

**ASSESSING THE CURRENT STATUS OF THE CAVE SCORPION
Euscorpiops cavernicola Lourenço & Pham, 2013 (Scorpiones: Euscorpiidae)
IN NORTHERN VIETNAM**

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ABSTRACT: Status survey of the cave scorpion, *Euscorpiops cavernicola*, was carried in a cave system of Bac Kan province. A total of 56 (9 adults) and 45 (7 adults) individuals were recorded during the years 2014 and 2015, respectively. This species is only known from Hua Ma cave, which is strongly threatened by tourism development. Based on the current area of occupancy (AOO) and extent of occurrence (EOO) of *E.cavernicola*, associated with its recent decline in both AOO and number of individuals, this species can be classified as Critically Endangered by IUCN.

Keywords: Cave scorpion, conservation status, IUCN criteria, red list, Northern Vietnam.

INTRODUCTION

The most critical threat to scorpion species is destruction of their natural habitat. Habitat loss and habitat destruction strongly influence on scorpion distribution patterns since many species have quite specific habitat requirements and well defined natural ranges. Many natural areas, previously suitable for scorpions, have now been destroyed. Many specific habitats within these natural regions are rapidly destroyed due to logging, agriculture, developmental construction, and development of tourism. Natural habitats of all kinds are destroyed at an alarming rate. Many scorpion species are literally losing their ‘homes’ and they could be rapidly vanished.

Caves contain unique habitats populated by specialized, endemic scorpions. Howarth (1983) [2] shows that invertebrates including cave scorpions are very typical in morphology and show high endemic levels. The separation of cave ecosystems from external environments, with differences in light regime and moisture, can lead to cave species speciation adapted to cave environments. Nowadays, caves are exploited for tourism development, consequently many cave scorpion species are threatened by human impact. These will be come extinct unless conservation actions are implemented. The development of tourism has not only destroyed the natural structure of caves, but also affected the fauna living in the caves.

Euscorpiops cavernicola, belongs to the family Euscorpiidae, was described on the basis of two male and two female specimens collected in the Hua Ma cave located in the Quang Khe commune, Ba Be district of Bac Kan province in Viet Nam [3]. In fact, the habitat of this scorpion species is probably getting narrowed due to human impact as long as its conservation status remains unassessed.

The aim of this contribution is to bring assessment on the status of this species based on IUCN criteria and on the available data obtained on the species in order to make recommendations to the local and national authorities for consideration.

MATERIALS AND METHODS

Besides Hua Ma cave, our survey was also conducted in the cave system of Bac Kan province. The Hua Ma cave is located in Quang Khe commune, Ba Be district, Bac Kan province. It has been naturally shaped during a “several-million-year” process in geological changes. It is 700 m in length with some impressive dorms reaching up to 50 m in height. Inside the cave, there are thousands of stalagmites and stalactites.

This survey is composed of two major components: a demography study and the habitat condition. The demographical study targeted a specific population. Demographics

are the quantifiable statistics of a given population to characterize such a population at a specific point in time. Demographics can be viewed as an essential information source about the population of a region. Demographic data include population size (number of individuals) and age structure (adults, juveniles). An ultraviolet light was used to scan every site within a 5 meter distance in the cave for 1 hour. The cuticle of scorpions fluoresce to a bright green under UV light making individuals easy to detect in a relatively non-invasive way. Scorpions were collected using forceps, then photographed, marked with an individual dot number using non-toxic paint and returned to the capture place.

The second component of the survey is habitat condition throughout all the sites in the cave. The survey results lead to an assessment of the habitats: disturbed or undisturbed habitats, invasion by exotic species, light regime, rubbish, noise, and so on. All these results should lead to an estimation of the population reduction of the target species.

In addition, other surveys were carried out in other caves in the area to ascertain the total surface of occupancy. The survey was conducted in two periods with duration of 15 days each. To assess the conservation status of each species, IUCN criteria will be used together with data obtained during the survey period to produce recommendations to the local and national authorities.

Survey was carried out during August of two consecutive years, 2014 and 2015.

RESULTS AND DISCUSSION

Table 1. Abundance data for *Euscorpions cavernicola* recorded in 2014 and 2015

	Individuals recorded	
	In 2014	In 2015
Adults	9	7
Juveniles	47	38
Total number of individuals	56	45

From the total of 56 individuals recorded in 2014 with 9 were adults and 47 juveniles. Some of the adults and juveniles recorded in 2014 were not found again during the 2015 survey (table 1).

This species is known from only Hua Ma cave which is strongly disturbed by tourism development. The inside environment of each cave is polluted by visitors activities, such as eating, drinking and smoking. This is resulting in large amount of rubbish throughout the caves' space. The rubbish range from plastic drink bottles, fruit juice cartons, beer and soft-drink cans, footwear, clothing, fruit peel, eggshells, peanut shells. These artificial food sources have the potential to attract pest species into the caves, artificially altering community structures and greatly impacting on the natural species diversity in the cave systems. The presence of lighting system within the caves also affects the faunal diversity. The current lighting system in cave is not conducive to creating a suitable habitat for cave fauna. The constant light is a detrimental effect on the invertebrate populations in the caves. It also creates a fantasy world that is a potential source of the excitement (exhibited as noise) felt by visitors in the cave. This noise will be of great disturbance to the invertebrate populations within the cave systems. Due to the undefined nature of the pathways in cave, the floor of each cave has been badly trampled with any suitable habitat and destroyed.

The five criteria used by IUCN assessments are: (a) reduction in population size; (b) small geographic range; (c) small population size and decline; (d) very small or restricted population; and (e) quantitative analysis of extinction risk (International Union for Conservation of Nature 2001). An overview of the IUCN criteria and its applicability to *Euscorpions cavernicola* can be seen in table 2. Criteria (b), (c) and (d) are applicable while (a) and (e) are data deficient due to lack of additional observations. Criteria (d) meet the category of Endangered but criteria (b) and (c) is at the highest level of threat, thus receiving priority over the former.

Table 2. Overview of the IUCN Red List criteria, and its applicability in the present study. (AOO-Area of Occupancy; EOO-Extent of Occurrence; n-mature individuals) (Based on Cardoso et al., 2011)

Criterion	Critically endangered	Endangered	Vulnerable	Applicability	Justification/decision
A. Population reduction (over 10 years or three generations)	($\geq 90\%$ AND causes are reversible, understood and ceased) OR $\geq 80\%$	($\geq 70\%$ AND causes are reversible, understood and ceased) OR $\geq 50\%$	($\geq 50\%$ AND causes are reversible, understood and ceased) OR $\geq 30\%$	No	Insufficient data
B. Geographic range	(EOO <100 km ² OR AOO <10 km ²) AND two of: (a) fragmentation and/or a single location; (b) continuing decline; (c) extreme fluctuations	(EOO <5000 km ² OR AOO <500 km ²) AND two of: (a) fragmentation and/or locations ≤ 5 ; (b) continuing decline; (c) extreme fluctuations	(EOO <100 km ² OR AOO <10 km ²) AND two of: (a) fragmentation and/or locations ≤ 10 ; (b) continuing decline; (c) extreme fluctuations	Yes	Critically endangered
C. Small population size and decline	n < 250 AND (reduction $\geq 25\%$ over 3 years or one generation OR (reduction AND (larger subpopulation ≤ 50 OR $\geq 90\%$ individuals in a single subpopulation OR extreme fluctuations)))	n < 2500 AND (reduction $\geq 20\%$ over 5 years or two generations OR (reduction AND (larger subpopulation ≤ 250 OR $\geq 95\%$ individuals in a single subpopulation OR extreme fluctuations)))	n < 10,000 AND (reduction $\geq 10\%$ over 10 years or three generations OR (reduction AND (larger subpopulation ≤ 1000 OR 100% individuals in a single subpopulation OR extreme fluctuations)))	Yes	Critically Endangered
D. Very small or restricted population	n < 50	n < 250	n < 1000 OR AOO <20 km ² OR locations	Yes	Endangered
E. Quantitative analysis of extinction risk	$\geq 50\%$ over 10 years or three generations	$\geq 20\%$ over 20 years or five generations	$\geq 10\%$ over 100 years	No	Insufficient data

The criteria and their applicability to *Euscorplops cavernicola* can be overviewed in table 2. Some comments on each one of them are as follows:

a) To use criterion (a) a good estimate of the relative temporal change in species abundance is needed. However, it is usually difficult to determine the total abundance of a particular species of invertebrate. In the present study, population size was inferred using a methodology that involved high sampling effort over the entire area. However, as no similar sampling of the species was made before this study, comparable data is not available and this criterion should not be applicable to the risk assessment of *Euscorpiops cavernicola*;

b) Criterion (b) can be analyzed in both terms of the Extent of Occurrence (EOO) and Area of Occupancy (AOO). Because this species is known from only one cave, its known range is about 0.035 square kilometers, so EOO and AOO fit the category for Critically Endangered (EOO <100 km², AOO <10 km²). The cave as an isolated habitat from others and species is known from only one cave provided the evidence about fragmentation and single location. Adding to the fact that the habitat is threatened by uncontrolled and increasing tourism practices, so the quality of this habitat are Continuing decline (requirement B2(b)(iii)), the category of Critically Endangered is the one best suited for criterion (b);

c) Criterion (c) fits the category of Critically Endangered due to the abundance only recorded 56 individuals with 9 adults for 2014 and 45 individuals with 7 adults for 2015, and a comparison between 2014 and 2015 to estimate an abundance reduction $\geq 25\%$ over 3 years;

d) The abundance estimation mentioned for criterion (c) is above the threshold value for the category of Endangered in criterion (d) with $n < 250$;

e) Criterion (e) demands a large amount of data, which are not available so far.

From the applicable criteria, (b) and (c) takes priority over (d) since it is the one with the highest extinction threat level (the former fitting the category for Endangered), the authors have classified *Euscorpiops cavernicola* as Critically Endangered. Based on the present data, this classification was recently integrated in the IUCN database.

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**ĐÁNH GIÁ TÌNH TRẠNG HIỆN TẠI CỦA LOÀI BỌ CẠP HANG ĐỘNG
Euscorpiops cavernicola Lourenço & Pham, 2013 (Scorpiones: Euscorpiidae)
Ở MIỀN BẮC VIỆT NAM**

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TÓM TẮT

Loài bọ cạp *Euscorpiops cavernicola* được phát hiện trong động Hua Mạ, huyện Ba Bể, tỉnh Bắc Cạn. Khảo sát tình trạng hiện tại của loài bọ cạp này được tiến hành trong năm 2014 và 2015 tại tất cả các hang động khu vực tỉnh Bắc Cạn. Tổng số 56 cá thể bao gồm 9 cá thể trưởng thành ghi nhận được trong năm 2014 và 45 cá thể bao gồm 7 cá thể trưởng thành ghi nhận được trong năm 2015. Loài bọ cạp *E. cavernicola* chỉ phân bố ở động Hua Mạ. Động Hua Mạ đã và đang khai thác phát triển các hoạt động du lịch. Nơi sống của bọ cạp bị tác động mạnh và đang bị thu hẹp bởi các hoạt động của con người. Dựa vào kết quả khảo sát, theo các tiêu chí của IUCN, loài bọ cạp hang động *E. cavernicola* có thể được đề xuất ở tình trạng cực kỳ nguy cấp (CE) cần đưa vào Sách Đỏ của Việt Nam và IUCN.

Từ khóa: Bọ cạp hang động, Sách Đỏ Việt Nam, tiêu chí IUCN, tình trạng bảo tồn, miền Bắc Việt Nam.

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