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A SURVEY OF THE HABITAT OF *SUS SCROFA* (WILD BOAR) IN REGION OF KHAN KAMANDAR MOUNTAIN OF LORESTAN PROVINCE BY HEP AND HSI METHODS

Hasan Minaee[1], Behrouz-Behrouzi-Rad[1]
[1]Department of Environment, College of Agriculture and Natural Resources, Islamic Azad University, Ahvaz Branch, Ahvaz, Iran

ABSTRACT
Central Zagros forests as the greatest forest areas in Iran are the habitats of most of valuable species. Region of Khan Kamandar Mountain in the central sector of Zagros is the habitat of big mammals as Sus scrofa. This study applied habitat suitability index (HSI) and HEP method to evaluate the suitability of Sus scrofa habitat in Khan Kamandar mountain of Lorestan. 8 quantitative and five qualitative variables of needs of Sus scrofa and each of them is determined separately in winter and spring. The results showed that habitat suitability of Sus scrofa was different in winter 2013 and spring 2014 and habitat suitability for Sus scrofa was very good for 6 months.

KEYWORDS: Central Zagros, Khan Kamandar Mountain, Sus scrofa, Habitat suitability of Lorestan province, Iran

INTRODUCTION

As the greatest factor of wild life threat is destruction of habitats and according to IUCN estimation, until 1980, 30% of extinctions were only due to the destruction of wild life habitats (Allen, 1982). Habitat is used as one of the most important factors to protect the species namely valuable species and wide ecological impact (Glenz *et al*., 2001). Thus, we need the methods by which we can evaluate habitats and achieve quality loss in these habitats. The investigations on habitats are mostly qualitative. To recognize the effects of human activities and the investigation of the changes of a habitat, it is required to perform evaluation as numerical (quantitative) (Allen *et al*., 1987). HEP method was developed in 1980 in response to the need of documentation of non-financial values of wild life resources and fish and it is a method evolved by a developed evaluation method in MISSOURI by LAMAIRE and DANIELS in 1974 (HANDBOOK USFWS WEBSITE, 2006). In Iran, Salman Mahini (1994) for the first time evaluated the habitat of heder and ewe in protected region of Turan by HSI method. Various evaluations have been performed on different species and habitats. No research has been conducted in Zagros region regarding the suitability of *Sus scrofa* habitats.

MATERIALS AND METHODS

Studied area

Region of Khan Kamandar mountain is located in southwest of Khorramabad city, in the proximity of Khorram-Zal freeway and is composed of high and forest mountains. The area of this region is about 4575 hectare and is in distance 30km of Khorramabad. The region is rough in terms of topography and the lowest zone is about 1250m and highest zone is about 2050m.

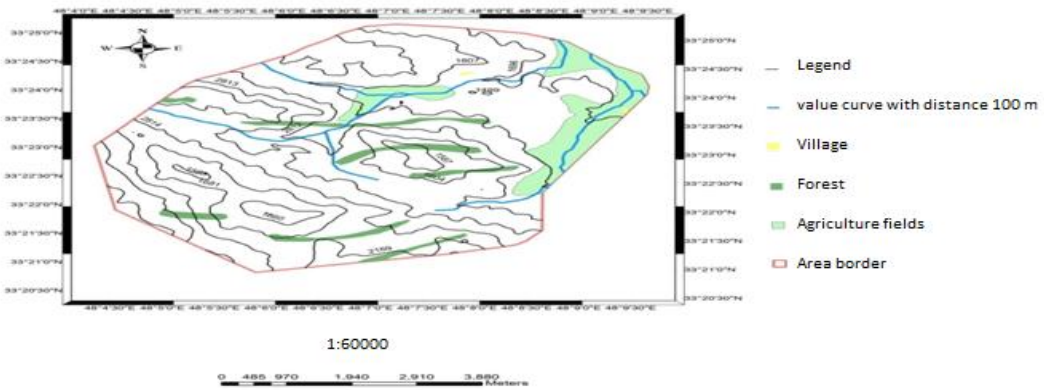

Figure 1: Topography map of region of Khan Kamandar Mountain

The evaluation method of habitat

Two methods are used to evaluate *Sus scrofa* habitat (Jasikoff, 1982) and the first method is ranking the habitat variables of HSI and second method HEP.

First method: The following stages are used in evaluation of the habitat by ranking method:

1- Providing a list of living factors on which species life is dependent. Thus, we can measure these factors or their quantitative amount (if, necessary) is achieved by other resources. Thus, at first, great volume of habitat information is achieved.
2- Living factors with close relationship with living stages of animal are selected and the rest of information is ignored.
3- Ranking of the data is as:

-If the data is quantitative, based on factor condition, rank 5 is given to the best case and rank 1 is given to the worst amount (values 1-5)

-If the information is not quantitative, we can give descriptive value to each of them by very much, much, fair, low and very low and then each factor described by very much rank 1 (worst) and in other conditions, ranks 4, 3, 2, 1 are dedicated.

4- The factors regarding habitat evaluation are divided into two sections, first food needs of *Sus scrofa* and second is including the factors with direct effect on habitat security needs.
5- The matrix of threatening factors and living needs matrix are written in table and a rank is given to each visited section and at the end of table, the sum of values and ranks are written.
6- We can draw a separate table to enter the matrix ranking results and achieve their sum.
7- To evaluate habitat, we can give a habitat suitability index to the habitat based on the achieve value rank (Rogers, 1987).

$$HSI=\frac{\text{Output rank of studied region}}{\text{Highest existing rank}} \quad (1)$$

8-In each last stage as the basis of HEP method, we can determine the number of habitat units for *Sus scrofa* in the region.

(Equation 2) Total area of available habitat of *Sus scrofa* habitat suitability index= the number of habitat unit

Second method and HSI model for *Sus scrofa*

The habitat evaluation in this method is based on HEP method in U,S, fish and wildlife service (USFWS) (ESM 103-USFWS WEBSITE,2006).

Thus, five steps are taken to provide the model:

First step:

Determining the goals, evaluation can include the evaluation of an only species with a stage of life (ESM 103 – USFWS WEBSITE, 2006).

This step includes three continual stages.

First stage:

This stage includes result and acceptable output of model. Thus, HSI model output is ranging 0, 1 with linear relation with win capacity. As HSI output is quantitative, this scale presented by limitation of habitat should be related to species performance in habitat (Aspinal, 1993). It should be said that what species performance index in habitat is. The performance index or *Sus scrofa* indices in mountainous and forest habitat include the remaining, excrement, trace and nest (Bergstrom and skarpe, 1999).

Second stage:

It includes determining geographical limit as HSI belongs to a definite geographical area. Our study area is the entire *of region of Khan Kamandar Mountain* with area of about 4575 hectare.

Third stage:

In third stage of first step, we can determine the season of using model. In other words, we should say that the designed model is used for the entire year or for definite season of the year. The present study for *Sus scrofa* is provided for six months, winter 2013 and spring 2014.

Second step

In this step, we can determine the model variables. The habitat variables are building blocks of a habitat suitable index. In this step, to determine the model variables, we should be familiar with the species habitat features.

These variables should be evaluated as directly with evaluated species habitant needs.

Finally, showing this relation is via drawing tree chart. This step includes six steps as:

First step:
In this stage, we can limit the number of variables, among the various variables measured or achieved by various resources, only those with close relation with species habitat are selected and their relation is defined.
Second step:
It includes determining coverage types. In HEP method, two usefulness are expressed to determine the coverage types as:

a. By determining coverage types, measured variables are grouped in the groups facilitating the collection of field data.
b. Coverage types are used to determine the spatial relations among the components of habitat.

Third stage:
The species are divided in two types in terms of using habitat (Dunham, 1997):

a. Those species fulfilling all their needs inside a coverage type.
b. Those species using some coverage type

Fourth stage:
This step includes the determination of the life needs and life stages and determining the sensitive and critical stages. No specific critical stage is defined for *Sus scrofa*.
Fifth stage:
In this stage, the species habitat needs as limited in the first stage are expressed and their relation is defined with tree chart.
Sixth step
To major concepts in this stage are defined in HEP method and one of them is the concept of overlapping that suitability index should be obtained based on it. This concept defines the proximity of living needs of an animal to vital needs of other animals.
Indeed, higher HSI is obtained when overlapping is high. Another concept in sixth stage is COMPOSITION and is relative value of a region providing habitat need to optimal value.

Table 1: Habitat variables

The chart of habitat variables of HSI of *Sus scrofa*			
Habitat variables	Habitat needs	Total coverage of region	Habitat suitability index
The presence of hunters in region	Shelter and food	Mountainous and forest	HSI
The presence of livestock and nomads			
The presence for entertainment			
The presence of wild animals and hunters			
The occupy and destruction of fields in region			
Distance from agriculture fields			
Distance from residences			
Distance from road			
Distance from water sources			
Vegetation type			
Slope direction			
Slope			
Height			

Third step (organizing model)
Each defined variable in the previous steps should be combined with other model variables to provide a habitat suitability index. In other words, in this step, we can determine the relations of variables and this is possible via the various methods (Allen, 1984):

1- Verbal and description
2- chart
3- Mathematics

Descriptive models are formed by making a sentence about the variables or their various compositions and the quality and consistency of explanatory variables are explained by tree charts.
Fourth step (model documentation)
In HEP method, it is defined to write various stages of making model (Debeljak *et al*., 2001).
Fifth step (model test):
To be sure whether habitat model and its components act as the producer intends or not, the model should be tested by a sample of available data.

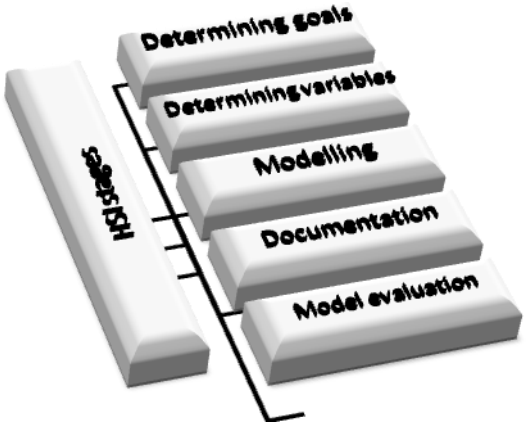

Chart 1: The summary of habitat evaluation stages by HSI method

The last stage in model making
As the calculated HSI is presented for each of factors and variables, there are four methods to express a total HSI:

1- Arithmetic mean
2- Minimum function
3- Functions sum
4- Geometry mean

The raking method is shown in the following Table:

Table 2: The numerical ranking method to descriptive terms in HSI model

Output	Numerical rank	HSI value
Excellent	5	**1=5.5**
Very good	4	**0.8=4.5**
Good	3	**0.6=3.5**
Average	2	**2.5=0.4**
Weak	1	**1.5=0.2**

Table 3: The numerical ranking and scoring of each variable from qualitative value

Qualitative value	Numerical rank	Obtained score
Very much	5	1
Much	4	2
Average	3	3
Low	2	4
Very low	1	5

Results

After investigation of 13 variables in region and observations in each visit and species or species habitat index by GPS and numerical data, the species in various levels of each of quantitative variables is defined. The qualitative variables based on the registered observation sand view of experienced local people in each section are defined and the score of each class of total variables is shown in Table 4. It can be said that 6 months study of 94 areas are registered for the presence of *Sus scrofa* and their frequency in the classes of 8 quantitative variables was significantly different.

Table 4: The score and classes of each of habitat variables of S*us scrofa* in *region of Khan Kamandar Mountain* in winter 2013 and Spring 2014

Variables	Classes of each variable and score (value) of each class				
	5	**4**	**3**	**2**	**1**
The presence of hunters in region	Very low	Low	Average	Much	Very much
The presence of livestock and nomads	Very low	Low	Average	Much	Very much
The presence for entertainment	Very low	Low	Average	Much	Very much
The presence of wild animals and hunters	Very low	Low	Average	Much	Very much
The occupy and destruction of fields in region	Very low	Low	Average	Much	Very much
Distance from agriculture fields (km)	0-500	500-1000	1000-1500	Above 2000	1500-2000
Distance from water sources (km)	500-1000	0-500	1000-1500 m	Above 2000	1500-2000
Distance from residences (km)	Above 4000m	3000-4000	2000-3000	0-1000	1000-2000
Distance from road (km)	Above 2000 m	1500-2000	1000-1500	0-500	500-1000
Vegetation type	Shrub	Tree	Bush	Rock areas (without vegetation)	Grassland
Slope direction	North	West	East	No direction	South
Slope	0-20%	20-40%	40-60%	Above 80%	60-80%
Height	1200-1400	1400-1600	1600-1800m	Above 2000	1800-2000m
Habitat quality	Excellent	Very good	Good	Weak	Average

Habitat suitability number for each of months is calculated after the calculation of final value of habitat in each month separately and then the quality of habitat is determined based on suitability for *Sus scrofa* in habitat (area of Khan Kamandar Mountain) per month and these rankings and qualities are shown in Table 5:

Table 5: Habitat suitability index number, total HSI and HSI of winter 2013 and spring 2014 separately

The mean of habitat suitability index and quality of habitat suitability in each of months						
Season and month / Calculated titles	Winter 2013			Spring 2014		
	January	February	March	April	May	June
The mean of habitat suitability index for each month	0.74	0.72	065	0.54	0.54	0.63
Suitability index of 5 scores	3.7	3.6	3.25	2.7	2.7	3.17
Achieved final value per month	48	47	42	35	35	41
Habitat quality	Very good	Very good	Very good	Good	Good	Very good
Achieve value	45.5			37		
Quality of habitat of each season	Very good			Good		
Total mean of habitat suitability in both seasons	0.635					
Habitat quality rank	Very good					

The suitability index calculated for each of months of two seasons of winter 2013 and Spring 2014 is shown in chart 2 and the maximum habitat suitability is 1 and minimum value is 0. Indeed, this chart is an abstract of total results regarding the habitat suitability of *Sus scrofa* in area of khan Kamandar Mountain.

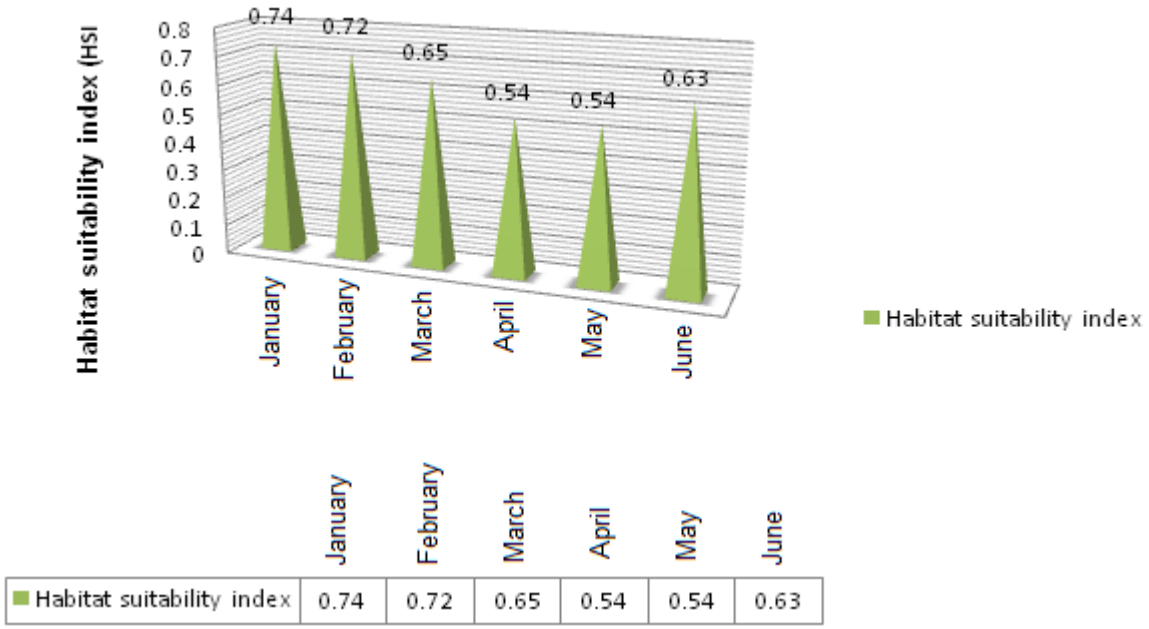

Chart 2: Habitat suitability index (HSI) in the region of *Khan Kamandar Mountain* in each of months of seasons of winter 2013 and spring 2014

As shown in chart 2, HSI in each month is shown. The maximum habitat suitability in January month is 0.74 and lowest suitability in six months is dedicated to April and May and in these two months, habitat suitability index is equal and 0.54. In other months of winter and spring, after January is descending in HSI, February with index 0.72, March with index 0.65 and June with index 0.63 are observed.

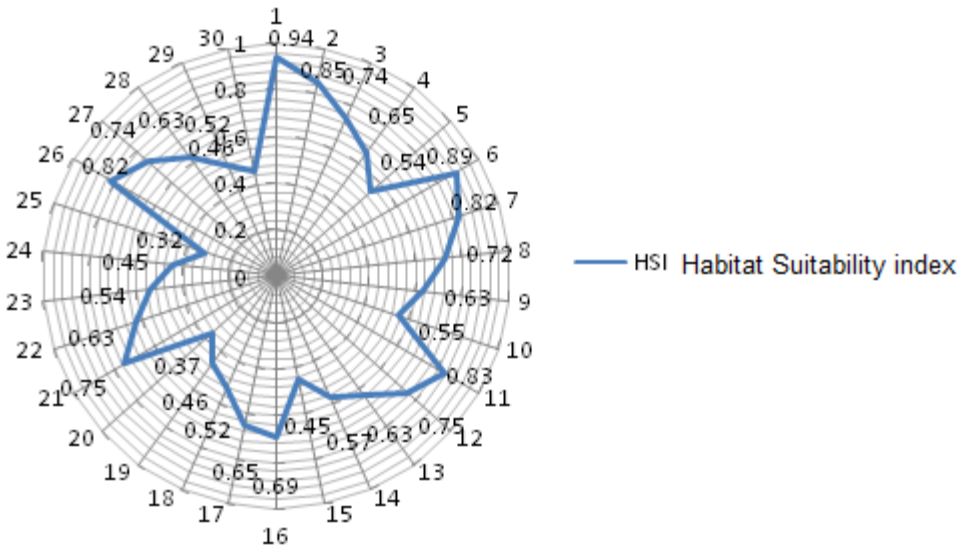

Chart 3: Habitat Suitability Index (HSI) of *Sus scrofa* in total visits

As shown in Chart 3, the fluctuations of HSI in 30 visits in Khan Kamandar Mountain are shown. The highest HSIT is dedicated to January visits and the lowest value is given to May.

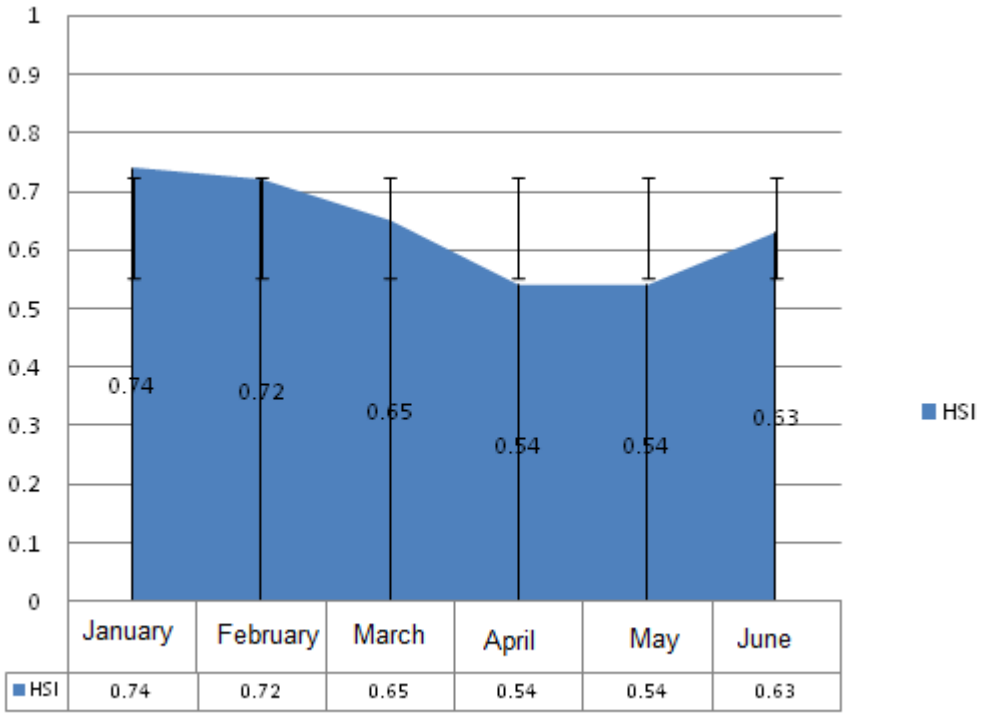

Chart 4: The comparison and habitat suitability index of winter 2013 and spring months 2014 in *region of Khan*

DISCUSSION AND CONCLUSION

By the investigations during six months (winter 2013 and spring 2014) on 13 factors to determine habitat suitability index of Susscrofa and the results in Table 5, we can compare the habitat suitability of Susscrofa in two seasons of

winter and spring. According to the statistics in this six-month study, the habitat in winter had better quality compared to spring and habitant suitability index (HSI) is high and this result indicates the valuation and statistics in visits of each season. The habitant suitability index (HIS) of scrofaSus is 0.70 in winter 2013 and 0.57 in spring 2014. The habitat quality in winter is very good and spring as good. HSI of scrofaSus in total six months is 0.64 and habitat quality is estimated very well. As it was said, in this study, habitat has very good quality but we should say this habitat quality for total six months is based on quality and habitat suitability index of scrofaSus in winter. As shown in chart 2, 4, HSI and scrofaSus quality in winter was much more and better than spring.

***Kamandar mountain* of Lorestan**

One of the reasons of descending trend of reduction of habitat suitability after January and February is warming, increase of good taste plants and increase of temporary views in region and the increase of animal farmers and seasonal and temporary users in the region. Therefore in April and May, the highest presence of birds hunters, scrofaSus hunters, wild animals, nomads and livestock, recreation users, farmers and the highest destruction are registered and this reduced the habitat suitability of scrofaSus in the region based on the highest living needs of scrofaSus in winter (mating and reproduction) and spring (pregnancy and breastfeeding). The above mentioned items had accumulative effect as all of them are relevant continually and the security and feed of studied species are affected. Indeed, the main factor of the difference between HSI in winter 2013 and spring 2014 is reduction of habitat security in spring 2014 compared to Winter 2013 and this reduces food security. Thus, it is proposed to perform more investigations regarding protection area of the region and the habitat suitability of other species in region can be investigated.

REFERENCE

Allen A. W. (1982). Habitat suitability index models: marten. *FWS/OBS (USA).*

Allen A. W. (1984). Habitat Suitability Index Models: Gray Partridge (No. FWS-82 (10.73)). Fish And Wildlife Service Fort Collins Co Western Energy and Land Use Team.

Allen A. W., Jordan P. A. and Terrell J. W. (1987). Habitat suitability index models: moose, Lake Superior region. *U.S. Fish Wild. Serv. Biol. Report*. 82:(10.155). 47. pp.

Armbruster M J. (1987). Habitat suitability Index Model: Greater sand hill. U, S, fish and wildlife service.

Aspinal R. (1993). Habitat mapping from satellite imagery wildlife survey using a Bayesian modeling procedure in a GIS.

Bergstrom R. and skarpe C. (1999). The abundance of large wild herbivores in a semi-arid savanna in relation to season, and livestock. *Afr. J. Ecol.* 37: 12-26.

Debeljak M., Džeroski S., Jerina K., Kobler A. and Adamič, M. (2001). Habitat suitability modelling for red deer (Cervus elaphus L.) in South-central Slovenia with classification trees. *Ecological Modelling*, *138*(1), 321-330.

Dunham K. M. (1997). Population growth of mountain gazelles Gazella gazelle reintroduced to central Arabia. *Biol. Conservation.* 81(3): 205-214.

Glenz C., Massolo, A., Kuonen, D., & Schlaepfer, R. (2001). A wolf habitat suitability prediction study in Valais (Switzerland). *LandscapeUrban Planning.*, *55*(1), 55-65.

http://www.U.S.fish and wildlife Service.org, (ESM-103). [website].

Jasikoff T. M. (1982). *Habitat suitability index models: ferruginous hawk* (No. FWS/OBS-82/10.10). Fish Wildlife Service Fort Collins Co Western Energy And Land Use Team

Rogers L. L. (1987). Effects of food supply and kinship on social behavior, movements, and population growth of black bears in northeastern Minnesota. *Wildlife Monographs.* 3-72.

