Egypt 2018

1. Contestant profile

▪ Contestant name:	**Kareem Mohamed Elsaid Soliman**
▪ Contestant occupation:	Lecturer, Faculty of science, Ain Shams University
▪ University / Organization	University
▪ Number of people in your team:	**4**

2. Project overview

Title:	**Impact of quarrying activities on biodiversity of Tourah Portland quarry habitats, Egypt.**
Contest: (Research/Community)	**Research**
Quarry name:	**Tourah**

Impact of quarrying activities on biodiversity of Tourah Portland quarry habitats, Egypt.

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Abstract

This study aimed to increase the scientific knowledge about biodiversity in Tourah Portland quarry and to improve management actions at quarry level to ensure sustainable wildlife conservation. Nine biodiversity monitoring field surveys were conducted during winter, spring and summer 2018 to investigate the fauna and flora biodiversity, in two localities (A & B) of Tourah Portland quarry habitat, Egypt. Moreover, some physicochemical parameters for water and soil samples were analyzed to know how far this site is suitable for wildlife. Besides field surveys, the study integrated eight historical satellite images from 2011 to 2018 of the study area with GIS to attain habitat information (as, land use/land cover changes, water bodies' formation as well as vegetation) for the years prior to the start of the monitoring programme. Results of the present study showed that pH water values varied between 6.3 and 7.6 indicating good water quality. TDS in water exceeded 10,000 mg/l in both localities indicating a saline habitat. Regarding fauna, sixteen animal species were observed as follows; one reptilian species, twelve avian species belonging to seven orders and three mammalian species. From Tourah satellite images, we noticed the increase in occurrence and clustering of floral biodiversity year by year. Moreover, size of water bodies increased in 2014, especially in locality (A), offering a suitable life for wildlife. The study concluded that the high level of biodiversity in the two localities of Tourah Portland quarry reveals that there is great opportunity to protect and enhance the environment with the right planning and management that help to achieve the equilibrium between conservation of ecosystems and the interests of the company or the project planning.

Introduction

In the past few decades, interest in the environment has reached a peak as popular opinion has become aware of the extent of the human impact on natural systems. Biodiversity essentially refers to the range of living species, including fish, insects, invertebrates, reptiles, birds, mammals, plants, fungi and even microorganisms. Biodiversity conservation is important as all species are interlinked, even if this is not immediately visible or even known, and our survival depends on this fine balance that exists within nature.

One of the biggest negative impacts of quarrying upon the environment is the damage to biodiversity (**Anand, 2006**). While quarrying can cause significant negative impacts on geo- and biodiversity during the extractive operations, abandoned quarries can enhance biodiversity afterwards by acting as refuges for many plant and animal communities, including a range of rare and/or endangered species of high conservation value. Thus, with the right planning and management, many of the negative impacts can be minimized or controlled and in many cases, there is great opportunity to protect and enhance the environment, such as with the translocation of existing habitats or the creation of new ones. Therefore, to achieve the equilibrium between natural ecosystems, project planning, formulation and implementation are needed. Combination of exposed rock walls and bare surfaces, nutrient-poor soils, water bodies and associated wetlands are some of the abiotic factors that contribute to the wildlife potential of abandoned hard rock quarries.

The advent of mining works have resulted in the interruption of the water table and the construction of aquatic channels and water drains that led to the formation of water ponds that can extend in sizes in time of rain, causing the complete submersion of entire areas. In some ponds, you find a constant presence of water throughout the year, supplying a minimum water level that allows the survival of many plant species. The development of this vegetation has created new ecological niches that wildlife species can colonize easily. In these ponds, where the water is present all year round, several colonies of birds have established a permanent home.

In this study a biodiversity survey was conducted to investigate the present vegetation species and vertebrates (mammals, reptiles and birds), at the Tourah Portland Quarry habitats to fulfill the objective of integrating aspects of conservation into quarry operations in an attempt to mitigate adverse impacts on species inhabiting the quarry site.

Study area

The study area, viz. Tourah (**Figure 1**) (was known to the ancient Egyptians as *Troyu* or *Royu*), is located about halfway between modern Cairo and Helwan, Egypt. It is uniquely referenced on latitude 29°54'36.90" – 29°55'6.66" N and longitude 31°17'53.76" – 31°18'41.58" E. Tourah is the largest clay quarry in Egypt and the oldest clay quarry for cement plant in Africa. The depth of the quarry is 70 m and 40 m below the sea level. Currently, the quarry is surrounded by many civil military and cultivated areas. An important highway and railway run adjacent to the west and east sides of the quarry. The active area among the quarry represents 10% of its original area. Quarry habitats are often hard to access, and they have usually unusual and unfamiliar species, therefore biodiversity in clay areas is often harder to detect and study than in some other areas.

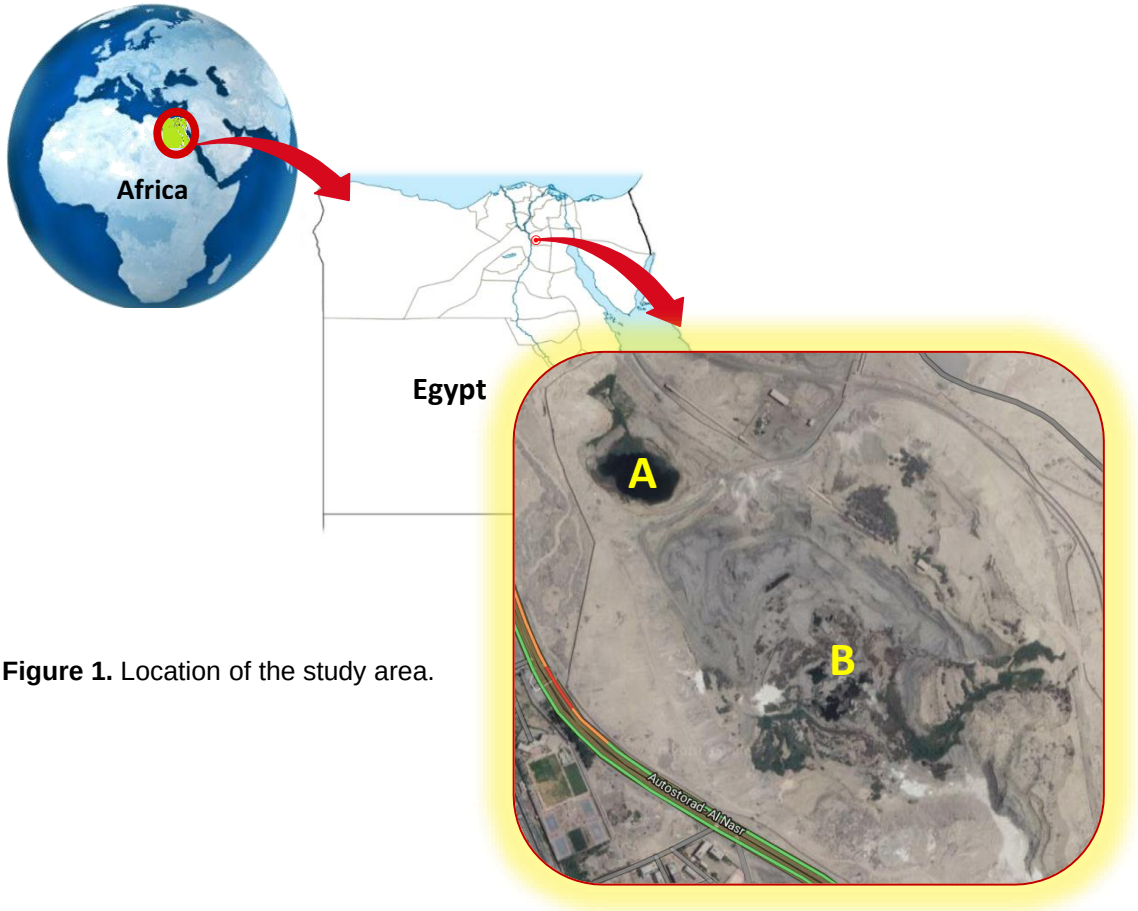

Figure 1. Location of the study area.

Materials and Methods

The current report integrated high-resolution satellite data, ArcGIS software and data collected from field surveys.

1. Satellite data

Eight high-resolution satellite data (2.5 m) of study area covering the period from 2011 to 2018 were obtained from Google Earth as historical records to understand when and how the examined features have changed (**Figure 2**). Near anniversary acquisition dates were used to eliminate the effects of seasonal differences.

Figure 2. Eight superimposed historic satellite images along the study area.

2. Field surveys

Through nine field trips, two different localities (**A** and **B**) in Tourah Limestone Quarry (**Figure 3**) were investigated during three seasons; winter, spring and summer 2018; to find out the size and extent of organisms (fauna and flora) inhabiting the localities and the quality of their habitat.

Thirty sampling sites covering the entire study area were selected to collect vertebrate animals with live traps during February, April, May, July and August 2018 in Tourah Limestone Quarry (**Figure 4**). Trapped animals were identified, classified and then set free. Moreover, sight and animal tracks were recorded. Animals especially birds were photographed whenever possible.

Physicochemical parameters of water and soil samples were examined in Desert Research Center, Egypt during the study period.

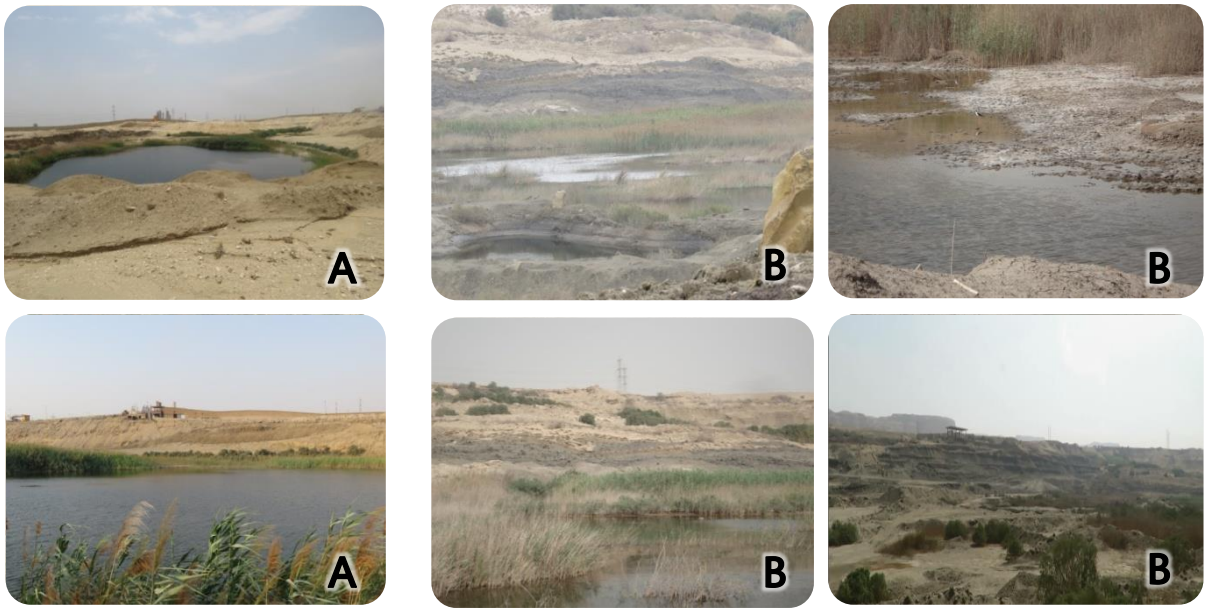

Figure 3. Photographs of the two different localities (**A** and **B**) investigated in Tourah Limestone Quarry during the study period 2018.

Figure 4. Biodiversity monitoring field surveys.

Results

1. Habitat quality:

In the present study, measurements of some water and soil physicochemical parameters involving, pH, Total Dissolved Solids, conductivity, Ca, Mg, Na, K, CO_3, HCO_3, SO_4 and Cl recorded in two localities (A and B) during 2018 in Tourah are shown in **Table (1)**. pH values of water and soil in Locality A and soil in locality B are alkaline with slight variations. TDS values of water in both localities exceeded 10,000 mg/l.

Table 1. Water and soil physicochemical parameters measured in the two localities (A and B) in Tourah during the study period 2018.

	Locality A		Locality B	
	Water	Soil	Water	Soil
pH	7.6	7.6	6.3	8.3
Total dissolved solids (TDS),mg/l	12648	31004	70179	7056
Electrical Conductivity	18060	48.2	104900	12.14
Calcium (mg/l)	1350	134.73	9220	42.61
Magnesium (mg/l)	675	127.47	3550	35.76
Sodium (mg/l)	2100	286.9	12500	47.82
Potassium (mg/l)	160	4.08	200	1.17
Carbonate (mg/l)	12	ND	ND	ND
Bicarbonate (mg/l)	97.6	0.9	366	2
Sulphate (mg/l)	3338	28.08	2823	22.56
Chloride (mg/l)	4964	525	41702	98

2. Fauna:

During this field study, sixteen animal species were observed as follows; one **reptilian** species (**Figure 5**), twelve **avian** species belonging to seven orders (**Figures 6, 7, 8 & 9**) and three **mammalian** species (**Figure 10**) (**Table 2**). **Figure (11)** shows observed tracks of mammalian species.

Figure 5. Reptilian species ***(Trachyiepis quinquetaeniata)*** observed during Tourah field survey.

Table 2. Taxonomic list of Vertebrate Fauna observed during the field surveys. (R): Resident; (M): Migratory.

Class	Order	Species	Common Name	Location	Remark
Reptilia	Squamata	*Trachyiepis quinquetaeniata*	African Five-lined Mabuya	A	Sight Record
Aves	Charadriiformes	a. *Himantopus himantopus*	Black-winged stilt (R)	B	
		b. *Vanellus spinosus*	Spur-winged lapwing (R)	A + B	
	Passeriformes	a. *Passer domesticus*	House sparrow (R)	A + B	
		b. *Oenanthe lugens*	Mourning wheatear (R)	A + B	
		c. *Corvus rhipidurus*	Fan-tailed raven (R)	B	
		d. *Motacilla alba*	White wagtail (R)	A + B	
	Anseriformes	*Anas platyrhynchos*	Mallard (R)	A + B	
	Podicipediformes	*Tachybaptus ruficollis*	Little grebe (M)	A + B	
	Gruiformes	a. *Fulica atra*	Eurasian coot (R)	A	
		b. *Gallinula chloropus*	Common moorhen (M)	A	
	Columbiformes	*Spilopelia senegalensis*	Laughing dove (R)	A + B	
	Coraciiformes	*Merops persicus*	Blue-cheeked bee-eater (M)	A	
Mammalia	Carnivora	*Canis lupus*	Domestic Dog	A + B	Sight
			Fox	B	Tracks
	Rodentia	*Rattus rattus*	Brown rat	B	Collected + Tracks

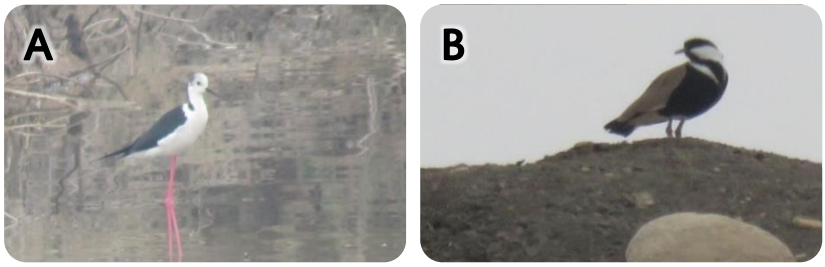

Figure 6. Two species of charadriiformes observed during Tourah field survey.
[A] *Himantopus himantopus*, [B] *Vanellus spinosus*

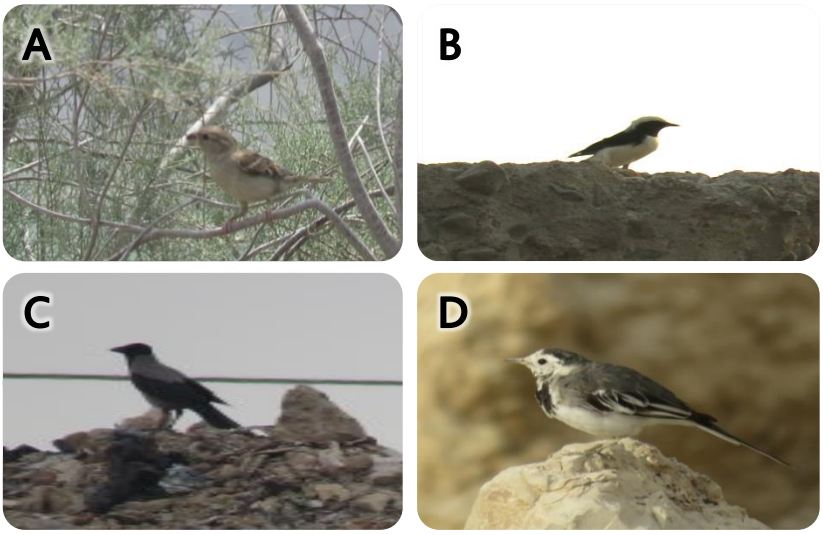

Figure 7. Four species of passeriformes observed during Tourah field survey.
[A] *Passer domesticus* [B] *Oenanthe lugens*
[C] *Corvus rhipidurus* [D] *Motacilla alba*.

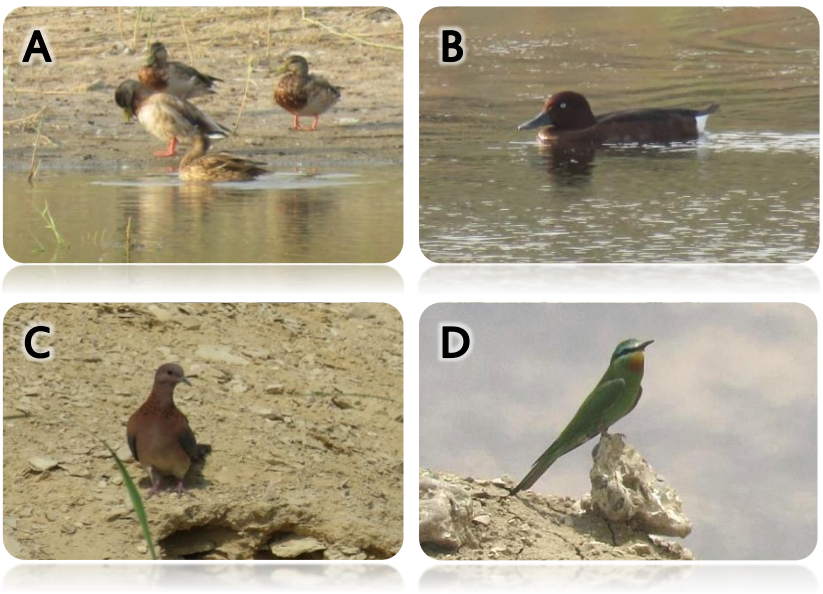

Figure 8. Avian species observed during Tourah field survey.
[A] ***Anas platyrhynchos***, (O: Anseriformes).
[B] ***Tachybaptus ruficollis*** (O: Podicipediformes).
[C] ***Spilopelia senegalensis*** (O: Columbiformes).
[D] ***Merops persicus*** (O: Coraciiformes).

Figure 9. Two species of Gruiformes observed during Tourah field survey.
[A] ***Fulica atra***, **[B]** ***Gallinula chloropus***

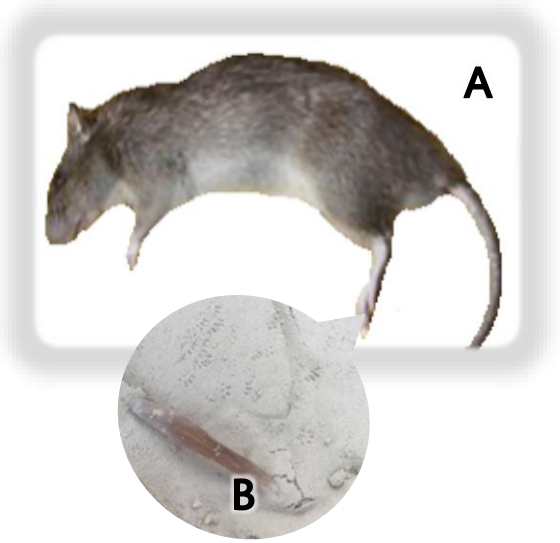

Figure 10. Brown rat and its tracks

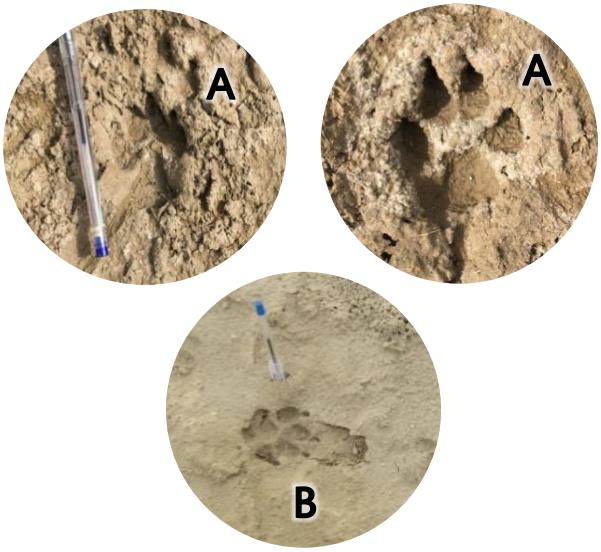

Figure 11. Mammalian tracks observed during Tourah field survey. **[A]** Fox's tracks, **[B]** Dog's tracks.

3. Flora:

During the field study, two plant species were observed (**Table 3; Figure 12**), at both study locations.

Table 3. Taxonomic list of Flora observed during the field surveys.

Kingdom	Family	Species	Location
Plantae	Poaceae	*Phragmites australis*	A + B
	Juncaceae	*Juncus rigidus*	

Figure 12. Plant species observed during Tourah field survey

Discussion

The earth's surface is in continuous change due to both natural and anthropogenic pressures. The recovery process of ecosystems is complex, occurring at a multiplicity of biological levels over different time scales (**O'Neill, 1999**). Consequently, to ensure sustainable wildlife and habitat conservation, monitoring wildlife programme is a prerequisite. Integrating fieldwork with remote sensing (RS) technology and geographical information system (GIS) in monitoring programs assist ecologists efficiently.

Although, quarrying activities provide much of the materials used in traditional hard flooring, such as granite, limestone, marble, sandstone, slate and even just clay to make ceramic (**Lameed and Ayodele, 2010**), they significantly affect the environment, especially biodiversity (**Okafor, 2006**). According to that, we started our fieldwork with studying some physicochemical properties of water and soil in both localities of Tourah quarry to know how far they are suitable for growth of algae, microorganisms and small invertebrates that represent the start point in food chains.

Measuring pH, electrical conductivity (EC) and total dissolved solids (TDS) of any habitat, aids in characterizing its strength. In the present study, pH water values

varied between 6.3 and 7.6 indicating good water quality and this range is typical of most drainage basins of the world **(UNEP/GEMS, 2007)**. Conductivity (EC) and total dissolved solids (TDS) describe salinity level. In closed water bodies, rich geologic rocks besides high water surface evaporation concentrate the dissolved solids in the remaining water resulting in increasing its EC and TDS. That's why, current Tourah values of TDS in water exceeded 10,000 mg/l. According to water classification of **Todd and Mays (2005)**, both localities are saline.

The current study, analyzed eight historical satellite images for Tourah quarry from 2011 to 2018 with GIS to attain habitat information (as, land use/land cover changes, water bodies' formation as well as vegetation) for the years prior to the start of the monitoring programme. From Tourah satellite images, we noticed the increase in occurrence and clustering of floral biodiversity year by year. Moreover, size of water bodies increased in 2014, especially in locality (A), offering a suitable life for wildlife.

Observation of 12 bird species of which three were migratory during the three studied seasons indicate a well level of biodiversity because birds have always been demonstrated to serve as good indicators of biodiversity and environmental change (**Bibby *et al*., 1992**). Presence of birds either resident or migratory in large numbers in Tourah quarry during the study period indicate not only, the richness of the environment with their diet (seeds, aquatic invertebrates, insects) but also, how far place is suitable and safe for their population growth. These two environmental characters are so important for rehabilitation and high levels of biodiversity.

Conclusion

In spite of the arid harsh environmental conditions in the two localities of Tourah Portland quarry, it was very interesting to observe the evolution, over time, of aquatic habitats, flora and fauna due to anthropogenic activities, like evolving of water bodies by the mining activities, carried out by the company. The high level of biodiversity reveals that there is great opportunity to protect and enhance the environment with the right planning and management that help to achieve the equilibrium between conservation of ecosystems and the interests of the company or the project planning.

Recommendation

The main idea behind the project was to reflect the true image of work in quarries in general and to show the biodiversity in the area. Our results gave us a good picture about biodiversity in Tourah quarry and its environmental values. So we recommended for the improvement of the current status of the area and its sustainable management:

1. Enhancement of local participation in biodiversity conservation initiatives,
2. Initiation of public education and awareness campaigns,
3. Integration of traditional and modern knowledge system of biodiversity conservation,
4. Rehabilitation,
5. Introduction of alternative forms of biomass energy,
6. Provision of incentive packages for implementing agencies.

References

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To be kept and filled in at the end of your report

Project tags (select all appropriate):

This will be use to classify your project in the project archive (that is also available online)

Project focus:

- ☒Beyond quarry borders
- ☒Biodiversity management
- ☐Cooperation programmes
- ☐Connecting with local communities
- ☐Education and Raising awareness
- ☐Invasive species
- ☐Landscape management
- ☐Pollination
- ☒Rehabilitation& habitat research
- ☒Scientific research
- ☐Soil management
- ☒Species research
- ☐Student class project
- ☐Urban ecology
- ☐Water management

Flora:

- ☒Trees & shrubs
- ☐Ferns
- ☒Flowering plants
- ☐Fungi
- ☐Mosses and liverworts

Fauna:

- ☐Amphibians
- ☒Birds
- ☒Insects
- ☐Fish
- ☒Mammals
- ☒Reptiles
- ☐Other invertebrates
- ☐Other insects
- ☐Other species

Habitat:

- ☐Artificial / cultivated land
- ☐Cave
- ☐Coastal
- ☐Grassland
- ☐Human settlement
- ☒Open areas of rocky grounds
- ☒Recreational areas
- ☒Sandy and rocky habitat
- ☐Screes
- ☐Shrub & groves
- ☐Soil
- ☐Wander biotopes
- ☒Water bodies (flowing, standing)
- ☐Wetland
- ☐Woodland

Stakeholders:

- ☒Authorities
- ☐Local community
- ☒NGOs
- ☐Schools
- ☒Universities