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Insect faunal diversity collected through light trap at Akola vicinity of Maharashtra with reference to Scarabaeidae of Coleoptera

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ABSTRACT
Investigations were undertaken to know the species composition of insect fauna attracted towards the light trap. Observations revealed that order Coleoptera showed a rich population i.e. 41.81% and 35.10% of the total collection for 2011-12 and 2012-13, respectively followed by Hemiptera 16.86% and 21.77% and Lepidoptera 12.96% and 12.89%, respectively. 19 species of scarab beetles belonging to 10 genera were found to be the prominent visitors for both the years. Subfamily, Melolonthinae had rich species diversity with five species of genus *Holotrichia* and *Schizonycha ruficollis.* Amongst Rutelines, *Rhinyptia indica*, *R. nigrifrons*, *Anomala varicolor, A. dimidiata, A. ruficapilla* and *Adoretus bicolor* prevailed. *Onthophagous gazelle* ruled the scarabaeinae fauna. *Protaetia aurichalcea, P. teracea, Oxycetonia jucunda, O. versicolor, Clinteria klugi, Heterorrhina micans* of Cetoninae were also found predominant in this vicinity. Shannon Biodiversity index for the various insect orders collected was calculated to support the findings.

Keywords: Biodiversity, Coleoptera, Light trap, Scarabaeidae

1. Introduction
Insects are positively phototrophic and use of light traps for insect catches produces valuable faunistic data. This data can be seen as a parameter of health of biodiversity of the concerned vicinity. The data provided by light trap catches could throw light on period of maximum activity of insects. Ramamurthy et al used Mercury, Black and Ultra-violet light traps for insect capture and found that Coleopterans dominate the catches followed by Hemipterans, Hymenopterans and Lepidopterans [1]. When various colour lights were used as attractants; the common orders frequented were Diptera, Coleoptera and Lepidoptera [2]. In Wheat, Clover, Corn, Alfalfa and vegetable agroecosystems, considering the light trap catches, forty eight species belonging to forty three genera of Coleopterans were identified in which Scarabaeidae includes 9 species [3].
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is with diverse flora and fauna. It lies in 20°42′N 77°00′E, with 285 m as latitude. The various crop ecosystems of the area include Pigeon pea, cotton, okra, sesamum, soybean, vegetables, nurseries and forest gardens.
Earlier Frost studied Scarabaeidae taken in light traps at Archbold biological station, Florida as well Yahiro took notes on ground beetles (Coleoptera: Caraboidea) caught by a light trap during Ten years [4, 5]. Though collection of insects by light traps is cheap and convenient process, in spite of certain foreign workers, this area of work has been under negligence by the Indian scientists. Keeping this idea in mind, the present study has been carried out focusing the scarabaeids.

2. Materials and Methods
The data presented here shows collection of light trap installed at Department of Entomology, Dr. PDKV Akola. 160 W Mercury light was used as attraction source. Lighting hours were set for 12 hours. A cotton swab dipped in ethyl acetate was put in the light trap collection chamber to anesthetize the insects. Generally the light trap was operated every night in all the seasons. In all the cases the traps were run at least at 85% of the nights. Insect catches during 2011- 2012 and 2012 - 2013 were taken into consideration. Counts were not made during April, May for both the years as it's a period of minimum or no insect activity in this area.
The insects were removed from the collection chamber every day and the cotton swab used to anesthetize the insects was changed daily. The collected insects were then allowed for labeling, and sorting order wise. Coleopteran specimens specifically scarabaeids were further taken into

consideration and classified up to species level with the use of available literature. There was no other light source except for this in the respected vicinity and the trap continued to operate since then.

The vegetation of the area includes various crop fields of the university, orchards and forests located within an area of 800 m of the trap. The average temperature ranged from 30–42 °C maximum and 14–27 °C minimum. Three commonly used measures of diversity, Simpson's index, Shannon's entropy, and the total number of species, are related to Renyi's definition of generalized entropy. These measures provide estimates of the effective number of species present, and differ only in their tendency to include or to ignore the relatively rare species [6]. The Shannon index is affected by both the number of species and their equitability, or evenness. A greater number of species and a more even distribution both increase diversity as measured by H'. Species richness is a measure of the number of different species present in an ecosystem, while species evenness measures the relative abundance of various populations present in an ecosystem.

Like Simpson's index, Shannon's index accounts for both abundance and evenness of the species present and can be calculated by formula -

$$H = -\sum_{i=1}^{S} p_i \ln p_i$$

Where, *H'* - Shannon's diversity index

S - otal number of species in the community (richness)

pi - proportion of *S* made up of the *i*th species

3. Results and Discussion

A total of 29,049 insects were collected during the study period i.e. 2011-12 (15350) and 2012-13 (13699), respectively. Among various insects collected in the trap, the major contributors were Coleopterans, Hemipterans, Lepidopterans, Orthopterans and Hymenopterans.

Table 1: Order-wise Per cent composition of various insects caught in light trap during 2011-12 and 2012-13

Sr. No.	Order	Per cent composition 2011-12 (%)	Per cent composition 2012-13 (%)
1	Coleoptera	41.81	35.10
2	Hemiptera	16.86	21.77
3	Lepidoptera	12.96	12.89
4	Hymenoptera	7.12	6.45
5	Orthoptera	9.56	7.66
6	Diptera	6.31	4.23
7	Isoptera	5.18	2.89
8	Neuroptera	2.76	1.22
9	Odonata	1.60	1.66
10	Dermaptera	1.99	1.19

Coleopterans dominated the catches for both the years contributing 41.81% during 2011-12 and 35.10% of the total collection during 2012-13. Ashfaq M *et al*. [2] studied the effect of different colors on light trap catches. Light of six different colors (Blue, green, yellow, red, black and white) was arranged in a line on agricultural land. Tree rows/blocks, forest nursery, fruit garden, wheat, maize and fodder crops were the main vegetative covers. The highest number of insects was observed in container placed under the black light (UV light), while the lowest in that of red light. The common insect orders frequented among all colour lights were, Diplura, Coleoptera and Lepidoptera [2]. In the present study, the dominance of Coleopterans was followed by Hemipterans with 16.86% and 21.77% and Lepidopterans with 12.96% and 12.89%, respectively, during 2011 – 12 and 2012-13. Hemipterans were dominant in collection during the monsoon. Besides these major orders, other contributors to the collection includes Hymenoptera 7.12% and 6.45%, Orthoptera 9.56% and 7.66%, Diplura 6.31% and 4.23%, Isoptera 5.18% and 2.89%, Neuroptera 2.76% and 1.22%, Odonata 1.60% and 1.66% and Dermaptera 1.99% and 1.19% during both the consecutive years. (Table 1)

The effect of three light sources in light traps i.e. Mercury, Black and UV on insect catch revealed that Coleopterans dominated the catches followed by Hemipterans, Hymenopterans and Lepidopterans. Mercury light was more efficient for Lepidoptera, Hemiptera, Hymenoptera, Odonata and Diptera while black light was more efficient for Coleoptera, Orthoptera, Isoptera and Dictyoptera. Similar attractiveness to Mercury and black light sources were found for Coleopterans [1]. 160 W Mercury light as a light source was used in the present study and the dominance of Coleoptera followed by Hemiptera and Lepidoptera for both the years has been found to be in coordination with earlier findings.

Considering Scarabaeidae as the largest family of Coleoptera, subfamilies Melolonthinae, Rutelinae, Scarabaeinae and Cetoninae showed rich diversity. 19 species of scarab beetles belonging to 10 genera were found to be the prominent visitors for both the years. Melolonthinae, Rutelinae and Cetoninae were abundant in catches while a single species of Scarabaeinae ruled its fauna. Rutelins contributed 42.07% share of the family during 2011-12 and 48.18% during 2012-13 and were followed by Scarabaeinae with 39.68% during 2011-12 and 35.25% during 2012-13. Species composition of the subfamily Melolonthinae was calculated around 14% during both the years. Cetonines were the least in count sharing 4.19% in 2011-12 and 2.54% during 2012-13. Maximum scarabs were collected during June to October which can be considered as the period of highest activity for the scarabs. (Table 2).

Table 2: Sub-family wise composition of family Scarabaeidae in light trap catches.

Sr. No.	Subfamily	Per cent composition 2011-12 (%)	Per cent composition 2012-13 (%)
1	Rutelinae	42.07	48.18
2	Scarabaeinae	39.68	35.25
3	Melolonthinae	14.03	14.01
4	Cetoninae	4.19	2.54

Earlier Mohammed et al reported forty eight species belonging to forty three genera by two different light traps at two different levels in Qena Governorate. These genera were arranged into 18 families, in which Scarabaeidae included nine species whereas other contributing families were Tenebrionidae, 7 species; Staphyllinidae, Elateridae and Carabaeidae giving 4 species. Amongst the scarabaeids, *Adoretus garamas, Ontophagus sellatus* and *Schizonycha nilotica* were the prominent ones [3]. Ground beetles (Coleoptera, Caraboidea) were studied by Yahiro and data of ten years was analyzed. A total of 77 species belonging to Omophronidae, Carabaeidae and Brachinidae were caught, illustrating the effect of environmental factors [5]. Frost has given notes on common Scarabaeidae taken in light traps at Archbold Biological Station, Florida. Data for seven winters from 1959 to 1965 was analyzed. Fifty three species of Scarabaeidae have been taken in these light traps. Forty seven were listed by Frost earlier. Only nine species were considered common which includes *Anomala nigropicta, Dyscinetus morator, Phyllophaga elizoria* etc. [4, 7]. In spite of such work on light trap diversity of insects by foreign authors no or little work has been done in India.

In the present study 19 species of scarab beetles belonging to 10 genera were found to be the prominent visitors. Five species of genus *Holotrichia* (*H. serrata, H. nagpurensis, H. akolana, H. fissa, H. reynaudi*) were trapped in noticeable numbers after first monsoon showers in the month of June along with *Schizonycha ruficollis.* These have been reported earlier by Dadmal *et al.* [8] from various agroclimatic zones of Maharashtra and hence are active in this region. *H. serrata* [9] is known to attack on Soybean crops of this vicinity and its presence in the light trap catches proves its dominance amongst scarabaeidae. Considering Rutelines, *Rhinyptia indica*, *R. nigrifrons*, *Anomala varicolor, A. dimidiata, A. ruficapilla* and *Adoretus bicolor* prevailed and dominated. *Protaetia aurichalcea, P. teracea, Oxycetonia jucunda, O. versicolor, Clinteria klugi, Heterorrhina micans* of Cetoninae were also found predominant in the catches. *Onthophagous gazelle* ruled the scarabaeinae fauna (Fig. 1) (Table 3).

Table 3: Species composition of family Scarabaeidae in light trap catches during 2011-12 and 2012-13

Sr. No	Subfamily	Species
1	Melolonthinae	*Holotrichia serrata*
		H. nagpurensis
		H. akolana
		H. fissa
		H. reynaudi
		Schizonycha ruficollis
2	Rutelinae	*Rhinyptia indica*
		R. nigrifrons
		Anomala varicolor
		A. dimidiate
		A. ruficapilla
		Adoretus bicolor
3	Cetoninae	*Protaetia aurichalcea*
		P. teracea
		Oxycetonia jucunda
		O. versicolor
		Clinteria klugi
		Heterorrhina micans
4	Scarabaeinae	*Onthophagous gazelle*

Apart from the effect of various colored lights and different light traps, Nowinszky and Pukas studied the light trap catch of the harmful insects in connection with the ozone content of the air and established that, the light trapping of the European corn borer (*Ostrinia nubilalis* Hbn) and the common cockchafer (*Melolontha melolontha* L.) was most fruitful when the ozone content of the air is high. Low ozone values were reported to reduce catching efficiency [10].

4. Biodiversity index

The Shannon biodiversity index as calculated for cumulative collection of all insect orders during 2011-12 is 1.89 while that of 2012-13 is 1.74 indicates moderate to rich diversity and coleopteran enjoying abundance in population. For family Scarabaeidae it is 1.13 during 2011-12 and 1.08 during 2012-13 indicates somewhat moderate diversity in which Scarabaeines were the great attractor towards light (Table 5).

Table 4: Shannon Biodiversity index as calculated for the frequent insect orders in light trap during 2011-12 and 2012-13

Order	pi(In(pi))	
	2011-12	**2012-13**
Coleoptera	-0.3655	-0.36749
Hemiptera	-0.2932	-0.32868
Lepidoptera	-0.2544	-0.26408
Hymenoptera	-0.1879	-0.17663
Orthoptera	-0.22443	-0.1968
Diptera	-0.17417	-0.13358
Isoptera	-0.15335	-0.10242
Neuroptera	-0.09882	-0.05342
Dermaptera	-0.07795	-0.05273
Odonata	-0.06585	-0.06803
H’	1.8955	1.7438

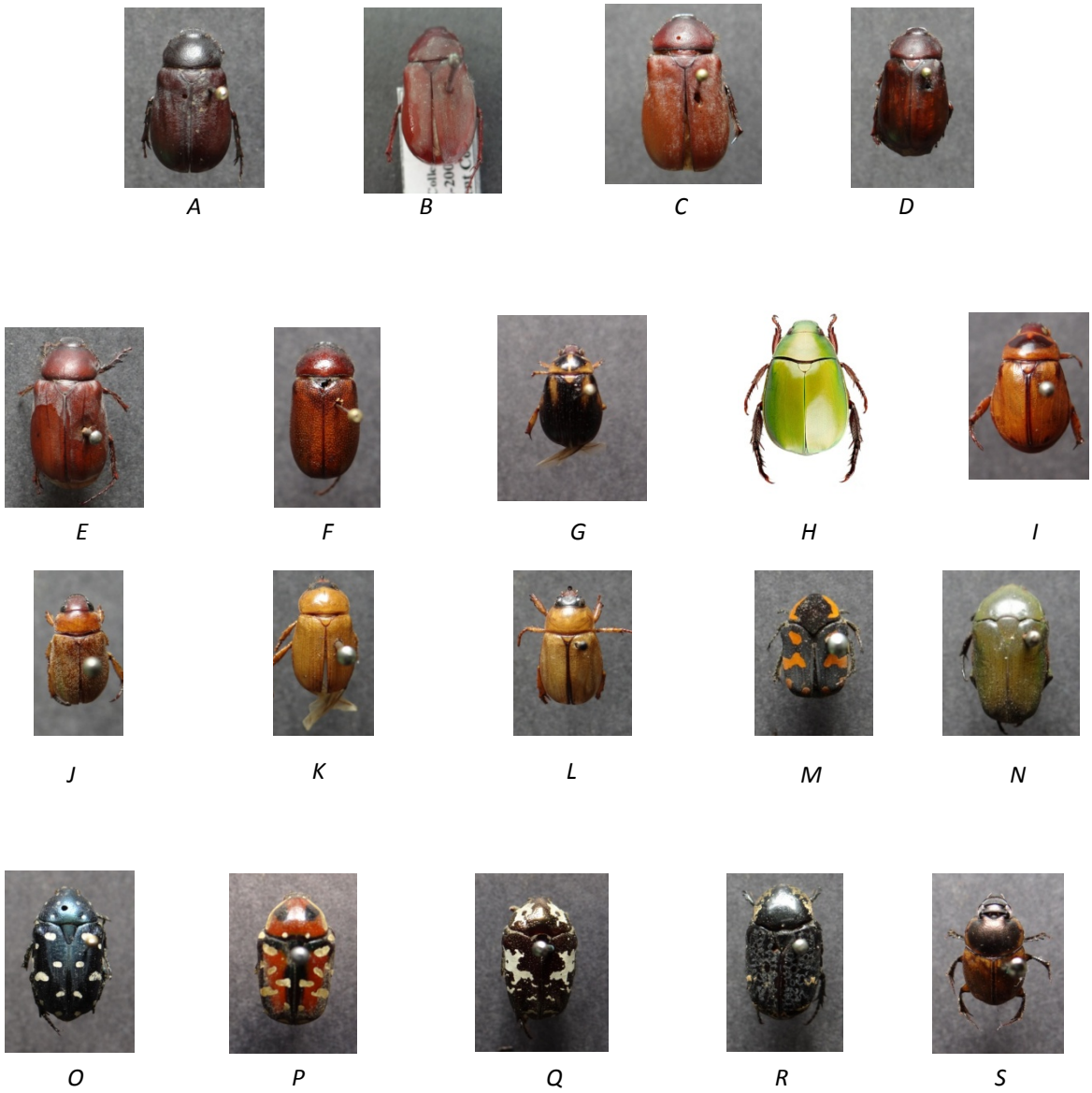

Fig 1: A - *Holotrichia akolana, B- H. fissa, C- H. nagpurensis, D- H. reynaudi, E- H. serrata, F- Schizonycha ruficollis, G- Anomala ruficapilla, H- Anomala dimidiate, I- Anomala varicolor, J- Adoretus bicolor, K- Rhinyptia indica, L- Rhinyptia nigrifrons, M- Clinteria klugi, N- Heterorrhina micans, O- Oxycetonia jucunda, P- Oxycetonia versicolor, Q- Protaetia aurichalcea, R- Protaetia teracea, S- Onthophagus gazelle*

As far as family Scarabaeidae is concerned, the biodiversity index of the subfamilies accounted so far is given in Table 5.

Table 5: Shannon Biodiversity index for Scarabaeidae in light trap during 2011-12 and 2012-13

Subfamily	pi(In(pi))	
	2011-12	**2012-13**
Rutelinae	-0.36426	-0.35182
Scarabaeinae	-0.36677	-0.36755
Melolonthinae	-0.27555	-0.27535
Cetoninae	-0.13293	-0.09329
H'	1.1395	1.08802

From the present study it can be inferred that Coleoptera dominates the insect orders followed by Hemiptera, Lepidoptera and Hymenoptera. The Shannon index values support the present findings. In order Coleoptera, the family Scarabaeidae, subfamily Rutelinae shared the maximum collection followed by Melolonthinae, Scarabaeinae and Cetoninae. Maximum collection of scarabs was achieved during June to October. Specifically, Melolonthines, Rutelines and Scarabaines were trapped in good numbers during June to first fortnight of July which was the peak period for adult activities and it was continued to be so till October. Cetoniid beetles were low in catches being typically diurnal. Such a wonderful biodiversity was recorded in scarab beetles in this vicinity out of which some are agricultural pests and some are scavengers in nature. The collected taxa fall under the group of economically important scarabs damaging various crop ecosystems. This preliminary information on the scarab diversity may be utilized in future to access diversity and conservation problems from the region and solving the scarab pest problem, formulating an effective management strategy.

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