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## Wet Season Diversity of Butterflies in Restored Mine of Wazo Hill Tanzania

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### ABSTRACT

Mining activities destruct biodiversity in Wazo hill, quarry. The Tanzania Portland Cement Company has revegetated the mined quarry sites for remedy of destructed biodiversity. In order to test the impact of revegetation as means of restoring quarried sites, butterflies were used to determine the effect of restoration by examining their diversity and abundance. Sweep nets and butterfly traps were used for sampling in the revegetated and un-mined sites. However the difference in abundance and diversity between the two sites was statistically insignificant. We concluded that, revegetation has potential to restore the biodiversity by bringing back the species which were lost during mining activities. This suggested that, mined areas should be ecologically restored for rejuvenation of deteriorated ecosystem.

**Keywords:** Mining, Ecological restoration, Wazo hill, Butterflies diversity, Wet season.

### 1. Introduction

Butterflies at Wazo Hill have been observed to be the good indicator for measuring biodiversity health in the restored Wazo hill quarry [5]. Wazo hill area is a source of raw materials for cement production to the Tanzania Portland Cement Company (TPCC) factory. In Wazo hill the limestone is exploited through quarrying to get the raw material for the factory, nevertheless quarrying lead to destruction of environment in general and biodiversity in particular, thus calling a need for ecological restoration [6].

A study done in Kibaha showed that, human activities like quarrying were the major course in the decline of plant species and ants [7]. This agrees with [2] who pointed out that, different levels of disturbance vary in impacts to biodiversity. To ameliorate the impacts of quarrying in this area, the TPCC has developed a restoration program for improving biodiversity [5]. Measured the impact of restoration as means of improving biodiversity by using butterflies. The results, showed that, diversity of butterflies were higher in revegetated than in un-mined areas, which explains the vitality of ecological restoration in quarried areas.

Many studies have shown that, seasons are among factors which can affect the abundance and diversity of insects. For instance the relative abundance of Carabidae in Udzungwa Mountain, Tanzania [9] and the abundance of insects in Kibale forest-Uganda, where season together with vegetation cover had impacts on insects [3, 4] Wazo hill is not exceptional for this phenomenon.

This paper enfolds a report on the study that aimed at determining the influence of wet season to the diversity of butterflies in the restored Wazo hill quarries, by assessing the diversity of butterflies in restored quarries during the wet season, comparing abundance of butterflies between the revegetated and the un-mined sites.

### 2. Materials and Methods

#### 2.1 Study Area

The study took place at Wazo hill quarry area, Dar-es-Salaam. Wazo Hill is located between latitude 6°34' south and longitudes 39°23' and 39°25' East at Tegeta area with a distance of 25Km from the Dar es Salaam city centre. The rich rock material extends for about 2.5 km parallel to Dar es Salaam-Bagamoyo Road, has 15M thick coral limestone bed reserve estimated at 20Mt. Dar es Salaam has daily temperatures averaging at 27 °Celsius, the highest air temperature goes up to 31 °Celsius [5]. The rainfall is high ranging from 1,000 to 1,900 mm per year. The rainfall pattern is bimodal where a period of short rains occurs between October and December and a period of long rains is between March and May. The area is dominated by Eastern African Coastal vegetation type.

## 2.2 Methods

Two seasons were considered in this study (dry and wet seasons). Sampling in wet season took place in April and May, while the sampling during dry season took place in July and August.

Two plots of 140 X 140 m (4.8 Acres) were identified for the study where, one plot was in the area quarried previously but currently been restored by revegetation (revegetated area) and another in un-quarried area. The sweep nets and Butterfly traps were used for collecting the butterflies. Two people captured butterflies randomly in each plot using sweep nets. The activity involved walking slowly along the plots and capture Butterflies that were immobilized and preserved. Two hours were spent in each plots searching for the Butterflies. At the same plots also Butterfly traps baited with rotting banana and banana mixed with wine were used to capture Butterflies, where two traps were run for sixteen Butterfly day traps from both two sites. The specimens were taken to Kingupira Wildlife Research Center museum for preservation.

Shannon Weiner and Margalef indices were used to determine the diversity of butterflies in the two sites.

## 3. Results

### 3.1 The abundance of butterflies in wet season.

A total of 108 (Mean=1.662±0.200, S.D = .613, n = 5) butterflies were collected in wet season. The Highest abundance was observed to *Catopsilia florella* (17.59%) followed by *Colotis euipe omphale* (12.037%) and *Dixeia spilleri* (6.48%) while low abundance were observed for *Papilio demodocus* (0.925%) and *Anthene princeps* (0.925%) which occurred as singletons. In comparing between the revegetated site and the un-mined area, the revegetated area (S.D = 1.089, Max = 5, Range = 4, n = 44) had high abundance of butterflies than the un-mined area (S.D = 1.911, Max = 9, range = 9, n = 44), (Fig 1). However the difference in abundance between the two sites were insignificant (Mann-Whitney U test statistic = 453.500, P = 0.864).

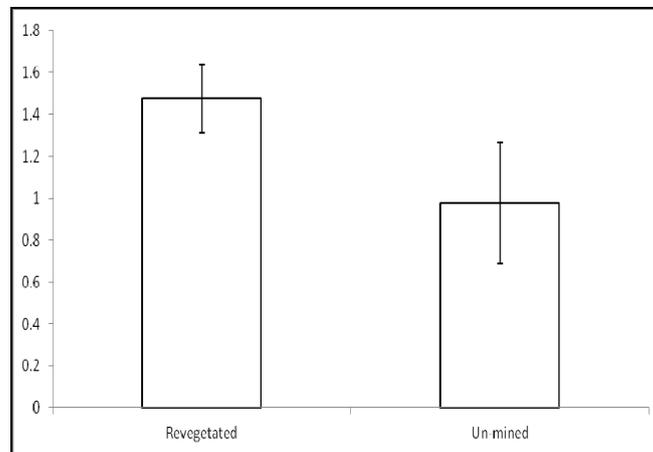


Fig 1: The abundance of butterflies in two sampling sites (Mean ± S.E, n=44) in wet season.

### 3.2 The diversity of butterflies in wet season

Generally the total species of butterflies identified during wet season were 31 with Shannon Weiner and Margalef index of 2.933 and 6.472 respectively. Some species were observed to be site specific, for instance *Eurema regularis*, *Colotis amatus sp* and *Anthene ligures* occurred only in the revegetated area while species

like *Papilio demodocus* and *Bicyclus saffitz sp* occurred in un-mined site only during this season. Different indices revealed high diversity of butterflies in the revegetated site. Randomization test Using a Shannon Wiener index with 10000 random partitions revealed that, the difference was not significant (Randomization Test=-0.363575, P=0.1431).

Table 1: The diversity indices of butterflies in the wet and dry seasons, were H= Shannon wiener, D= Margalef index, J=equitability index, F=fisher alpha index

Diversity Indices	Revegetated wet	Un-mined wet
Species number	23	17
H	2.7313	2.3677
D	5.3733	3.7222
J	0.76822	0.6659
F	13.64	8.1805

## 4. Discussion

The previous study report which involved both wet and dry seasons, showed that, 36 species of butterflies were recorded in the Wazo hill quarries [6]. This suggests that, wet season harbors higher diversity (86.11%) of the butterflies in the quarry sites, found in both wet and dry seasons.

### 4.1 The abundance of butterflies in Wet season

In comparing the abundance of butterflies between the revegetated

site and un-mined site in the wet season, no difference was observed. This can be possibly due to similarity in terms of habitats between the two sites, and close locations between the sites which allowed individuals to migrate between the sites. A study done in this area, considering both season (wet and dry season) still found no difference in the abundances of butterflies between the sites [6]. Habitat heterogeneity play great role in the insect abundance [7]. The habitats with high resources required for insects these are food, shelter, shed, protection against predators) will attract higher

number of insects than the habitat with low resource [4, 8]. In Wazo hill restored quarries, similarity in abundance which indicates that, the revegetation has potential to recreate the former habitats for biodiversity was shown.

#### 4.2 Diversity of butterflies in wet season

The diversity of butterflies in Wazo hill showed different scenario in comparison with the previous study which involved both seasons. Analysis for the wet season showed that, the difference in diversity of butterflies in the wet season was not statistically significant. This also can be explained by the fact that, during dry season both sites received the same resources for vegetation such as minerals, sunlight and water while in dry season resources like water was limited to some parts. For instance, it was observed that, during the dry season, irrigation for some plants in the revegetated area was taking place. These suggest that, the habitats between the two sites provided different resources of different quality. This means, the revegetated area favored more butterflies than the un-mined sites.

The less similarity in species diversity between the sites, explain that, if mining is accompanied by ecological restoration, there can be potential impact to bring back the normal biodiversity health status. Also, restoration accompanied by human efforts can have positive effects in biodiversity conservation.

#### 4.3 Implication in biodiversity conservation

Many countries including Tanzania are experiencing the growth in mining industry. It is well known that, mining destructs environment and deteriorates the habitat quality for biodiversity conservation. Ecological restorations have been a new venture for remedy. From above, it has been observed that, the ecological restoration has potential to bring back the lost ecological health status. Restoration through revegetation can attract wildlife species which were lost during the mining activities. For this reason, it is suggested that there should be two phases in mining; first is the economic exploitation of the resources available in the ground, and second is restoring the ecosystem health for better biodiversity conservation.

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#### 6. Reference

1. Allouche O. New theory provides better basis for biodiversity conservation than existing models. Hebrew University. Jerusalem. 2010.
2. Blair RB. Land Use and Avian Species Diversity along an Urban Gradient. *Ecological Applications*, 1996, 6:506–519.
3. Cancelado R, Yonke TR. Effect of prairie burning on insect populations. *Journal of Kans Entomology*, 1970, 43:274-281.
4. Hassan SN, Rusch GM, Hytteborn H, Skarpe C, Kikula I. Effects of fire on sward structure and grazing in western Serengeti, Tanzania. *African Journal of Ecology*, 2008, 46: 174–185.
5. Ngongolo K, Mtoka S. Using Butterflies to Measure Biodiversity Health in Wazo Hill Restored Quarry. *Journal of*

*Entomology and Zoology Studies*. 2013a. 1(4):81-86.

6. Ngongolo K, Mtoka S. Biological conservation and urbanization, who to win? A case of Kibaha in coastal region, Tanzania. *Tanzania Journal of Natural and Applied Sciences*, 2013b, 4(1):613-618.
7. Ngongolo K, Mtoka S. Challenges of Wildlife Conservation in Urban Areas. The 9th TAWIRI Biannual Scientific Conference, 4th-6th December 2013, Snow Crest Hotel, Arusha, Tanzania, 2013.
8. Ngongolo K, Nyundo AB. Impacts of Wildfire on Insect Diversity in the Selous Game Reserve, The 9th TAWIRI Biannual Scientific conference, 4th-6th December 2013, Snow Crest Hotel, Arusha, Tanzania, 2013d.
9. Nyundo AB. The diversity of Carabidae beetle (Coleoptera: Carabidae) in Udzungwa mountains National Park, Tanzania. The thesis submitted in the Fulfillment of the requirements for the Degree of Doctor of Philosophy in Zoology of the University of Dar-Es-Salaam, 2002.