The Allocation of Frpce Endangered Plants Species Fund

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Abstract: With the acceleration of human development, many people nowadays have a better living standard compared to hundreds of years before. However, besides the prosperity of human society, many contaminations were produced and severely affect the environment, leading to an artificial disaster to nature. Many valuable species were wiped out of their habitat and become extinct. In order to turn the scales, there are many non-profit organizations that started to raise money to protect the endangered organisms. But there is usually some conflict between the cost and the money we collected, they are simply not equivalent. For the sake of solving this question of the distribution of the fund, in this paper, we aim to address this issue and create a model that is determined by its cost benefits analysis to calculate the priority of protection of a certain plant and use this model to simulate a cost schedule about protecting all plants. The first part of our model is to assume that we will protect all the 48 plants at the same time, since its urgency of being conserved. In this section, we use Excel to calculate and draw the graph of the relation between the years and the cost. We objectively summarize the benefits and the drawbacks of this situation. Then we use the explanatory description to analyze the reason why this model is not suitable for the question and our assumptions. Then we introduce some influence factors that affect the priorities.

1. Introduction

The birth of creatures can be traced back to 3.5 billion years ago, and after billions of years of evolution, many types of creatures have gradually appeared on Earth. The earth is a very natural living environment for living creatures, but the emergence of humans has gradually broken the natural balance. Some scientists speculate from data analysis that four million years ago, human ancestors such as the Dryopithecus may have caused the endangerment or even extinction of certain carnivores.

With access to fire, the destruction of the Earth's environment has been going on since the Stone Age, when smoke from burning trees polluted the air. As civilization progressed, the damage to the Earth increased, with the worst of the pollution beginning with industrialization in the 18th century. With industrialization, climate change, air pollution, soil and water pollution, and over-exploitation have caused tremendous damage to the earth's environment, as well as to living things. Within a hundred years, humans had reduced the world's forests by 50 percent. This devastating environmental destruction has led to many species losing their habitat and being endangered, and this situation is still continuing. Forests have been deforested, wetlands drained, grasslands cleared and coral reefs destroyed, particularly in Asia: 94% of the habitat in Bangladesh, 83% in Sri Lanka and 80% in India is no longer viable. Along with the destruction of the environment, human hunting of animals has also had a major impact on the ecosystem. In general, many species have been driven to extinction by humans, such as the Sphynx macaw and the Javan tiger, whose habitats were occupied by humans, the Dodo and the Great Auk, whose habitats were hunted to extinction by humans, and the golden toad and the Madera great white butterfly, whose habitats were polluted by humans. Biodiversity is being destroyed on an unprecedented scale, with one species now disappearing from the world every hour. The disappearance of a species can also cause a chain reaction through the food chain, making other species endangered or even disappear. According to

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the Earth's Vitality Report 2018, released by the World Wide Fund for Nature (WWF), the world's largest non-governmental environmental protection organization, on October 30, wildlife populations decimated by 60 percent from 1970 to 2014. In recent decades, Earth's species have been disappearing at a rate 100 to 1,000 times faster than centuries ago. The United Nations Environment Program estimates that 25 percent of the Earth's total biodiversity will be at risk of extinction in the next 20-30 years. Between 1990 and 2020, deforestation could result in the loss of 5-25% of the world's species, or 15,000-50,000 species per year, or 40-140 species per day. In Florida, the state we will focus on, there are over 16,000 species of native fish, wildlife, and invertebrates, including 147 endemic vertebrates and about 400 terrestrial and freshwater endemic invertebrates. Eighty-two species are currently listed as federally endangered or threatened in Florida. Another 59 species are listed as endangered or threatened by the United States, including 21 species of birds, eight mammals, 13 reptiles, four amphibians, nine fish, and four invertebrates. It is therefore essential for mankind to protect biodiversity and prevent the situation from deteriorating further.

The conservation of biodiversity is very important: firstly, it protects the plant, animal, microbial and genetic resources used for food production, agriculture and ecosystem functions, and ensures food security; and secondly, it helps to grow economies, as some 1.6 billion people in the world depend on forests and non-timber forest products for their income and subsistence, and in developing countries alone, some 1.5 billion people are dependent on forests. 2.6 billion people depended on fisheries for their livelihoods; conserving biodiversity also helped to protect the environment and reduce weather extremes, for example, the protection of mangroves and other coastal ecosystems could reduce the catastrophic effects of climate change, such as floods and storm surges.

Because of the importance of biodiversity and the enormous threats it faces, international organizations and agencies, as well as many national governments, have taken steps to work for its conservation and sustainable use. The United Nations Environment Program (UNEP), in its United Nations System-wide Medium-Term Program for the Environment 1990-1995, drafted in 1987-1988, set out goals, strategies and implementation plans for the conservation of biodiversity. In 1988, environmental scientist Myers proposed a hotspot conservation program in Threatened biotas: hotspots in tropical forests. In addition, the World Wide Fund for Nature (WWF) has proposed the Eco-regional Biodiversity Conservation (ERBC) approach, and The Nature Conservancy (TNC) has proposed a planning-based approach to biodiversity conservation.

However, because there are so many complex factors involved in biodiversity conservation, simply choosing to protect as many species as possible or the easiest species to protect is not the best option. The purpose of this study is to weigh the “benefit”, “taxonomic uniqueness”, “feasibility of success”, “cost” and “conservation cycle” and to rationally allocate resources for the species needing protection and perform the most effective protection.

2. Assumption and Definition

2.1 Assumptions

(1) The impact of unexpected factors on species, such as natural disasters or large-scale damage, is not considered. Because in the actual situation, natural disasters and unpredictable damage will lead to great changes in the development of the project, mainly the project cycle and project cost. In this case, the change of the project can not be estimated and will not be considered in this paper.

(2) The budget of project cost is fixed. It does not change along with time;

(3) Assuming that the project can not be interrupted after the start-up, the investment should be carried out in strict accordance with the project planning;

(4) It is assumed that frpce will raise approximately the same amount of funds each year, that is, it is not possible to raise a large amount of funds at the same time.

2.2 Definition of Variables

The main variables defined in our models are explained in Table 3.1 as follows:

Table 1 Variables and Its Meanings

Variables	Meanings
$Uniqueness(k)$	uniqueness of the *i*-th imperiled plant species.
$\max\{\cdot\}$	the maximum calculation
$\min\{\cdot\}$	the minimum calculation
$\lambda_1, \lambda_2, \lambda_3$	the weight coefficients of the three value factors respectively.
$e(k)$	score of the evaluation
$\mathbf{s} = (s_1, s_2, \cdots, s_i, \cdots, s_n)$	the schedule of the project arrangement
$c_{i,k}$	the cost of the *i*-th plant from the project implementation to year *k*
T_i	the duration of the *i*-th plant protection project
$y_{i,j}$	the cost of the *i*-th species in *j*-year
B_i	benefit
U_i	its uniqueness
P_i	the feasibility of the plan

3. Analytic Hierarchy Process Based Model for Species Evaluation

3.1 Ahp Based Model of Species Conservation Value Evaluation

According to the analysis of Question 2-1 in 3.3 above, the evaluation of the priority order of species protection projects needs to comprehensively consider the different factors such as “Benefit”, “Taxonomic Uniqueness”, “Feasibility of Success” and so on according to the different goals. It is based on general characteristics according to the different objectives

Because of the large number of species to be protected, we need to do a reasonable analysis to determine the ultimate priority of funding. Each species has its own characteristics and the resources needed for investment, so in order to successfully and effectively protect these species, we need to analyze in terms of the “Taxonomic Uniqueness”, “Total cost per plant”, “Feasibility of Success” and “Benefit” and “Protection cycle” of the species. Therefore, this paragraph will use the analytic hierarchy process (AHP) to establish an evaluation system for 48 species, and make recommendations for the priority of allocation of funds through this evaluation system.

According to the characteristics of species, “Taxonomic Uniqueness”, “Total cost per plant”, “Feasibility of Success” and “Benefit” are selected as evaluation indexes in this section. The set of evaluation indexes $\mathbf{U}$ is as follows:

$$\mathbf{U} = \{\text{uniqueness, total cost per plant, feasibility of success, benefit}\} = \{U_1, U_2, U_3, U_4\} \quad (8)$$

After determining the evaluation index, the factors of problem design are divided into three layers: the target layer is the rescue sequence; the criterion layer is “Taxonomic Uniqueness”, “Total cost per plant”, “Feasibility of Success” and “Benefit”; the scheme layer contains 48 species that need to be rescued, so the hierarchical structure model is shown in the figure below:

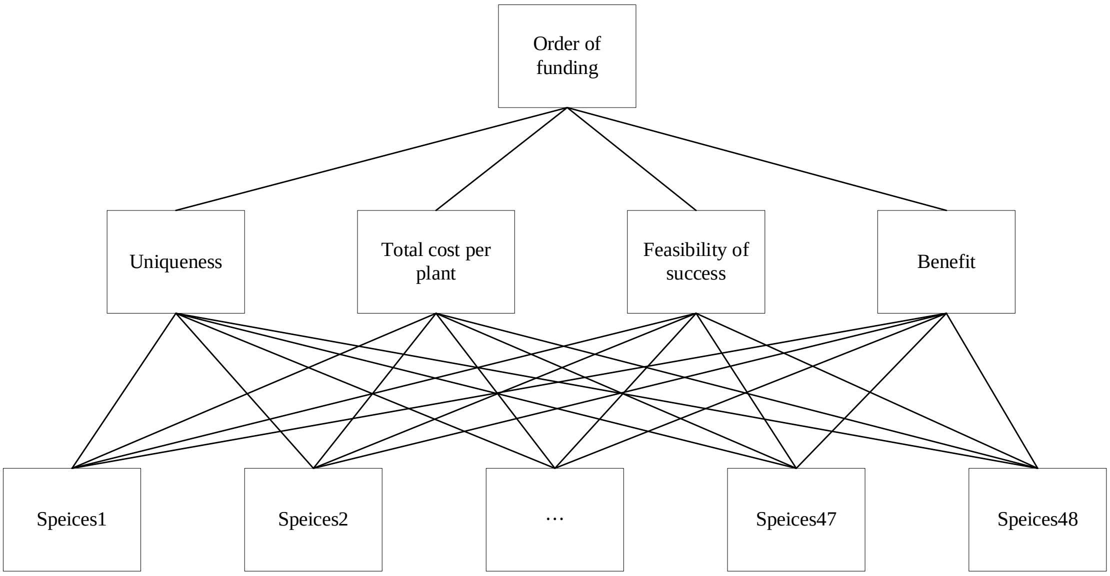

Fig.1 Ahp Framework

Next we need to find the weight of each consideration factor through the analytic hierarchy process. As shown in the table, we enumerate the uniqueness, total cost of a single plant, success rate and benefits and determine their relative importance through the pair-wise comparison matrix. First of all, one row and one column, two rows and two columns, three rows and three columns, four rows and four columns are all 1, because they are all ratios of the same factor. Secondly, according to the goal of our plan, which is to save as many species as possible and save rare species first, the total cost of a single plant is the most important, followed by benefits, then uniqueness, and finally success rate. Therefore, as shown in the table, the ratio of uniqueness to the total cost of a single plant is 1/4, the ratio to the success rate is 1/2, and the ratio to benefits is 1/3; the ratio of the total cost of a single plant to uniqueness is 4/1, the ratio to success rate is 8/1, and the ratio to benefits is 2/1; the ratio of success rate to uniqueness is 1/2, and the ratio to individual plant assembly is 1/8, which is more The ratio is 1/5; the ratio of benefit to uniqueness is 3/1, the ratio of single plant assembly is 1/2, and the ratio of success rate is 5/1.

$$\mathbf{A}=\begin{pmatrix} 1 & \frac{1}{4} & 2 & \frac{1}{3} \\ 4 & 1 & 8 & 2 \\ \frac{1}{2} & \frac{1}{8} & 1 & \frac{1}{5} \\ 3 & \frac{1}{2} & 5 & 1 \end{pmatrix}$$

In the process of finding the weight, we used the arithmetic average method. First, we found the sum of each column, and divided the value of each column by its corresponding total, so that the table was normalized by column. Secondly, through the newly obtained values in the table, we found the average value of each row, which is the weight ω. In order to verify whether the weight is reasonable, we will use the original form $\mathbf{A}$ multiplies with the weight ω to perform vector multiplication to find our $\mathbf{A}\omega$.For example, the first $\mathbf{A}\omega$ is the first item in the first row of the original table multiplied by the first weight plus the second item in the first row multiplied by the second weight plus the third item in the first row multiplied by the third A weight is added to the fourth item in the first row and multiplied by the fourth weight, and so on.

A	Uniqueness	Total cost per plant	Feasibility of success	Benefit		ω	Aω
Uniqueness	0.117647059	0.133333333	0.125	0.094331079		0.117577868	0.470498565
Total cost per plant	0.470588235	0.533333333	0.5	0.566043076		0.517491161	2.08455633
Feasibility of success	0.058823529	0.066666667	0.0625	0.056604308		0.061148626	0.245380424
Benefit	0.352941176	0.266666667	0.3125	0.283021538		0.303782345	1.221004658

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51

According to the formula $\lambda_{\max}=\sum_{i=1}^{n}\frac{[\mathbf{A\omega}]_i}{n\boldsymbol{\omega}_i}$, we calculated the value of the largest eigenvalue $\lambda_{\max}$, approximately equal to 4.016.According to $CI=\frac{(\lambda_{\max}-n)}{(n-1)}$, we calculated the consistency index CI approximately equal to 0.0052. Because $\mathbf{A}$ is a fourth-order matrix, according to the random consistency index chart, the value of the random consistency index RI is 0.9.

According to the uniformity ratio formula, the uniformity ratio is calculated as $CR=\frac{CI}{RI}=\frac{0.0052}{0.9}=0.0058<0.1$, the consistency test is passed, so the weight is available. The final eigenvector $\lambda_{\max}=4.016$ is the weight :

$$\boldsymbol{\omega}=\left(0.1176,0.5175,0.0611,0.3038\right)^{\mathbf{T}}$$

3.2 Calculation Result

According to the above model, calculate the index weight:

$$\boldsymbol{\omega}=\left(0.1176,0.5175,0.0611,0.3038\right)^{\mathbf{T}}$$

Then the priority is evaluated based on the AHP method according to the weight calculation, and the results are shown in the following table 2:

Table 2 Priority Evaluation Based on Ahp Model

	Uniqueness	TotalCost’’	probility	Benefit	Evaluation(A*W)
1-Flowering Plants-502	0.0211	0.0313	0.0240	0.0208	0.0265
1-Flowering Plants-436	0.0211	0.0301	0.0088	0.0208	0.0249
1-Flowering Plants-536	0.0211	0.0276	0.0348	0.0311	0.0283
1-Flowering Plants-486	0.0211	0.0245	0.0284	0.0208	0.0232
1-Flowering Plants-183	0.0211	0.0276	0.0044	0.0208	0.0233
1-Flowering Plants-480	0.0211	0.0263	0.0092	0.0208	0.0230
1-Flowering Plants-135	0.0211	0.0263	0.0168	0.0208	0.0234
1-Flowering Plants-481	0.0211	0.0251	0.0288	0.0208	0.0235
1-Flowering Plants-176	0.0211	0.0241	0.0152	0.0208	0.0222
1-Flowering Plants-475	0.0211	0.0238	0.0108	0.0208	0.0218
1-Flowering Plants-546	0.0211	0.0235	0.0196	0.0208	0.0222
1-Flowering Plants-558	0.0211	0.0232	0.0300	0.0208	0.0226
1-Flowering Plants-553	0.0211	0.0229	0.0260	0.0208	0.0222
1-Flowering Plants-442	0.0211	0.0229	0.0196	0.0208	0.0218
1-Flowering Plants-537	0.0211	0.0226	0.0296	0.0208	0.0223
1-Flowering Plants-548	0.0211	0.0235	0.0344	0.0154	0.0214
1-Flowering Plants-426	0.0211	0.0226	0.0124	0.0154	0.0196
1-Flowering Plants-452	0.0211	0.0197	0.0208	0.0311	0.0234
1-Flowering Plants-173	0.0211	0.0213	0.0056	0.0208	0.0202
1-Flowering Plants-455	0.0314	0.0197	0.0108	0.0208	0.0209
1-Flowering Plants-133	0.0314	0.0223	0.0240	0.0104	0.0198
1-Flowering Plants-168	0.0211	0.0210	0.0236	0.0208	0.0211
1-Flowering Plants-476	0.0211	0.0210	0.0268	0.0208	0.0213
1-Flowering Plants-543	0.0211	0.0219	0.0228	0.0154	0.0199
1-Flowering Plants-137	0.0211	0.0232	0.0388	0.0104	0.0200
1-Flowering Plants-485	0.0211	0.0185	0.0100	0.0311	0.0221
1-Flowering Plants-528	0.0211	0.0185	0.0228	0.0311	0.0229
1-Flowering Plants-520	0.0211	0.0201	0.0292	0.0208	0.0209
1-Flowering Plants-514	0.0211	0.0185	0.0396	0.0311	0.0239
1-Flowering Plants-517	0.0211	0.0185	0.0096	0.0311	0.0221
1-Flowering Plants-529	0.0104	0.0238	0.0212	0.0154	0.0195
1-Flowering Plants-557	0.0211	0.0194	0.0144	0.0208	0.0197
1-Flowering Plants-492	0.0211	0.0194	0.0116	0.0208	0.0196
1-Flowering Plants-186	0.0211	0.0191	0.0084	0.0208	0.0192

1-Flowering Plants-179	0.0211	0.0191	0.0388	0.0208	0.0210
1-Flowering Plants-560	0.0211	0.0188	0.0348	0.0208	0.0206
1-Flowering Plants-530	0.0104	0.0197	0.0332	0.0311	0.0229
1-Flowering Plants-440	0.0211	0.0197	0.0152	0.0154	0.0183
1-Flowering Plants-513	0.0104	0.0223	0.0116	0.0154	0.0181
1-Flowering Plants-127	0.0211	0.0182	0.0196	0.0208	0.0194
1-Flowering Plants-524	0.0211	0.0191	0.0212	0.0154	0.0183
1-Flowering Plants-122	0.0211	0.0166	0.0396	0.0208	0.0198
1-Flowering Plants-508	0.0211	0.0172	0.0040	0.0154	0.0163
1-Lichens-567	0.0211	0.0163	0.0056	0.0154	0.0159
1-Flowering Plants-507	0.0211	0.0147	0.0172	0.0154	0.0158
1-Flowering Plants-519	0.0211	0.0125	0.0208	0.0208	0.0165
1-Flowering Plants-551	0.0211	0.0085	0.0224	0.0311	0.0177
1-Flowering Plants-415	0.0211	0.0031	0.0244	0.0154	0.0103

Based on the evaluation results above, substituted into the Fund Raising Schedule Model for calculation, the results obtained are shown in Table 3. The table gives the priority order of each species and the time when the project of the final schedule starts. It can be seen from the results in the table that the weights calculated by the currently given matrix A fully consider the importance of the cost, and the priority order of each species and the project start time are basically consistent with expectations.

Table 3 Priority Evaluation Based on Ahp Model

species	order	s_i	species	order	s_i
Plants1	2	1	Plants25	30	3
Plants2	3	1	Plants26	18	1
Plants3	1	1	Plants27	11	1
Plants4	9	1	Plants28	27	2
Plants5	8	1	Plants29	4	1
Plants6	10	1	Plants30	19	1
Plants7	6	1	Plants31	37	4
Plants8	5	1	Plants32	34	4
Plants9	15	1	Plants33	36	4
Plants10	20	1	Plants34	39	4
Plants11	16	1	Plants35	25	1
Plants12	13	1	Plants36	28	3
Plants13	17	1	Plants37	12	1
Plants14	21	1	Plants38	40	4
Plants15	14	1	Plants39	42	4
Plants16	22	1	Plants40	38	4
Plants17	35	4	Plants41	41	4
Plants18	7	1	Plants42	33	4
Plants19	29	3	Plants43	45	6
Plants20	26	1	Plants44	46	6
Plants21	32	4	Plants45	47	7
Plants22	24	1	Plants46	44	6
Plants23	23	1	Plants47	43	6
Plants24	31	3	Plants48	48	11

4. Advantages and Disadvantages

In this paper, the strategy of species diversity protection is studied, and the benefit, taxonomic unity, feasibility of success and cost information of species protection projects are comprehensively considered, and the quantitative model of species protection decision is established.

The main points of this paper are as follows: (1) considering different objective, and establishing a comprehensive objective based on value cost maximization. (2) The general characteristics of the selection factors of species protection were analyzed in detail. The given data is used to conduct sufficient data mining, and five indexes are given. (3) Aiming at the consistency between total cost data and target, a data preprocessing method is proposed, which is applied to AHP model to make the model more reasonable. (4) Finally, an effective funding raising optimization model and corresponding calculation method are established to solve the arrangement of species projects.

The disadvantage of this study is that due to the lack of necessary information, only the unique species is given in the given data_ The specific variety is unknown. Therefore, we can not get more information to analyze the urgency of species.

5. Acknowledgment

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