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The *Leucaena leucocephala* Floral Visitors, Pollinators and their Predators in the Restored Wazo Hill Quarry, Tanzania

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ABSTRACT

This study investigated the potential pollinators, floral visitors and predators of the Leucaena leucocephala. Monitoring of the standardized number of flowers was done at specified time interval, and the number of predators was also counted at standardized time interval and the data collected were analyzed and tested using F-test. There was a positive relationship on the floral visitors and individual probing flowers ($P<0.05$) however the difference between visitation and probing rate was insignificant ($P>0.05$). The predation had positive correlation with probing while having negative relation with visitation. The relationship between the visitation and probing suggests that, there is a need to conserve the pollinators in integrated approach by considering other species. This will benefit not only Leucaena leucocephala but also other plant species in the restored sites. Further studies should be done to determine the impact of predators other than dragonflies on the pollination and seed setting.

Keywords*; Floral Visitors, Pollinators, Predators, Leucaena leucocephala, Restored Wazo Quarry*

INTRODUCTION

Quarrying in Wazo hill is an extractive activity that produces the raw material to Tanzania Portland Cement Company factory for cement production. It is a fact that in the course of quarrying, the environment and biodiversity in the area are impacted. As means of ameliorating the situation, the Tanzania Portland Cement Company (TPCC) has adopted the ecological restoration program [1,2,3,4]. The *Leucaena leucocephala* is among the plant species used in the restoration program. *L. leucocephala* is angiosperm, thornless long-lived shrub or tree in the order of Fabales and family of Fabaceae. It may grow to the heights of 7-18 meters with bipinnated leaves of 6-8 pairs of pinnae bearing 11-23 pairs of leaflets with a length of 8-16 mm. *L. leucocephala* a small and fast-growing mimosoid tree is also commonly known as white leadtree, jumbay and white popinac [5].

L. leucocephala is well known for being used as livestock fodder due to its high protein contents thus lead to high livestock production. In addition, the young pods are used as vegetable, and the wood is used as fuel. In Dar-es-Saalam region, the plant is utilized as ornament and offers ecosystem service to people through shed provision during sunny weather [3,5,6]. Regardless of all importance of *L. leucocephala*, the predation effect of its pollinators was documented in Wazo hill quarry. The study in this area showed that, dragonflies were predating the potential pollinators such as butterflies.

This study aimed at assessing the floral visitors and potential pollinators of the *L. leucocephala* in the restored Wazo Hill quarry with the following specific objectives: determine the relationship between the floral visitors and potential pollinators, the impact of the predators (Dragonflies) on the probing and visitation of the flowers.

MATERIALS AND METHODS

Study area

The study took place at Wazo hill quarry area located between latitude 6°34' south and longitudes 39°23' and 39°25' East in Dar-es-Salaam. Wazo hill is the main source of material for quarrying where parts of the quarried areas are restored through revegetation.There are three types of vegetation covers in the quarry: the first is unmined areas that have the natural vegetation cover of the local area, the second is the mining area that has the bare ground after removing the vegetation cover and some soils and rocks and the third is restored area that have mixture of vegetation cover following the restoration programme.

Methods

The survey on *L leucocephala* pollinators and floral visitors took place in the restored site because no flowering *L leucocephala* was observed in the mined and the unmined sites. Five sampling sites were used for monitoring the pollinators and floral visitors to the flowers. In each site, ten flowers were monitored with the partitioning of 20minutes. At each partitioning, the visitors were identified, number of flowers visited, probed and time spend were determined. Also for one minute the number of dragonflies which are considered as pollinators' predators were counted. In addition, the number of *Leucaena* trees surrounding the monitored flowers in the area of 5mx5m were counted and the weather conditions such cloudy, sunny and rainy was recorded.

In each study site, three *L leucocephala* trees each with at least 7-20 flowers was chosen randomly at each study day. The flower was monitored for 5 hours from 900hrs to 1400hrs for partitioning of 20 minutes per treatment.

The difference in visitation and probing was tested using F-Test two-sample for variance and linear regression was used to determine their relationship.

Plate 1; Restoration in Quarried are in Wazo hill Taking place(Field Photo).

Plate 2: Un-restored Quarry with natural recovery in Wazo Hill Quarry site (Field Photo)..

Plate 3; *L leucocephala* Flowers in Wazo Hill Quarry in the Restored site; (Field Photo).

Plate 4; Researcher Monitoring the Floral Visitors for *L leucocephala* in Wazo Hill Restored Quarry (Field Photo).

RESULTS

Table1. Potential *Leucaena leucocephala* Floral visitors and pollinators in Wazo Hill

Order	Family	Species	Abundances	Number of Floral Visitors	Number of Individuals Probed	Time spend to the flower
Lepidoptera	Nymphalidae	*Acreea sp*	3	3	1	13
Hymenoptera	Apidae	*Apis melifera*	37	73	64	1379
Coleoptera		Beetle	1	1	0	2
Lepidoptera	Pieridae	*Belenois Sp*	3	4	3	16
Hemiptera		Bug sp1	2	2	1	95
Lepidoptera	Pieridae	*Colotis eupe*	7	8	7	43
Diptera	Tachinidae	*Trichopoda sp*	16	19	7	49
Odonata		Dragon fly	8	8	0	98
Lepidoptera	Pieridae	*Eurema Brigitta*	2	4	4	18
Hemiptera		Bug sp2	1	1	0	20
Lepidoptera	Lycaenidae	*Lepidochrysops sp*	1	3	0	5
Hymenoptera	Megachilidae	*Megachile sp*	28	35	11	190
Lepidoptera	Pearidae	Pearinae sp	2	3	3	35
Hymenoptera	Apidae	*Ceratina sp*	2	2	1	20
Diptera	Tachinidae	*Tachnidae sp*	2	2	2	15
Hymenoptera	Formicidae	*Tetramorium Sp*	1	1	0	5
Hymenopterira		Wasp	37	47	17	290
		Total	**153**	**216**	**121**	**2293**

Preamble summary

A total of 1258 (Mean=12.79±0.369897, S.D=3.624236) flowers with Kurtosis=-1.78402, Skewness=0.242256, range =10, minimum=7 from 96 samples were monitored. The time spend by the floral visitors to the flowers was

1897 min (Mean=19.7604±3.138, S.D=30.7563), the relationship between the number of visitors and the number of flowers was positives (r=0.2532, r^2=0.054, S.E= 3.5181,F=6.370821, P<0.05).

Species Visitation and Probing

High visitation, probing frequencies and time spent was observed to *Apis melifera:* Apidae followed by Wasp and *Megachille* sp:Hymenoptera. Low visitation rate, probing and time spend was observed to order Coleoptera, *Tetramorium* sp: Formicidae (Table 1). The visitation frequency was higher than the probing frequencies. F-Test Two-Sample for Variances showed that the difference was not statistically significant (Mean=0.7494, F=0.74943,S.E= P>0.05). The relationship of individual probed and individual visited was evaluation. The result showed that, the relationship was significantly positive co-related (r=0.8108, r^2=0.6537, F=180.3802, S.E= 0.5622, P<0.05). In addition, the probing was related with the time spent by the floral visitors, the results were significant positive relationship (r=0.3803, r^2= 0.135, F= 15.898, S.E= 1.026, P<0.05).

Impact of Predators

Dragonflies were considered predators to the floral visitors in this area. This due to the previous studies in this area which showed that, Dragon flies (odonata) are predators to the potential pollinators including the butterflies [1]. A total of 576 (Mean=6±0.585834, S.D=5.73998, Max=22, Min=0) Dragonflies with Kurtosis=0.614684, Skewness=1.026271 were encountered during the study.

The increases of predators in the study sites cascaded to the decreased in the floral visitors and floral probing for sampling time between 1-13, 37-49, 65-73 and 85-93. However in some sampling time, the relationship was positive, thus during the increase in the predators abundance there was an increase in visitation and probing rate. (Figure 1). Generally the relationship between the probing and presence of predators was insignificant positive (r= 0.11962, r^2=0.0038,f=1.3646, S.E=1.1016, P>0.05). If the presence of predators were to be compared with the visitation frequencies, the relationship was insignificant negatively correlated (r=-0.01063, r^2=3.684E-06,f=0.000346, S.E=0.9606, P>0.05).

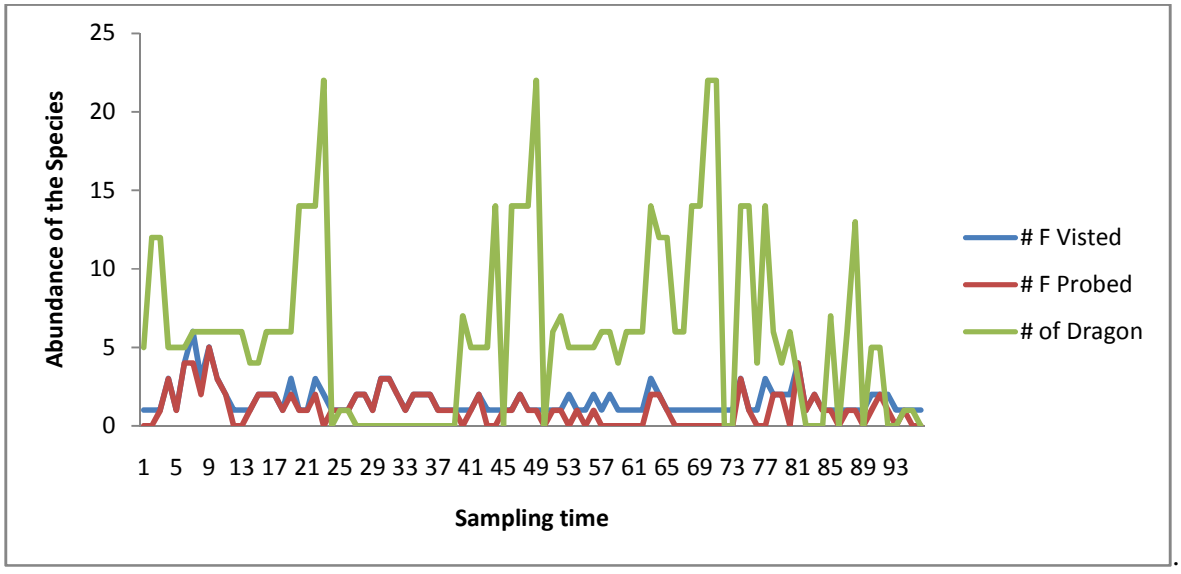

Figure 1: The relationship between the abundance of Predators (Dragonflies) with the Floral Visitors(F-Visited) and the Floral Probers (F-Probed)

DISCUSSION

Species Visitation and Probing

The finding from this study showed that number of individuals visited the flowers was higher than those probing. The slight variation between visitation and probing is attributed by different factors. This showed that, not all species that visit the flowers are potential pollinators. The different species visits the flowers for different reasons. Some species visit the flower for predation, resting, shelter and protection. During the study we observed *Tachnidae*

sp visiting for rest, dragonflies (odonata) visiting for predation and ants (*Tetramorium Sp)* visiting flowers for other reasons not one mentioned above. Previous study in this area showed that dragonflies were good predators of butterflies [1],[7], also reported that, different species visits the flowers for different reasons including finding shelter, predation, resting and pollination. The increase in floral visitors leads to higher chance of potential pollinators to the flower. This is proven in this study to which, the higher the visitation frequencies the higher the probing rate. This suggests that, conservation of pollinators should be in integration approach to which complex ecosystem should be involved. This agrees with other observers [8,9,10,11&12] who suggested that conservation in integration manner while considering multiple species is essential for ecosystem monitoring. Conservation of pollinators in this area is very important, the previous finding showed that restored area with higher pollinators had positive impacts on the seed setting and vigor of the *L leucocephala* [3]. Other studies from different plants have similar observation. For instance insects (open pollination) were observed to increase the number of seeds per pod, weight of pods, seedling vigour, weight of seeds, germination success and oil contents of *Sesamum indicum* [13]. This implies that, the impacts is not only in this plant species but also other plants specie are affected by the pollination efficiency.

Impact of Predators

In this study we hypothesized that, the presence of predation surround the flowers will affects the pollination activities. However the finding revealed different scenario. From this study it was noted that, predation did not have impact on the on the floral visitation and probing of the flowers of the plants. This is contrast to the study which was done in higher Andean in Bolivia for *Chuquiraga oppositifolia*. This study showed that, the predation to pollinator insects had negative impacts on their abundance and seed setting of the *Chuquiraga oppositifolia* [14]. Their finding agreed with [15] who also found similar impact on the predation to the pollinators. In this study the difference results possibly is due to consideration only on one specie (Dragonflies) as predators. We recommend other studies should be done for other species and impacts on the setting.

However the relation varied, the increases in predation reduced the visitation of the insects but while increases the probing. This can suggest that, those species which were visiting the flower and inhibiting the potential pollinators like *Apis melifera:*Apidae are the one who were affected by the predation from the Dragonflies. In addition to that, other factors especially weather need to be considered in the interpretation of this finding. For it was observed that, during rainy season, the visitation and probing of the insects to the flowers of *L leucocephala* to be low while being higher in dry season. Other study also has observed that, weather has significant impact on pollination activities and their impacts on the plants productivity [16].

CONCLUSION

From this study is evident that, the floral visitors of the *L leucocephala* are highly correlated with the frequency of floral probing. That is the higher the visitation the higher the probing. However the predation by dragonflies in this area did not have impacts on the floral visitation and probing of the flowers. We recommend that the conservation of the pollinators in this area should not only consider single species but in should be in the integration manner which consider ecosystem at large. The previous study showed that, pollination has positive impacts on the seed setting thus reproduction success. This implies that, if the *L leucocephala* is to be propagated for human utilisation, there is a need to ensure that, the supplies of the pollinators through effective conservation is ensured. If the plant is to be considered as invasive in given area, the conservationists need to control their pollination.

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