EVALUATION OF HABITAT SUITABILITY OF ZIGZAG MOUNTAIN VIPER (*VIPERA ALBICORNUTA*) IN THE NORTH OF ZANJAN PROVINCE, IRAN

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ABSTRACT

The study of ecological characteristics of wildlife species has an important role in their management. Deciding on appropriate management practices is only possible by determining the ecological requirements of a species. Also, recognizing the distribution of species for conservation and management of populations, particularly for threatened species, is essential. One way to determine the distribution of the species is to evaluate the habitat. The models that predict species ranges can be a useful tool for conservation and management purposes. In this present study, the modeling of *vipera albicornuta* habitat is performed in part of the habitat of this species, using binary logistic regression. The habitat variables are: elevation, aspect, slope, distance to water, rocky cover, distance to roads, stack vegetation, tall grass vegetation, short grass vegetation, the tall herbaceous vegetation, distance to residential areas, the presence points (25 points) and absence points (26 points) of species also considered as dependent variables. The results of statistical analysis showed that rocky coverage is the most determining factors in species habitat, and variables such as elevation, aspect, distance to water, distance to roads, the stack vegetation, tall grass vegetation, tall herbaceous vegetation and distance to residential areas are other variables that affect the presence of species.

Keywords: Evaluation, Regression, Habitat, variables, Zanjan

1. Introduction

Protection theory predicts that the possibility of extinction is very high in species that have small populations and limited dispersion (Manne *et al*., 1999). Human factors also have significant role in the extinction of species (Hawkins *et al*., 2000). Moreover, specific habitat dependencies, and unique biological properties leads to increase extinction probability (Own and Bennet, 2000). On the other hand, the habitat destruction has introduced as the greatest threat to biodiversity. So that, until 1980, about 30% of the extinction of species, have been attributed to the destruction of wildlife habitats (Salman Mahini, 2009). Therefore, we need methods by which we can evaluate habitats and over time, their decreasing quality can be estimated. To identify the affects of human activities and assessing the changes of a habitat, it is necessary to evaluate it, quantitatively. For this purpose, the habitat suitability modeling techniques have increasingly being used, in the habitat evaluation and management, since 1970 (Bartoszewics *et al*., 2008). In this study, the modeling of *vipera albicornuta* habitat is performed in part of the habitat of this species, using binary logistic regression. These species of viper are mountainous and endemic index of Iran. They are among Iran and world's reptiles' genetic resources. Identifying the factors that affects the habitats of these species can be highly helpful in optimal management of limiting habitats in Iran.

2. Materials and Methods

2.1. Selected study region

This selected study region is one of the best and most important habitats of *vipera albicornuta* and this region has been chosen in order to study and examine the habitat of this species. The

district, with an area of 65000 hectares and a minimum height of 453 meters and a maximum altitude of 2700 meters above sea level, is a very mountainous area in North of Zanjan (See Figure1).

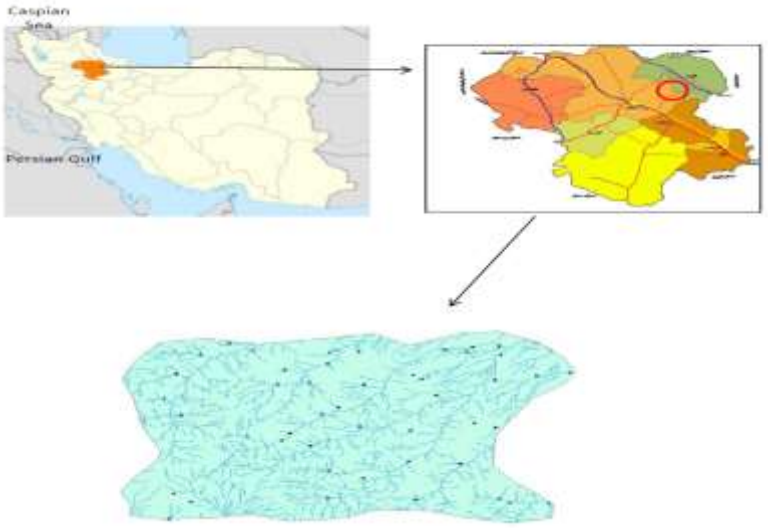

Figure 1

2.2. Sampling method

In summer and in October by random sampling quadrat method, sampling was done. After finding the desired species, the location recorded by GPS and the environmental variables within a square plot of 12 × 12 m (Watling and Donnelly, 2008), with the centralization of the present point, were experimented. Because, there has not been made any studies on the territory and home range of snakes' species in Iran before, we've moved from the present point in a random direction to where there are different types of habitat variables, in order to determine absence points of the species. Then, this place was fully examined, to ensure the absence of any species. If no species found in this location, it was recorded as the absence point.

Some of variables having the most important role in determining species' habitat popularity, based on the information about natural history of species and ecological factors , are selected to make a model from distribution of species in field of the study.

In fact, distribution of species may depend on lots of the free variables; however, biological information about the species should cause the model to be composed of several main variables that have the greatest impact on species' distribution patterns (Simpson and Day, 2004).

This research includes the following selected variables (because of the variable long names, instead, the abbreviations are used in the text, tables and analysis): elevation(Elvev), aspect, slope, distance to water(Dist-riv), rocky cover(stone), distance to roads(Dist-road), stack vegetation(cham), tall grass vegetation(Hhig), short grass vegetation(Hlow), the herbaceous vegetation(Ghig), distance to residential areas(Dist-vill). as well as presence points (25 points) and absence points (26 points) of the species, as dependent variables, were sampled.

2.3. Data Analysis

2.3.1. Logistic regression predicting model

Logistic regression is used to model the relationship between a dependent Binary variable and one or more environmental predictor variables (independent). In other words, a logistic regression can be used to predict the dependent variable based on the predictor variables. Models in the presence or absence of species are the results of biological monitoring. In this way it is reviewed in which sampling position a species is present or not. Model in which both

presence and absence data used in the analysis could predict the probability of species presence at not taken position. Based on the data collected and in accordance with various statistical models are used to this kind of research, the best predictive model for the calculation based on binary data, is a binary logistic regression model that has been applied to the study. This model is generalized linear models (GLM) and comes with the best results. In this way, the distribution potential of the species in the modeling area can be predicted (Alizadeh, 2006).

In equation (1) relation to the model used to predict the species is shown (Binary logistic regression model):

$$Y_i = \beta_{0i} + \beta_{1i}x_{1i} + \beta_{2i}x_{2i} + \ldots + \beta_{ni}x_{ni} \quad (1)$$

In this equation, Y_i is equal to linear predictive value of i, β_{0i} coefficient constant equations, β_{1i} to β_{ni} the regression coefficients and X_{1i} to X_{ni} are values of each variables. Constant and variable coefficients were calculated by importing variables to Minitab software and generally due to error variance constant to calculate these variables weighted least squares method was used.
Equation (2) to calculate the probability of species presence in habitat based on the values of predictive variables is applied:

$$P_{Presence} = \frac{1}{1+\exp(-Yi)} \quad (2)$$

$P_{Presence}$ is probability of presence and Y_i is predicted variable (the dependent variable).

Number obtained from Eq2 can be between 0 and 1. And by closing the number to 1, the likelihood of the species presence in the region increases (Bahadori, 2008).

3. Results

3.1. Effective Variables

In order to conduct this experiment, individual variables were entered into a binary logistic regression equation separately and finally, variables that have p <0.05, indicated influence of them in presence of species and entered in the final model. Effective variables and Ineffective variables are given in table (1).

According to table (1), effective variables between that variables are taken in the presence of the *vipera albicornuta* is including: elevation, slope, distance to water, distance to roads, the stack vegetation, tall grass vegetation, rocky coverage and distance to residential areas.

Table 1: Effective variables and Ineffective variables in presence of species

P-Value	variables
0.00	Elev
0.11	Slope
0.00	Aspect
0.00	Dist-riv
0.00	Dist-road
0.00	Hhig
0.00	Ghig
0.88	Hlow
0.00	Stone
0.00	Cham
0.00	Dist –vill

3.2. The correlation matrix for evaluation of Interactivity between significant variables

Correlation matrix was formed to evaluate of interactivity between significant variables, and between both variables, one of them selected with choice that had correlation higher than 0.08 and was eliminated from the calculations (Bahadori, 2008). In the present study, because none

of the variables were not correlated each other, all the significant variables entered in the final model. Correlations between variables are given in the table (2).

Table 2: Correlations between variables according to Pearson correlation

	Elev	aspect	Dist-riv	stone	Dist-road	Hhig	Ghig	Dist-vill
Aspect	0.605							
Dist-riv	-0.511	-0.385						
Stone	0.622	0.568	-0.435					
Dist-road	0.557	0.446	-0.337	0.617				
Cham	-0.083	-0.068	0.000	-0.378	-0.084			
Hhig	-0.370	-0.248	0.112	-0.554	-0.276	0.170		
Ghig	0.494	0.264	-0.391	0.354	0.336	-0.105	-0.075	
Dist-vill	0.415	0.258	-0.376	0.533	0.515	0.124	-0.178	0.378

3.3. The accuracy of the regression model

After providing habitat utility model, the coordination of data with the model was estimated using the statistical G-test, Pearson test, Deviance test and Hosmer-Lemanshow test. Through the results of (Table 3), it is observed that the P value of the G-test is zero in all the obtained models. The P = 0.00 value of the G-test indicates that including the relevant environmental variables, increases the predictive power of the presence or absence *vipera albicornuta*. However, in all the obtained models, the results of Hosmer-Lemenshow, Deviance and Pearson tests had a P value above 0.05.

Table 3: G-test results in the last five models

The number of the model	Log-Likelihood	G	df	P-Value
1	-0.000	70.681	6	0.000
2	-0.000	71.580	9	0.000
3	-0.000	70.701	7	0.000
4	-0.000	70.681	6	0.000
5	-0.000	71.321	7	0.000

4. Conclusion

In selecting the final model, the model which has the higher number of variables may more efficiently be able to describe the relationship between the independent variables and the dependent variable. On the other hand, the number of significant variables in a model is effective in the strength of the model. Therefore, the model number 2 makes the best relationship between environmental variables and the presence or absence of any of the species.

As a result, the obtained information from this model was used to assess the habitat of *vipera albicornuta*. Therefore, based on the information of second model the degree of stone coverage is the most determinant factor in habitat selection by the species and this could be because of the cool highland region because the species under study is from the viper family and needs warm conditions therefore the rocky areas that become hot by the sunlight can be a good place as the species habitat. The stack vegetation as a shelter for the species has the next level in terms of its role in habitat selection by the species such as *Astragalus sp*, *Acantholimon sp* and other similar plants. The tall herbaceous vegetation (Ghig) and the elevation is among other factors affecting the species presence which has an important role in habitat selection. Distance from the road with a minimal coefficient doesn't have so much impact on the presence or

absence of the species. However, factors such as the aspect, distance to water, tall grass vegetation (Hhig) and distance to residential areas has a negative relationship with the presence of the species so that with a distance from residential areas the probability of the species presence increases and this is the proof to the negative role of human and the development of human activities on this species habitat destruction and extinction.

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