or ride motorcycles, and most tourists rent motorcycles to travel. This traffic resulted in a considerable number of road-killed wildlife in Kinmen. Therefore, the Kinmen government posted warning signs for otter crossings to remind drivers to slow down at the popular spots of otter movement. The Kinmen government constructed some ladders in the dams and underground tunnels to help otters move safely. However, some otter road kills still occurred in recent years, and many experts and conservationists proposed the proactive establishment of underpasses for Kinmen Eurasian otters and lowered speed limits around otter habitats.

Regarding the active conservation in the second stage, in addition to being aware of "habitat maintenance conservation", including maintaining and artificially constructing otter habitats, reducing the speed limit, and establishing underpasses, another 10% increase in the number of Eurasian otters is preferred. The results of this study are consistent with Steven, Smart, Morrison, and Castley [36] but contrary to Lehtonen, Kuuluvainen, Pouta, Rekola, and Li [37]. Steven, Smart, Morrison, and Castley [36] asserted that the public

was concerned about the number of endangered species. Lehtonen, Kuuluvainen, Pouta, Rekola, and Li [37] concluded that people's WTP is reduced when the population of an endangered species increases. The present study found that the public was concerned with the number of Eurasian otters. Road kills and attacks on the Kinmen Eurasian otter by stray animals are frequent in Kinmen [12]. One strategy to address this issue is to assign dedicated institutions to rescue, shelter, rehabilitate and release otters and monitor stray animal movements to reduce the threat to Eurasian otters. Based on the results of this study, increasing the Eurasian otter population would align with the preferences and promote the wellbeing of the public.

The third stage, "comprehensive conservation alternative", incorporated the attributes of "habitat maintenance conservation" and "active conservation", and the sale of unique products related to the Kinmen Eurasian otter and construction of a Kinmen Eurasian Otter Educational Park. As mentioned above, people prefer endangered wild species with a brand image. The application of this preference to the Kinmen Eurasian otter encouraged the design of products representing this species. Previous research showed that educational activities effectively reduced illegal activities against endangered species [71]. Therefore, educational activities related to the Kinmen Eurasian otter may be used to assist the public in understanding the importance of this species and improve the public's awareness of its conservation. For example, the Korea Otter Research Center (KORC), which is the only otter research facility in Asia, plays an important role in Eurasian otter conservation. The KORC is responsible for rescuing and rearing wild otters, expanding research on otters for issues of reproduction and the release of rescued otters after recovery from injuries [84]. The KORC also provides pictures, specimens, and profiles of the Eurasian otters to highlight their importance and promote their image in the media [84]. Kinmen can establish a Eurasian otter-related educational park in collaboration with local communities, and this park can provide Eurasian otter-related products and educational conservation activities. These approaches can strengthen the public's awareness of Eurasian otter conservation and promote the local community's economic development.

According to the analysis results of the LCM in this study, the market segmentation of Kinmen Eurasian otter conservation was divided into two groups. People in the second group were primarily tourists and highly educated. They knew that the Eurasian otter was a protected animal in Kinmen and previously participated in conservation activities for the Eurasian otter, which indicated that they supported more active conservation activities for Kinmen Eurasian otters. They preferred to change the current situation, maintain and artificially construct the habitat of the otter, increase the number of Eurasian otters by 10%, set up speed limits and underpasses, purchase Eurasian otter products, and build an educational park for otter conservation. The authorities should perform more practical plans to fulfill the demands of these people who support the active conservation of otters. For example, Zong, Cheng, Lee, and Hsu [78] proposed that tourists had heterogeneous preferences for participating in ecotourism alternatives for community-based ecotourism in a forest park. Their results show that high-income tourists had a higher preference for community-based ecotourism. Therefore, different community-based tourism experiences should be provided for different groups of tourists. Lin et al. [85] found that tourists and residents had heterogeneous preferences for the ecosystem dimensions of sorghum and wheat farmland in Kinmen, Taiwan. Their study concluded that many attractions and related cultural activities were free of charge in Kinmen, and they suggested levying taxes on transportation, including airline and ship travel, to establish funds for developing the ecosystem function of farmland in Kinmen.

## 6. Conclusions and Policy Implications

In summary, the implementation of conservation policies requires substantial efforts. The present study proposed three conservation strategies in response to the preferences of the public. These strategies involve the implementation of a habitat conservation alternative that includes maintaining and artificially constructing otter habitats and setting

up speed limits and underpasses, actions that would increase the number of Eurasian otters by 10%, and encouraging the development of a branded image for the Eurasian otter conservation plan and related cultural products in cooperation with the local communities. As mentioned by previous research, when people associate a brand with an endangered species, their awareness of conservation increases [48,50–52]. The results of this study provide information on the public's preferences for and attitudes about conservation of the Eurasian otter and suggest that brand building and conservation education will support a deeper understanding of the conservation of this species. We also realized that nearly 30% of respondents needed further information and understanding related to Kinmen Eurasian otter conservation, which is not conducive to the conservation of the Eurasian otter. For ecotourism in Kinmen National Park, only some exhibitions and tours have regular tour guides, but there is no guide to interpret current ecological conservation policies in other areas. Therefore, we suggest that authorities employ more tour guides to educate residents and tourists about conservation practices for Kinmen Eurasian otters and the ecological environment in Kinmen. Based on market segmentation, there was a group of residents who were not aware that the Eurasian otter is a protected animal and did not have much knowledge of the Eurasian otter. The Kinmen government should implement more educational plans to promote public understanding of Kinmen Eurasian otters. The results of the study will help the relevant authorities formulate a Eurasian otter conservation policy and provide a reference for budget allocation.

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