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# archaeological and biospeleological potential of Vaghurme natural cave ecosystem

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**Abstract-**The small state of Goa is world famous for natural caves and man-made excavations with research on lot of emphasis on study of architecture and archaeological aspects of these caves. However no attention has been paid to geoarchaeological, ecological and microbiological dimensions of these caves. This work forms part of a long term project to study microbiology of cave ecosystems in Goa. We identified 'Vyaghra Gumfa' or a 'Cave Of Tigers' at Vaghurme in Ponda taluka for focused studies. It is located on slope of a lateritic hillock at confluence of river Mhadei with river Khandepar. Geoarchaeology deals with the study of geological aspects of the study of caves. Biospeleology deals with biological studies of caves. We have used both these approaches in this work for studying Vaghurme natural cave ecosystem (VNCE). Geoarchaeologically the cave was identified as pre-historic human and animal shelter with geoglyphs. Biospeleologically the Vaghurme cave offers very interesting microhabitats as due to the huge colony of frugivorous cave bats and an underground stream. Samples of soil from the cave indicated interesting features. The relatively pristine VNCE holds excellent potential for isolation of useful microorganisms adapted to the special environment.

## Introduction

This cave is the ancient cave over 50,000 years old. The cave is located in the Dharbandora Taluka in the state of Goa (15Ú27´42.86½N,74Ú01´43.01½E) (**Fig 1**and **2**). The main objective was to study the architecture of the cave and the microorganisms present in the cave. The animal life which is present in the cave are fugivorous bats and many species of plants such as *Anacardium occidentale, Carrissa carandas* are seen surrounding the cave. The cave is made up of a laterite stone. The roof and walls of the cave are covered with biofilm such as the stalactites and algal growth is also seen on the walls and floor. Samples for mycological studies were collected. The study of cave microbiology deals with the microscopic life that resides in cave. Without photosynthesis, caves are cut off from most energy that supports life on the surface. As a result, cave microorganisms must look for alternative sources of energy for their survival, such as those found in the atmosphere, or present in the rock. Cave habitats are characterized by almost constant temperature and relative humidity all year round. A typical cave can be divided into three primary zones i.e entrance, transition and deep cave zone (Tobin et al 2013). Light intensity is the major factor which determines whether microbial communities of cave stone substratum will be autotrophic or heterotrophic (Albe 2012). The aim of this study was to examine the geoarchaeological and biospeleol potential of Vaghurme natural cave ecosystem





## Materials and Methods

Vaghurme cave details were found from maps and Google Earth before and after field and confirmed. Surveys were carried out in second half of 2015. Photographs of exteric interior of the cave were taken. Soil sample of roof, floor, wall material inside the cave collected in polyethylene bags. These were transported to laboratory and processed v 48-72 hours. Standard microbiological media was used for isolation of cultures.

## Results and Discussion

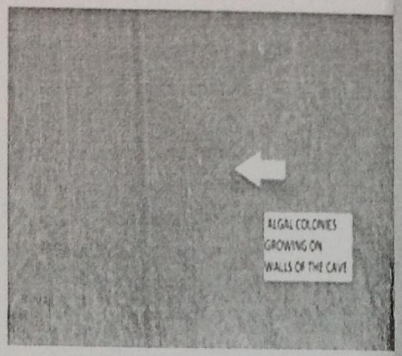
As shown in **Fig 2** the cave is located under hard lateritic rock of iron ore belt of Goa. indicates the low entrance of the cave and the wild vegetation. **Fig 4** depicts va geoarchaeologically and biospeleologically useful areas inside the cave. Algal biofilı cave walls are shown in **Fig 5**. The cave supports the huge colony of frugivores bats. shows their habitat on roof and excreta deposition on floor. The ammonia rich excı important in studying cave microflora.The roof of the cave as shown in **Fig 7** ind leaching of calcium salts and encrustations. The colonies of yeasts and fungi obtained cave samples are depicted in **Fig 8** and **9**.The ascomycetous unidentified yeast cel shown in f **Fig 10** and **11** indicates the mycelial morphology of a typical fungal cultur prehistoric cave at Vaghurme was found to be as ideal microhabitat for systematic sam and microbiological analysis considering the geoarchaeological importance of the V with a large bats colony and signs of ancient human habitation. Large deposition of ca salts on the roof,walls and algal mats sites becomes very interesting for micı bioprospecing. The initial results from our microbiological analysis are very encour shedding light on diversity of bacteria and fungi. Studies in progress are focused on id cation of useful microbial cultures for further advanced research.

## References

Harries DB (2008), A Review of the biospeleology of Meghalaya, India.Journal of Cave and Studies, v. 70, no. 3, p. 163–176.

Robbins LH (1996), Paleoenvironment and Archaeology of Drotsky's Cave:Western Kalahari I Botswana, Journal of Archaeological Science **23,** 7–22.

Google Earth image of Goa showing l ocation of the Vaghurme Cave

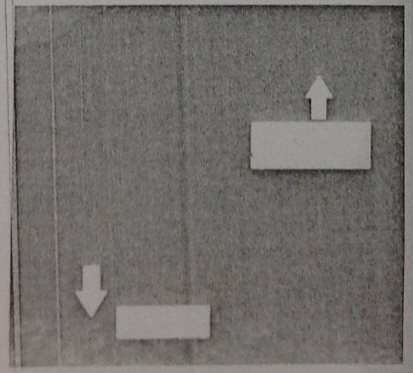



Algal growth on wall of cave

Google Earth image of the cave

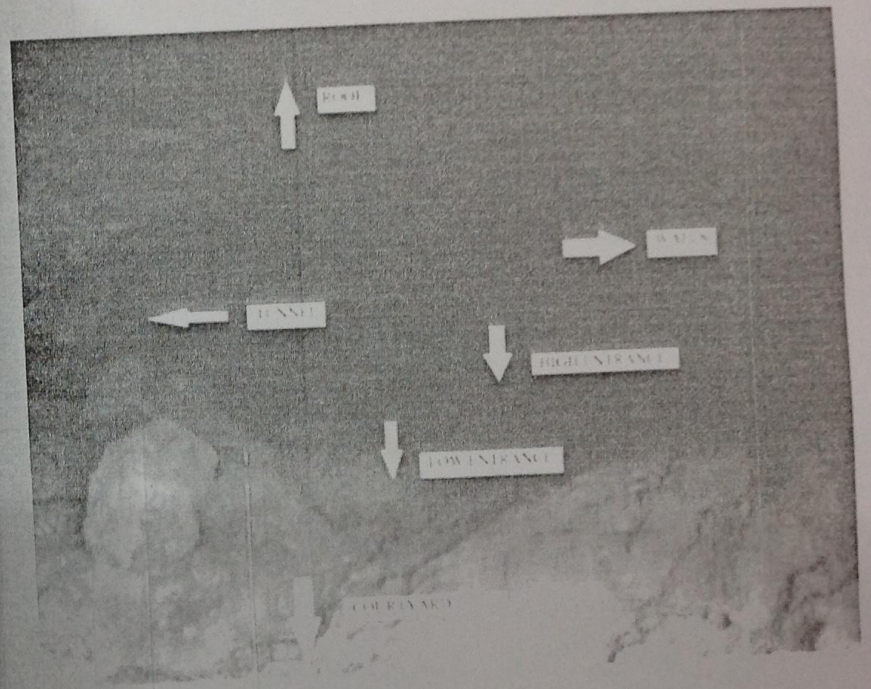
Calcium carbonate deposit on the wall of a cave

Exterior view of the Vaghurme Cave



Bats habitate inside the cave





Zones inside the cave

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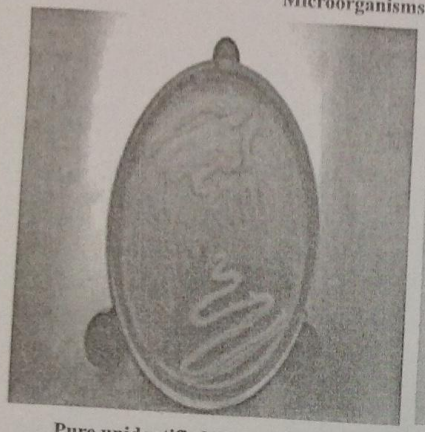
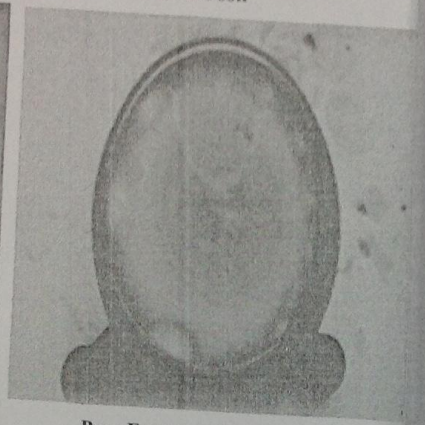
**Microorganisms isolated from the cave soil**

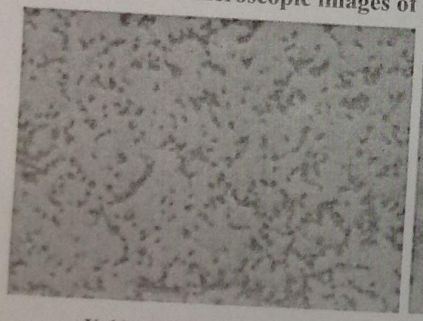


Pure unidentified Yeasts cultures

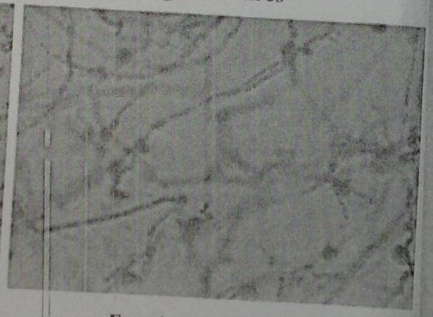


Pure Fusarium fungus cultures

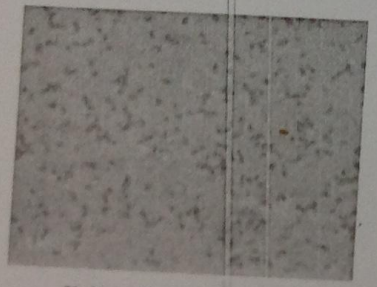
**Microscopic images of yeast and fungus cultures**



Unidentified yeast culture



Fusarium fungus culture



Unidentified yeast culture