

Study on the reduction of illegal wildlife trade based on data prediction

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Abstract. Wildlife is an important part of all life and natural ecosystem on earth, and their living conditions are closely related to the sustainable development of human beings. The current disorderly use has made the illegal wildlife trade become the third largest crime in the world, seriously affecting biodiversity, ecosystem service function, global social order and public security, and wildlife welfare. In recent years, the illegal wildlife trade involves as much as \$26.5 billion a year and is considered the fourth largest illegal trade in the world, protection of wildlife has become a top priority. In order to obtain the method to effectively reduce the illegal wildlife trade and predict the change trend of illegal wildlife trade in the next five years, based on this background, this paper uses the collected data and the AHP hierarchical analysis, GM (1,1) model to construct the model of illegal wildlife trade research in the next five years.

Keywords: Illegal Wildlife Trade, Data-Driven, AHP Hierarchical Analysis, Predictive Modeling.

1. Introduction

Wildlife plays a crucial role in maintaining the stability of global ecosystems, and in recent years they have become endangered in danger with the increase in illegal wildlife trade. In order to protect the increasingly scarce wildlife resources and restore their severe habitat ecological environment, it is feasible and necessary to introduce the new governance concept of diversified co-governance in the field of wildlife protection and guarantee it [1]. As theory and value guidance, to explore the practice of wildlife protection pluralistic work mode, the specific implementation way mainly for service and guide government-led wildlife protection, multi-subject interactive cooperation to promote wildlife protection and public participation in wildlife protection of multiple work[2], and wildlife protection of the rule of law implementation, in various aspects of construction has achieved certain results, mainly reflected in the wildlife protection pluralistic work system supply increasing and wildlife protection pluralistic work pattern of the prototype[3]. At present, there is difficult to obtain evidence, verify and identify, which falls into the problem of proving[4]. In the face of the reality of illegal wildlife trade, it is of great significance to analyze the reasons and negative effects behind it, actively look for practical countermeasures, better protect wildlife resources, and promote the harmonious coexistence between man and nature.

2. Analysis on measures to effectively reduce illegal wildlife trade

2.1. Modeling

Factor identification includes select Customer 1 (WCS), Customer 2 (Government), Customer 3 (Buyer), and Customer 4 (Trafficker).

Rights indicators is role in illegal wildlife trade, e.g. Client 1's reputation as an NGO, Client 2's contribution to international environmental cooperation in the past, Client 3's role as a facilitator of illegal wildlife trade, Client 4's ability to bind itself to illegal wildlife trade.

Resource indicator is annual financial budget, e.g. 10 million for Client 1, 5 million for Client 2, 2 million for Client 3, 1 million for Client 4.

Interest indicator is past participation in illegal trade crackdown projects, e.g. Client 1's history as a wildlife conservation organization, Client 2's activism in past projects, Client 3's performance in cracking down on illegal wildlife trade, and Client 4's activism in restraining illegal wildlife trade.

Assignment of weights this text use the collected data to construct a fourth-order judgment matrix.

The analysis yields an eigenvector of (1.330, 1.517, 0.577, and 0.577), and combining the eigenvec- tors, we can derive the maximum eigenroot:

$$\Lambda = \frac{1}{n} \sum_{i=1}^n \frac{(AW)_i}{a_i} = 4.154 \quad (1)$$

Hierarchical analysis [5] was utilized to rank the importance of the factors by determining the relative importance of power, resources, and interest through the sum-product method, as shown in Table 1.

Table 1. Results of weighting of factors.

	Power	Resource	Interest
Clicent1	37.694%	34.533%	36.535%
Clicent2	34.410%	37.224%	32.515%
Clicent3	13.948%	13.592%	17.992%
Clicent4	13.948%	14.651%	13.140%

The weights of the elements are aggregated by the sum-and-product method to derive the weights for the different clients, as shown Fig 1.

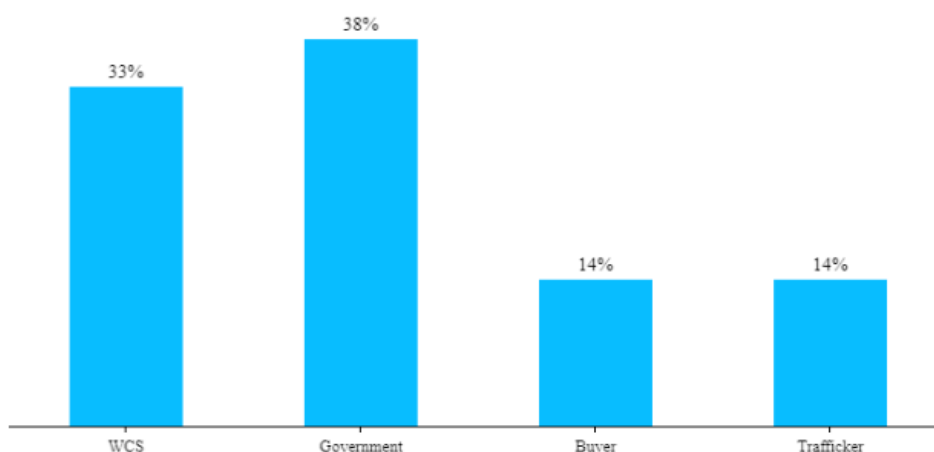


Fig 1. Percentage of different customer weights.

Consistency test, the fourth order corresponds to an RI value of 0.890, and the consistency test yields the fol- lowing table 2.

Table 2. Summary of results of consistency tests.

Maximum characteristic root	CI value	RI value	CR value	Consistency test result
4.154	0.051	0.890	0.057	pass

Normally, the smaller the CR value, the better the consistency of the judgment matrix, in gen- eral, the CR value is less than 0.1, the judgment matrix to meet the consistency test; if the CR value is greater than 0.1, it means that there is no consistency, and it should be adjusted appropriately after the judgment matrix is analyzed again. This time, the CI value is 0.051 for the 4 th order judgment matrix, and the RI value is 0.890, so the CR value is $0.057 < 0.1$, which means that the judgment matrix of this study meets the consistency test, and the weights obtained from the calculation have consistency. Therefore based on AHP hierarchical analysis it can be determined that the customer we have chosen is institutions.

2.2. Determination of clients

The text used Zhi.com, PubMed· Google Scholar and other journal search sites to search with illegal wildlife, and came up with the above results, through the results we can see that China's search

is particularly obvious, so this paper will position the project client on the Chinese institutions, the institutions can do:

(1) Enact strict laws and regulations [6]: The institutions can deter potential illegal trade by enacting strict laws prohibiting illegal trade in animals and imposing severe penalties on violators.

(2) Strengthen law enforcement: The institutions can increase monitoring and enforcement of illegal trade activities, including increased patrols, crackdowns on illegal trade network.

(3) Raising Public Awareness: The institutions can raise public awareness of the illegal trade in animals through publicity and education activities, and promote public opinion to form a consensus on animal protection.

(4) Support sustainable development: The institutions can support and promote projects and cooperation in the sustainable use of wildlife resources to help local communities transform the way they rely on their livelihoods and reduce their dependence on the benefits of illegal trade.

(5) Increase training for law enforcement officials: Provide training for law enforcement officials specifically targeted at combating the illegal trade in animals so that they can more effectively identify, intercept and combat such violations.

(6) Support protected area management: Institutions can increase investment in and support for protected wildlife areas and strengthen patrols and monitoring forces to ensure that wildlife is effectively protected.

2.3. Reasons for choosing a client

Through the first question AHP hierarchical analysis [7], the Chinese institutions is involved in the domestic illegal wildlife trade with the largest weight.

The Role and Capabilities of the Chinese institutions:

(1) Enactment of Laws and Policy Enforcement: China has enacted relevant laws on wildlife protection, such as the <<Law of the People's Republic of China on the Protection of Wildlife>>, and the <<Law on Severe Punishment of Crimes of Illegal Wildlife Trade in accordance with the law>>, etc. The Chinese institutions has the right to exercise its right to step up law enforcement, designate a number of relevant laws and regulations, and raise the cost of violating the law.

(2) International cooperation: As a major diplomatic country, China can establish contacts with other countries through diplomacy, promote global cooperation, work with other countries to combat illegal wildlife trade, and join hands with other countries to discuss effective relevant policies.

(3) Funding and resources: The Chinese institutions can allocate the necessary financial resources to support research, surveillance, law enforcement actions and public education programs, and rationalize the use of existing funds to support technological innovations and conservation programs, such as electronic tracking of wildlife.

(4) Public Education and Awareness Raising: The Chinese institutions has a certain convening power, and the institutions leads by example by raising citizens' awareness of the wildlife trade and actively encouraging them to participate in wildlife protection through appropriate educational activities.

2.4. Data-Driven Analytic

By analyzing the data on illegal wildlife trade in the country reported in the media from the first quarter of 2021 to the second quarter of 2022, we can predict the illegal wildlife trade in the next five years as a result of the implementation of the project by building a GM (1, 1) model [8].

Number of cases of illegal trade in domestic wildlife reported in the media from the first quarter of 2021 to the second quarter of 2022, as shown Fig 2:

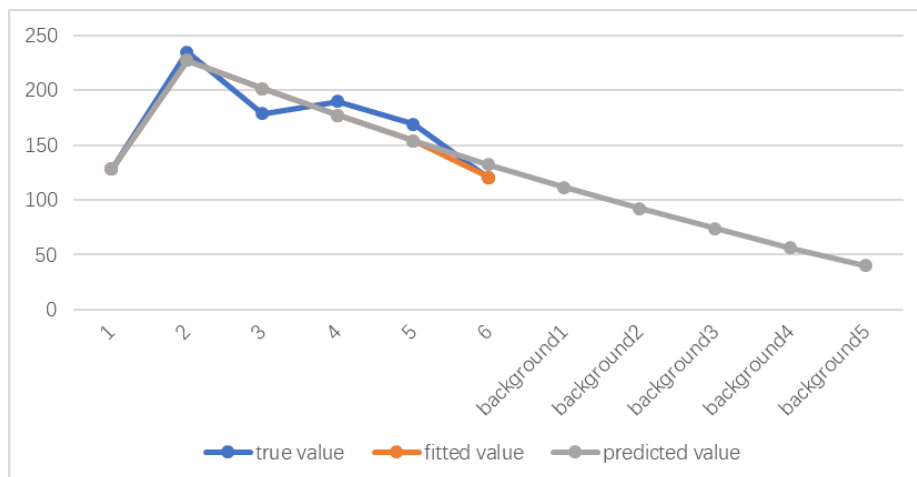


Fig 2. Number of cases of illegal trade in domestic wildlife.

Table 3. GM (1, 1) model level ratio.

GM(1,1) model level ratio table				
Serial number	Original value	The grade ratio λ	Raw value+translation shift value(shift=235)	The value of the converted stage ratio λ
1	128.000	-	363.000	-
2	235.000	0.545	470.000	0.772
3	179.000	1.313	414.000	1.135
4	190.000	0.942	425.000	0.974
5	169.000	1.124	404.000	1.052
6	120.000	1.408	355.000	1.138

From the above table 3, it can be seen that the GM (1, 1) model [9] construction for QUANTITY is firstly carried out the level ratio test, which is used to determine the applicability of the data series for model construction. The results show:

The original data did not pass the rank-ratio test, so a translation transformation was carried out, i.e., a translation transformation value of 235.00 was added to the original value, and the final rank-ratio test values of the translated data were all within the standard range interval [0.751, 1.331], implying that the present data are suitable for GM (1, 1) model construction.

Table 4. Model building results.

Model building results			
Development	Gray quantity	A posteriori difference	Small error probability
a	b	C	P
0.0577	497.0245	0.1233	1.000

For the GM (1, 1) model [10], it is necessary to calculate the development coefficient a, the gray role quantity b, as well as to calculate the a posteriori difference ratio C-value and the probability of a small error p-value, the results are shown in Table 4.

(1) The development coefficient a, and the gray role quantity b are model-building outputs;

(2) The a posteriori difference ratio C value is used for model accuracy grade test, the smaller the value the better. If $C < 0.35$, then the model accuracy grade is good; if $C < 0.5$, then the model accuracy is qualified; if $C < 0.65$, then the model accuracy is basically qualified; if $C > 0.65$, then the model accuracy is failed. Third: about the small error probability p value, if $p < 0.7$, then the model is unqualified; if $p < 0.8$, then the model is qualified, if $p > 0.95$, then the model accuracy is good.

As can be seen from the table above, the model is constructed to obtain the development coefficient a, the gray role quantity b, as well as the value of the a posteriori ratio C and the value of the probability of small error p; the value of the a posteriori difference ratio C of $0.123 < 0.35$ implies that

the model accuracy class is very good. In addition, the small error probability p-value is $1.000 < 1.0$, which means that the model is ok.

Table 5. GM (1, 1) model test.

Serial number	original value	Projected value	residual	relative error	Gradation deviation
1	128.000	128.000	0.000	0.000%	-
2	235.000	227.586	7.414	3.155%	0.486
3	179.000	201.635	-22.635	12.645%	-0.239
4	190.000	177.141	12.859	6.768%	0.111
5	169.000	154.020	14.980	8.864%	-0.061
6	120.000	132.197	-12.197	10.164%	-0.329

The GM (1, 1) model test table focuses on the residuals, including relative error, and rank deviation shown Table 5.

(1) The smaller the relative error value, the better, the value of less than 0.2 means that meet the requirements, less than 0.1 means that meet the higher requirements;

(2) The smaller the value of the grade ratio deviation, the better, the value of less than 0.2 indicates that the requirements are met, and less than 0.1 indicates that the higher requirements are met.

It can be seen that the model construction can be analyzed after the relative error and the level deviation values to verify the model effect situation; the maximum value of the relative error of the model, $0.126 < 0.2$, implies that the model fit meets the requirements. For the level deviation value, the value is less than 0.2 indicating that the requirements are met, and if it is less than 0.1, it indicates that the higher requirements are met; the value of the relative error of the model exceeds 0.2, which implies that the model is poorly fitted.

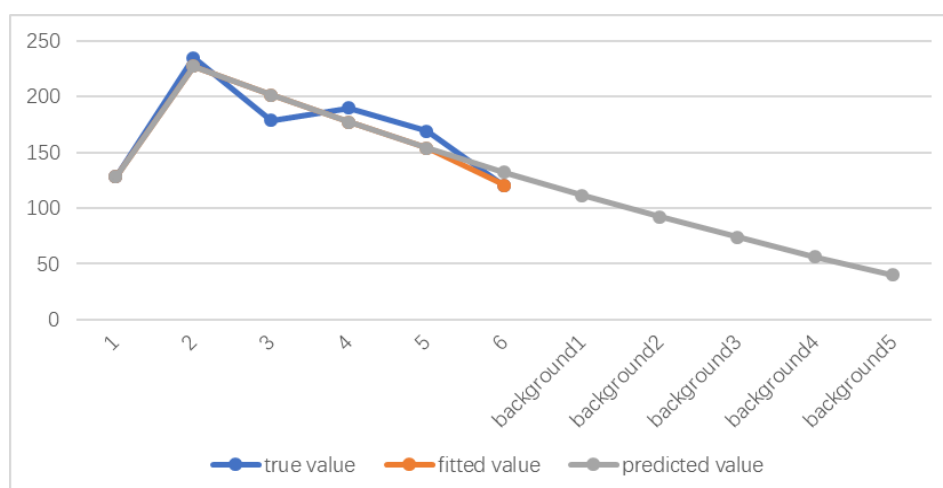


Fig 3. Projection chart.

Through the comparative analysis in Fig 3, the study shows that as a result of the early 2022, the Chinese institutions has taken a series of measures to protect the illegal trade in wildlife, including raising the penalties for violations of the law, increasing the efforts to combat the illegal wildlife trade, strengthening the regulation and management of the illegal trade in wildlife, and promoting the society to joint participation in actions to protect wildlife, and other measures. These measures aim to reduce illegal wildlife trade activities, protect wildlife resources, preserve biodiversity and promote sustainable development. As a result, the number of cases of illegal wildlife trade in China has been on a downward trend, and according to the model prediction has continued to decline in the following five quarters, which fully demonstrates that a series of measures taken by institutions agencies have a catalytic effect on the protection of wildlife, and also provides a precedent for the implementation of this project.

3. Conclusions

Wild animals are an important natural resource and ecological resource. Their illegal trade not only endangers the ecological environment and public health and safety, but also breeds and encourages a series of crimes such as illegal hunting and illegal transportation, and seriously damages the social order. In recent years, due to the low risk and high efficiency of online transactions, offline illegal trade is gradually shifting to online. More and more wild animals are sold through online channels, and crimes are further organized, large-scale and concealed. Therefore, it is urgent to face the problem of illegal wildlife trade. Based on the data collected about illegal wildlife trade, using AHP level analysis, the Chinese institutions play a decisive role in restricting the domestic illegal wildlife trade, and introduce corresponding policies to reduce the wildlife trade, such as formulating corresponding laws and regulations; raising public awareness; supporting the management of protected areas, etc. In addition, based on the GM (1, 1) model, the change trend of the illegal wildlife trade in the next five years, in the next five years, under the policy intervention, the illegal wildlife trade will decrease year by year. Obviously, the illegal wildlife trade has been effectively controlled under the intervention of relevant policies.

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