

# DIVERSITY OF WHITE GRUB BEETLES AND THEIR HOST RANGE FROM NORTHERN WESTERN GHATS, KOLHAPUR DISTRICT (MS) INDIA

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## ABSTRACT

The present work provides information on diversity of white grub beetles and their diet breadth from Kolhapur district, Maharashtra. The diet breadth of these species was assessed in both cultivated fields and natural stands. A total of 29 species were recorded during the study period under 22 genera distributed in 4 subfamilies of family Scarabaeidae. Grubs of *Leucopholis lepidophora*, *Holotrichia fissa*, *Holotrichia karschi*, *Holotrichia serrata*, *Adoretus versutus*, *Adoretus lasiopygus*, *Anomala bengalensis* are polyphagous root grubs and serious pests of agricultural, horticultural and silvicultural crops. One species of Dynastinae, *Oryctes rhinoceros* and eight species of Cetoniinae are well known scavenger principally engaged in decomposition of plant material but their adult forms feed on the floral parts without noticeable damage most likely helping in cross pollination of the host plants.

## INTRODUCTION

The beetles belonging to the dominant order of animal kingdom Coleoptera and are economically important. Several beetles are treated as serious pests of agricultural plants and stored products, plantations and to the natural stands. Beetles attack almost all types of wood that is living plants as well as processed fibers, grains, and wood products.

Scavengers and wood boring beetles play a crucial role in decomposition and recycling of organic nutrients. Predatory species, such as lady beetles, Histerid beetles, are potential biological control agents of several Homopteran and disease spreading dipterous flies' (www. Cals.ncuc.edu, Summerlin et al., 1982).

White grubs initially have been defined as larvae of melolonthinae (Wolcott, 1923) but the term has wider usage embracing the larvae of rutelinae, dynastinae and other subfamilies of scarabaeidae, all of which have in general similarity. White grubs are broad, fleshy, whitish or greyish white and the body is curved in the form of letter 'C' (Raodeo and Deshpande, 1987). Most of the white grubs especially from the subfamily melolonthinae are most destructive and troublesome soil insects in many parts of the world. In India white grubs are restricted to certain endemic pockets in the states of Rajasthan, Uttar Pradesh, Gujarat, Maharashtra and Karnataka.

The ICAR realized the importance of the white grubs menace

and initiated the research work through Ad-hoc research project from 1974 at five different localities in the country as AICRP on white grubs. In Kolhapur district (MS) India, *Leucopholis lepidophora* Blanch. is serious polyphagous pest damaging mainly sugarcane crop located along the banks of Kumbhi Kasari river. Besides, *Holotrichia serrata*, *Holotrichia fissa*, *Holotrichia karschi* and *Phyllognathus dionysius* also attained the pest status in fields of paddy, jowar, maize, turmeric and tobacco.

Taking in to account the importance of white grubs, it is decided to study the diversity of white grub beetles and host plants of both adult and immature stages in cultivated and natural stands from Kolhapur district.

## MATERIALS AND METHODS

Materials used during the study includes a collecting net, forceps, vials containing 70% alcohol and 4% formalin as preserving media, plastic containers for temporary storage and transportation. Polythene bags for storing plant material, rearing material, or other samples. Several digging tools were used to collect soil dwelling insects includes long handled spade, ground breakers and sickles. Extensive surveys were carried to find out the white grub beetles and their host range in the natural stands in two consecutive years 2010 and 2011. As the white grub beetles emerge after first shower of monsoon during evening, the observations on the host range were made from 00 pm to 10.00 pm in the each sampling site at selected

localities. Light traps were used to collect the beetles (Leather *et al.*, 2005).

For collection of cetoniid beetles, the sampling was made in morning hours from 7.30 am to 9.00 am. The collection of saproxylic beetles was made from live, freshly felled trees and also from the decayed wood according to Nieto and Alexander (2010). Collected beetles were brought to the laboratory for further studies. The identification of the specimens was done by Dr. V.V. Ramamurthy, IARI New Delhi, Insect Identification Service. The identification of few species was made with the help of available literature Arrow (1917; 1910); Brenske, (1892)

### Study area

#### Kolhapur District (MS) India

The Kolhapur district is situated between 15°43' to 17°17' N and 73°40' to 74°42' E 500msl. It has been divided into 12 talukas and 4 sections for managerial reason. The forest areas of Kolhapur division lie between N 15°43' to 17°10' and E 73°40' to 74°42' east. The division has eight forest ranges viz. Chandgad, Ajara, Gargoti, Radhanagari, Gaganbawada, Karveer, Panhala and Malkapur. For the present study, three representative forests from Western Ghats that comes in Kolhapur district of Maharashtra have been selected and study area of them is described below.

#### Sampling site: 1

**Amba Reserved Forest:** Amba reserved forest most popularly considered as tourism point by the people of Kolhapur district. It comes in Taluka Shahuwadi of district Kolhapur. According to geographical coordinates it is situated between 15°43' to 17°10' N and 73°40' to 74°42' E and 691.3 meters above mean sea level. It is situated at North-West of Kolhapur District. It consist tropical semi-evergreen forest of north Western Ghats. The geographical area is 318.16 ha. The average annual rainfall noted was 6000 mm. Temperature of this region during summer, winter and Rainy Season ranges from 25°C to 38°C, 10°C -30°C and 15°C -30°C respectively. The soil type is lateritic, red and yellowish to red-brown soil observed in the area. The area under study has part of mixed semi evergreen and moist mixed deciduous forest exhibits tremendous plant diversity and good vegetative cover and harbors vegetation types ranging from seasonal grasses, herbs and climbers to perennial herbs, shrubs and trees. Rainy season enjoys most greenery in the study region. The sampling of the specimens was made at 5 different localities by considering all type of habitats.

#### Sampling site: 2

**Radhanagari Wildlife Sanctuary:** Radhanagari wildlife sanctuary is declared as Wildlife Sanctuary by G.R. No. WLP-1085.CR-588/V/F-5 of government of Maharashtra, on 16<sup>th</sup> September, 1985. The Wildlife Sanctuary spreads along the hilly terrain of the Sahyadri ranges of Western Ghats, located in Radhanagari Tehsil of Kolhapur District, Maharashtra. It is just 55km away from Kolhapur. The sources of Bhogavati and Dudhganga rivers are located within, along with the entire catchments of Dudhganga and Radhanagari reservoir. It lies within the N 16°15' 00" to 16°29' 54" and E range of 73°54' 00" East, with the altitude range of 1033 msl to 530msl. Radhanagari Wildlife Sanctuary covers an area about

251.16km<sup>2</sup>. It is further categorized in as 115.73km<sup>2</sup> core zone, 21.09km<sup>2</sup> tourism zone, 96.03km<sup>2</sup> developmental zone, 49.50km<sup>2</sup>. Eco-restoration zone with rest of malki land. It receives the huge rainfall during monsoon. The average range of rainfall is 2846 to 5520 mm (Pande and Pathak, 2005). The temperature variation noted is about 4°C to 41°C. The sampling of the specimens was made at 8 different localities by considering all type of habitats.

#### Sampling site: 3

**Chandoli National Park:** Chandoli national park is declared as National Park by G.R. No. WLP1099/C.L.117/F of Government of Maharashtra on 14<sup>th</sup> May, 2004. It is located at the junction area of four districts i.e. Sangli, Kolhapur, Satara and Ratnagiri of Western Maharashtra. The National Park spreads along the hilly terrain of Sahyadri ranges of Western Ghats. The Western Ghats is considered to be a unique in ecological conditions with rich in floral and faunal diversity. The Chandoli National Park lies between Koyana and Radhanagari Wildlife Sanctuary from Satara and Kolhapur districts respectively, with more or less similar physical and biological conditions. It consists of the upper catchments area of Vasantsagar reservoir constructed on Warana River. The recently declared Chandoli National Park covers an area of 317.64km<sup>2</sup>. containing four villages. The park area comprises 61% reserved forest area and remaining 39% area comes under Revenue department, Irrigation department and private lands. According to the geographical coordinates, the park area lies within the latitude range of 17°03' 29" N to 17°17' 17" N and longitudinal range of 73°03' 29" E to 73°41' 55" E containing forest. As far as conservation and management practices of National Park, the Chandoli National park area is classified into 4 different zones, viz. Core zone - 167.30km<sup>2</sup>, Eco- restoration zone - 57.50km<sup>2</sup>, Developmental zone - 66.83km<sup>2</sup> and Tourism zone - 26.01km<sup>2</sup>.

The National Park area consist typical semi-evergreen and evergreen type of vegetation mixed with grassland patches, supporting to the variety of endemic plant and animal species. The sampling of the specimens was made at 7 different localities by considering all type of habitats (Pande and Pathak, 2005).

The survey was also carried out in the agriculture fields, Teak plantation at Panhala Taluka, in *Eucalypt* plantation at Ajara Taluka and in *Gliricidia* plantation at Karveer Taluka and Shahuwadi Taluka, Kolhapur district.

## RESULTS AND DISCUSSION

A total of 29 species were recorded during the study period under 21 genera distributed in 4 subfamilies of family Scarabaeidae. Table 1 presents the host range of adults and immature stages of the species encountered during the study. The host plant records, localities in which specimens were collected are included and arranged chronologically. The beetles collected during the course of investigation were shown in plate I and II. The light trap studies were carried in both woodland and cultivated field of agricultural crops. The selected localities were Amba reserve forest (Shahuwadi), Radhanagari Wildlife Sanctuary, Chandoli National Park, Ajara, Karveer and Panhala. The details of beetles captured on light traps shown in Table 2.

Table 1: White grub beetles and their host plants

S. No.	Taxon	Host records	Adults
1	<i>Apogonia</i> sp.	<i>Eleusine coracana</i> , <i>Pennisetum glaucum</i>	<i>Psidium guajava</i> , <i>Tectona grandis</i> , <i>Tamarindus indica</i>
2	<i>Brahmina</i> sp.	<i>Eleusine coracana</i> , <i>Oryza sativa</i> ,	<i>Cassia fistula</i> , <i>Terminalia arjuna</i>
3	<i>Holotrichia karchi</i>	<i>Cinnamomum tamala</i>	<i>Terminalia tomentosa</i> , <i>Terminalis arjuna</i> , <i>Guazuma almeifolia</i> , <i>Acacia auriculiformis</i> , <i>Syzygium cumini</i> , <i>Dalbergia latifolia</i> ,
4	<i>Holotrichia fissa</i>	Saccharum spp., nursery plants	<i>Terminalia arjuna</i> , <i>Terminalia tomentosa</i> , <i>Zizyphus jujuba</i> , <i>Syzygium cumini</i> , <i>Grewia</i> sp., <i>Butea monosperma</i> , <i>Careya arborea</i> , <i>Bridelia retusa</i> , <i>Embllica officinalis</i>
5	<i>Holotrichia serrata</i>	<i>Saccharum</i> spp., <i>Zea mays</i> , <i>Sorghum bicolor</i> , <i>Pennisetum glaucum</i> , <i>Arachis hypogaea</i>	<i>Azadirachta indica</i> , <i>Tamarindus indica</i> , <i>Acacia nilotica</i> , <i>Butea monosperma</i> , <i>Psidium guajava</i> , <i>Carissa carandus</i>
6	<i>Leucopholis lepidophora</i>	<i>Saccharum</i> spp., <i>Oryza sativa</i> ,	<i>Saccharum</i> spp., <i>Ficus</i> sp
7	<i>Maladera castanea</i>	Not known	<i>Carissa carandus</i> , <i>Dimocarpus longan</i>
8	<i>Maladera holosericea</i>	Not known	<i>Carissa carandus</i>
9	<i>Adoretus lasiopygus</i>	<i>Curcuma aromatica</i>	<i>Zizyphus jujuba</i> , <i>Terminalia tomentosa</i> , <i>Terminalia arjuna</i>
10	<i>Adoretus versutus</i>	<i>Curcuma aromatica</i>	<i>Zizyphus jujuba</i> , <i>Terminalia tomentosa</i> , <i>Terminalia arjuna</i>
11	<i>Anomala bengalensis</i>	<i>Arachis hypogaea</i>	<i>Syzygium cumini</i> ,
12	<i>Anomala</i> sp.	<i>Arachis hypogaea</i>	Not known
13	<i>Anomala</i> sp.	<i>Arachis hypogaea</i>	Not known
14	<i>Rhomborrhina glaberimma</i>	Not known	<i>Cassia fistula</i>
15	<i>Mimela vernate</i>	<i>Capsicum vernate</i>	Not known
16	<i>Rhyniptia indica</i>	<i>Sorghum bicolor</i> , <i>Pennisetum glaucum</i>	<i>Curcuma aromatica</i>
17	<i>Prodotetus</i> sp.	<i>Heteropogon contorum</i> , <i>Panicum virgatum</i>	<i>Curcuma aromatica</i>
18	<i>Dicaulocephalus feae</i>	Not known	<i>Apluda mutica</i>
19	<i>Oxycetonia versicolor</i>	Not known	<i>Sorghum bicolor</i> , <i>Pennisetum glaucum</i> , <i>Heteropogon contorum</i>
20	<i>Anthracophora crucifera</i>	Not known	<i>Sorghum bicolor</i> , <i>Pennisetum glaucum</i> ,
21	<i>Anatona stillata</i>	Not known	<i>Apluda mutica</i> , <i>Heteropogon contorum</i>
22	<i>Chiloloba acuta</i>	Decaying dung and vegetable matter	<i>Zea mays</i> , <i>Sorghum bicolor</i> , <i>Pennisetum glaucum</i> , <i>Apluda mutica</i> ,
23	<i>Clinteria</i> sp.	Not known	<i>Heteropogon contorum</i> , <i>Panicum</i> sp.
24	<i>Clinteria</i> sp.	Not known	<i>Mimusops elengi</i> , <i>Mammea suriga</i>
25	<i>Glycyphana horsefieldi</i>	Dead wood of <i>Samanea saman</i> and <i>A. lebbeck</i>	<i>Mimusops elengi</i> , <i>Mammea suriga</i>
26	<i>Protaetia aurichalcea</i>	Not known	Not known
27	<i>Xylotrupes gideon</i>	Decayed wood and dung	Not known
28	<i>Oryctes rhinoceros</i>	Decayed dung and vegetable matter	<i>Coccus nucifera</i> , <i>Ficus</i> sp.
29	<i>Phyllognathus dionysius</i>	<i>Oryza sativa</i> , <i>Zea mays</i>	<i>Coccus nucifera</i>

### Subfamily melolonthinae

Subfamily melolonthinae represented 8 species from the present study region. This group includes true cockchafers. These beetles feed on tender leaves of the trees at dusk and go back to the soil at dawn. Grubs of this group are injurious to seed beds and saplings in the nursery. In the plains, life cycle is annual with a larval period of 8 to 10 months. The most destructive genera of the Melolonthinae are *Holotrichia*, *Apogonia*, *Maladera*, *Leucopholis*, *Schizonycha* and *Autoserica* (Beeson, 1941; Nair, 2007; Butani, 1979).

#### *Apogonia* sp.

The grubs of this species were collected in the cultivated fields of *Eleusine coracana* (L.) Gaertn and *Pennisetum glaucum* (L.) R. Br. The adult specimens were collected on the foliage of *Psidium guajava* L. *Tectona grandis* L. and *Tamarindus indica* L. at Amba Reserve Forest. Beetles phototactic in nature. The species was abundant during June to August. The life cycle is annual. The adults and grubs were collected at all the sites.

*Apogonia clypeata* feed ragged patches at the edges of young leaves of *Tectona grandis* (Beeson, 1941; Regupathy et al., 1995). White grubs are widely distributed all over India damaging variety of economic crops including various fruit trees. Butani (1979) reported that *Apogonia* sp. is as a serious pest of grapevine.

#### *Brahmina* sp.

The beetles were collected on the leaves of *Cassia fistula* L. and *Terminalia arjuna* (Roxb.) Wight and Arn. The grubs of this species were obtained from the cultivated fields of *Eleusine coracana* (L.) Gaertn, *Oryza sativa* L. The species has life cycle of a year. Beetles phototactic in nature. The adults and grubs were collected at all the sites. The species was abundant during June to August. *Brahmina coriacea* feed on wide

**Table 2: Capture of white grubs beetles in all sampling sites**

Species	Amba Reserve forest(Shahuwadi)	Radhanagari Wildlife sanctuary	ChandoliNational Park	Ajara	Karveer	Panhala
<i>Apogonia</i> sp.	40	35	30	45	15	25
<i>Brahmina</i> sp.	2	4	8	5	2	1
<i>Holotrichia Karschi</i>	80	50	43	35	98	60
<i>Holotrichia fissa</i>	41	37	15	22	19	49
<i>Holotrichia Serrata</i>	15	24	12	45	40	38
<i>Maladera castanea</i>	10	12	34	55	65	34
<i>Maladera holosericea</i>	13	24	44	50	13	44
<i>Adoretus Lasiopygus</i>	35	24	12	14	150	140
<i>Adoretus versutus</i>	10	23	34	12	108	114
<i>Anomala bengalensis</i>	5	33	40	12	43	2
<i>Anomala</i> sp.	5	23	31	-	1	1
<i>Anomala</i> sp.	1	-	12	2	13	12
<i>Mimela vernate</i>	-	-	-	-	58	-
<i>RhyniptialIndica</i>	10	25	36	17	18	22
<i>Prodoretus</i> sp.	5	18	26	22	33	4
<i>Xylotrupes giedon</i>	3	-	-	2	1	2
<i>Oryctes rhinoceros</i>	-	-	-	-	5	1
<i>Phyllognathus dionysius</i>	5	1	1	1	2	-

variety of trees but it has been considered as major pest of fruit orchards (Beeson, 1941). Chandla *et al.* (1988) stated that it is a serious pest of *Solanum tuberosum* in Himachal Pradesh causing losses up to 56.3%.

#### ***Holotrichia karschi* Brenske**

The beetles were collected on the foliage of *Terminalia tometosa* (Roxb.) Wight and Arn., *Terminalia arjuna* (Roxb.) Wight and Arn., *Guazuma almifolia* Lam., *Acacia auriculiformis* Lam., *Syzygium cumini* (L) Skeels., *Dalbergia latifolia* Roxb. The grubs feed on the roots of *Cinnamomum tamala*. Saplings of *Cinnamomum tamala* are more susceptible to the attack of *H. karschi* grubs. Severe damage was noticed at Amba reserve forest. The species is dominant during June to August. Beetles phototactic in nature. The adults and grubs were collected at all the sites. No data are available on the pest status of this species from the natural stands. Beeson (1941) reported seven species of *Holotrichia* viz. *H. problematica*, *H. seticollis*, *H. tuberculata*, *H. consanguinea*, *H. longipennis* and *H. serrata*.

#### ***Holotrichia fissa* Brenske**

The larvae of *H. fissa* were collected from the fields of Sugarcane and Saplings of teak in the nursery. The adults and grubs were collected at all the sites. The beetles were collected from the foliage of *Terminalia arjuna* (Roxb.) Wight and Arn, *Terminalia tomentosa* (Roxb.) Wight and Arn, *Zizyphus jujuba* (L.) H. Karst., *Syzygium cumini* (L.) Skeels., *Grewia* sp., *Butea monosperma* Roxb. ex Willd, *Careya arborea* Roxb., *Bridelia retusa* Spreng, *Embllica officinalis* Gaertn. The beetles are easily attracted to light. Life cycle is annual. The species was abundant during June to August. This species feed on 22 different plant species in Konkan region Maharashtra (Lolage and Patil, 1988). Chandra (2009) reported this species from Panchmarhi Biosphere reserve, Madhya Pradesh. Grubs cause serious damage to teak seedlings in nurseries and plantation.

#### ***Holotrichia Serrata* Fab.**

The beetles were found to feed on the leaves of *Azadirachta indica* A. Juss., *Tamarindus indica* L., *Acacia nilotica* (L.) Willd. ex. Del., *Butea monosperma* Roxb. ex Willd, *Psidium guajava*

L., *Carissa carandus* L. at all the three sampling sites. The grubs were found to damage the roots of sugarcane, jowar, maize, paddy and groundnut at Panhala, Karveer, Shahuwadi and Ajara. The species was abundant during June to August. Beetles collected on the host plants and attracted to light. The damage caused by grubs of *Holotrichia serrata* in nurseries is one of the main problems in raising *Tectona grandis* plantations. The grubs feed on the tap roots of the seedlings and the damaged plants wilt and die (Bandara, 1990).

#### ***Leucopholis lepidophora* Blanchard**

The grubs were serious pests of Sugarcane from Kolhapur region. The sugarcane cultivated area at bank of river Kumbhi Kasari was the endemic pocket of this species. The grubs were also found in the fields of *Oryza sativa* L. The present flare up of the *Leucopholis lepidophora* in Kolhapur might be due to monoculture of sugarcane crop on large scale area. This indicates that food is sufficiently available to multiply rapidly which in turn help in easy spread of this species over an area. The beetles feed on the foliage of *Saccharum* spp., *Ficus* sp. The species occurs commonly in the Sugarcane fields. The species never recorded in the forested area during the study period. The species was abundant during August to September. Beetles phototactic in nature. Life cycle annual.

#### ***Maladera castanea* Arrow**

The larvae were found to feed on the roots of grasses in the grassland. The beetles devour the foliage of *Carissa carandus* L., *Dimocarpus longan* Lour. Beetles were freely attracted towards light. Life cycle annual. The species was abundant during June to August. The adults and grubs were collected at all the sites.

#### ***Maladera holosericea* Scopoli**

The beetles feed only on the leaves of *Carissa carandus* L in Amba reserve forest.

Grubs feed on the roots of grasses in the grasslands. The adults and grubs were collected at all the sites. The life cycle is annual. Beetles phototactic in nature. The species was abundant in the months June to August. White grubs are polyphagus pests which badly have an effect on the economic status of many

*Apogonia* sp.*Brahmia* sp.*Holotrichia karschi* Br.*Holotrichia fissa* Br.*Holotrichia serrata* Blanch*Leucopholis lepidophora* Blanch.*Maladera castanea*  
Arrow*Maladera holosericea*  
Scopoli*Adoretus lasiopygus*  
Burm*Adoretus verutus* Harold*Anomala bengalensis* Blanch.*Anomala* sp.*Anomala* sp.*Rhomborrhina glaberimma*  
Westwood*Mimela vernate***Plate 1: Diversity of white grub beetles from Kolhapur district (MS) India**

cultivators in India. For case *Maladera insanabilis* Brenske is one of the most injurious and troublesome of soil insects, threatening the total crop production (Awasthi and Dwivedi, 1996).

**Subfamily Rutelinae** - The subfamily Rutelinae represented 10 species.

***Adoretus lasiopygus* Burm**

The immature stages of this species found to damage the roots of *Curcuma aromatica* Salisb. and grasses. The beetles feed on the foliage of *Zizyphus jujuba* (L.) H.Karst, *Terminalia tomentosa* (Roxb.) Wight and Arn, *Terminalia arjuna* (Roxb.) Wight and Arn. Beetles phototactic in nature, life cycle annual. The species was abundant during June to August. The adults and grubs were collected at all the sites.

***A. versutus* Harold**

Beetles feed on the leaves of *Zizyphus jujuba* (L.) H.Karst, *Terminalia tomentosa* (Roxb.) Wight and Arn, *Terminalia arjuna* (Roxb.) at all the sampling sites. The grubs of this species found to damage the roots of *Curcuma aromatica* Salisb. and grasses at all the sampling sites. The species was abundant during June to August. Life cycle annual, Beetles freely attracted towards light.

*Adoretus* is a ruteline genus comprises several species over 100 in India which is nocturnal defoliator in beetle stage and is injurious to seedlings in larval stage. For instance *Adoretus bimarginatus* feed on the foliage of *Bombax malabaricum*, *Cassia fistula* and other trees (Beeson, 1941). Sheldon *et al.* (1995) reported *Adoretus sinicus* on 10 different plant species. In 1964, Habeck stated that this species utilizes 255 plant species as a food source.

***Anomala bengalensis* Blanch.**

The members of the genus *Anomala* feed on wide range of plants. But during the present study this species was recorded only on *Syzygium cumini* (L.) Skeels. The grubs feed on the roots of *Arachis hypogaea* L. The species has life cycle of a year. Beetle easily attracted towards light. Adult Swarming was noticed during May and June. The species was recorded at all the sites.

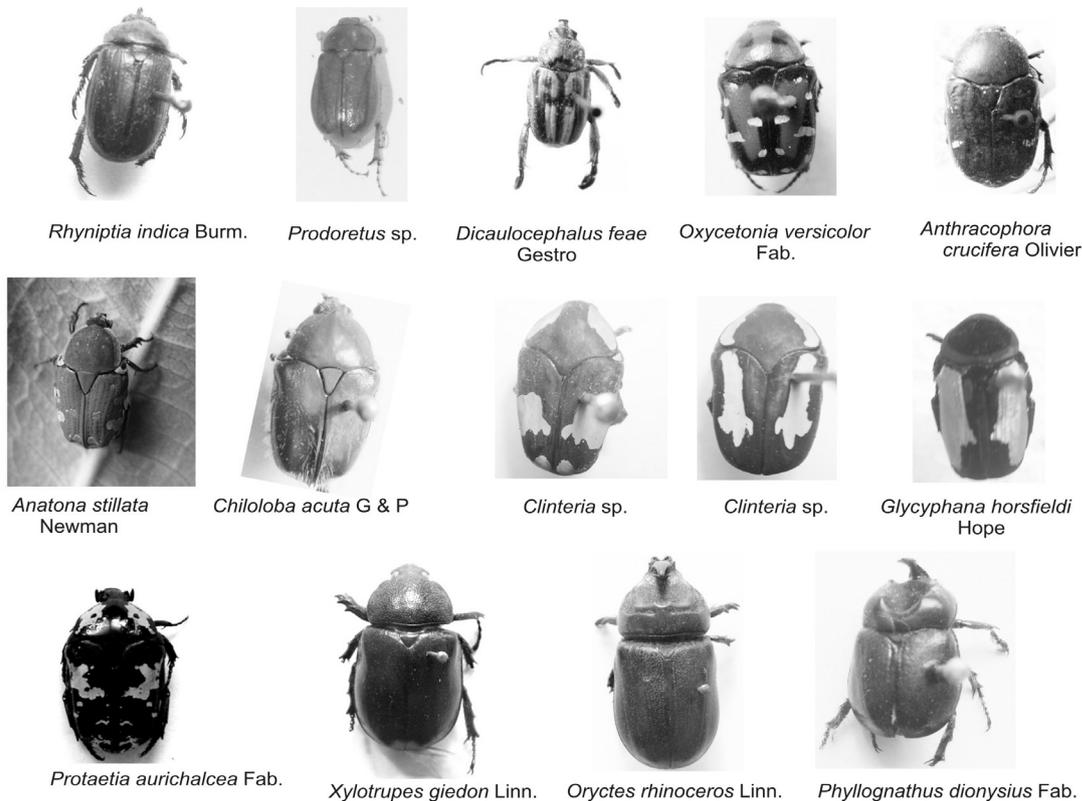
Beeson (1941) reported this species on *Cassia fistula*, *Lagerstroemia* and other trees. The grubs are also injurious to Sugarcane. He listed 13 species of *Anomala* feeding on wide range of trees. For case *Anomala dalbergiae* defoliates *Dalbergia latifolia*, *A. grandis* feed on *Alnus grandis*. Garg and Verma (1993) studied bionomics of *Anomala dimidiata* in Kumaon Hills and reported 32 food plants in beetle stage and 18 host plants during larval stage.

***Anomala* sp.**

The grubs feed on the roots of *Arachis hypogaea* L. Beetles feed on the foliage of *Psidium guajava* L., *Syzygium cumini* (L.) Skeels. The species was recorded at all the sites. Beetles were freely attracted to light trap. Life cycle annual and adults were abundant during June to August. This species was collected at Amba reserve forest, Radhanagari Wildlife Sanctuary, Chandoli National Park, Karveer and Panhala.

***Anomala* sp.**

The larvae feed on the roots of *Arachis hypogaea* L. Beetles feed on the foliage of *Psidium guajava* L., *Syzygium cumini* (L.) Skeels. The species was recorded at all the sites. Beetles were freely attracted to light trap. Life cycle annual and adults were



**Plate 2: Diversity of white grub beetles from Kolhapur district (MS) India**

abundant during June to August. This species was collected at Amba reserve forest, Radhanagari Wildlife Sanctuary, Chandoli National Park, Karveer and Panhala.

***Rhomborrhina glaberimma* Westwood**

Larval host plants are not known from the present study region. Beetles feed on the foliage of *Cassia fistula* L. The species was collected at Amba reserve forest, Chandoli National Park and Panhala during the months June to August. Beetles were not attracted to the light trap.

***Mimela vernate***

The adult host plants are not known from the present study region but grubs were found to damage the roots of *Capsicum* spp. The species was recorded at Karveer site. The species was abundant during June to August.

***Rhyniptia indica* Burm**

Beetles feed on the foliage of *Curcuma aromatica* Salisb. The adults were abundant during August to end of December. Grubs were found to damage the roots of *Sorghum bicolor* L and *Pennisetum glaucum* (L.) R. Br. The species was collected at all sites.

***Prodoretus* sp.**

Adults devour the foliage of *Curcuma aromatica* Salisb. The beetles were abundant during August to end of December. Grubs were found to damage the roots of *Sorghum bicolor* L. and *P. glaucum* (L.) R. Br. The species was collected at all sites.

***Dicaulocephalus feae* Gestro**

The larval host plants are unknown from the present study

region. Adults feed on the foliage of *Apluda mutica* Salisb. No earlier records are available on this species from this region.

**Subfamily cetoniinae**

This subfamily represented 8 species. Cetoniinae is a diverse group of the showiest scarabs comprises approximately 3900 species in 315 genera. Cetoniids are worldwide distributed except for sub polar areas and some offshore New Zealand Islands. Cetoniinae not only comprises shiny, bright metallic species but also velvety forms with cryptic disruption patterns. Adults of most species exhibit diurnal habit feed on flowers as well as plant sap and fruits (Mico *et al.*, 2008).

***Oxycetonia versicolor* Fab.**

As a rule, like other immatures of cetoniids, the grubs of this species feed on the decaying organic matter of plant and animal origin. Beetles feed on the floral parts of *Curcuma aromatica* Salisb., *Sorghum bicolor* L., *Pennisetum glaucum* (L.) R. Br and *Abelmoschus esculentus* (L.) Moench. and *Zea mays* L. The emergence of this beetle coincides with the flowering period of its host plants. The beetles were notice during August to September. The beetles were collected at Karveer, Panhala, Ajara and Amba reserve forest

***Anthracophora crucifera* Olivier**

The grubs of this species feed on the decaying organic matter of plant and animal origin. Beetles feed on the floral parts of *Curcuma aromatica* Salisb., *Sorghum bicolor* L., *Pennisetum glaucum* (L.) R. Br and *Abelmoschus esculentus* (L.) Moench. and *Zea mays* L. The emergence of this beetle coincides with the flowering period of its host plants. The beetles were notice

during August to September. The beetles were collected at Karveer, Panhala, Ajara and Amba reserve forest.

#### **Anatona stillata Newman.**

The immature stages feed on the decayed organic matter. Beetles feed on the floral parts of *Apluda mutica* L., *Heteropogon contorum* (L.) P. Beauv. ex Roem. and Schult. and *Panicum* sp. The beetles were noticed during August to September. The beetles were collected at Karveer, Panhala, Ajara and Amba reserve forest. The beetles were abundant during August to September.

#### **Chiloloba acuta G and P**

The grubs of this species were recorded in the composting heaps. The immature stages feed on the decayed dung and plant material. But the grubs were not recorded within buffalo dung pads in the grasslands. Beetles feed on the floral parts of the *Sorghum bicolor* L., *Pennisetum glaucum* (L.) R. Br., *Zea mays* L., *Panicum* sp., *Apluda mutica* L. and *Heteropogon contorum* (L.) P. Beauv. ex Roem. and Schult. The beetles were collected at all the sampling sites.

#### **Clinteria sp.**

The larval food of this species is not known from this region. Adults feed on the flowers of *Mimusops elengi* L. and *Mammea suriga* (Buch.-Ham. ex Roxb.) Kosterm.

*Clinteria* sp. is being reported for the time from Kolhapur district, Northern Western Ghats, Maharashtra. The species was abundant during March to May. The beetles were collected at Amba reserve forest and Chandoli National Park.

#### **Clinteria sp.**

The food of immature stages of this species is not known from this region. Adults feed on the flowers of *Mimusops elengi* Linn and *Mammea suriga* (Buch.-Ham. ex Roxb.) Kosterm. *Clinteria* sp. is being reported for the time from Kolhapur district, Northern Western Ghats, Maharashtra. The species was abundant during March to May. The beetles were collected at all the sampling sites. Regupathy et al. (1995) reported that grubs of *Clinteria klugi* were injurious to the roots of *Tectona grandis*.

#### **Glycyphana horsfieldi Arrow.**

The grubs are xilosaprophagous, found within the dead wood of *Albizia libbeck* Afr J. and *Samanea saman* (Jacq.) Merr. The food of adult was not known. Other ecological requirements of this beetle were not known. The species was collected at Karveer.

#### **Protaetia aurichalcea Fab.**

The adult and larval food of the species was not known from the present study region. The species was collected at Karveer.

#### **Subfamily dynastinae**

This subfamily represented 3 species. The dynastine beetles are performing a key role in nutrient recycling. The grubs are capable of fragmenting large amounts of wood during their feeding, very much expediting breakdown time (Morón, 1985). During this process, they generate detritus and excretions that make possible the action of other decompositional agents in the microfauna and microflora. This ecological role makes them very important for nutrient recycling in tropical woods (Morón, 1985). Mature reproductive forms of most species are active during dark or crepuscular and phototactic. Members

of the Dynastinae feed on foliage, sap secretions, fruits and floral parts of the plants. The immature forms are saprophagous or phytophagous, feeding on roots, stems, decaying logs, or organic matter. Few individuals are economically important, causing injury to crops such as corn and sugarcane (Morón, 2004). Males in several species especially in the tribes Dynastini, Agaocephalini, and Oryctini have prominent horns and they are large in size which give rise to vernacular names such as "rhinoceros beetle", "elephant beetle", "Hercules beetle" or "unicorn beetle" (Ratcliffe, 2003).

#### **Xylotrupes giedon L.**

The adults were recorded to feed on the *Coccus nucifera* L. and *Ficus* sp in the nursery. The species was collected at Panhala, Shahuwadi and Ajara. The beetles were abundant during June to August. The life cycle was annual. The beetles were easily attracted to light. The beetles were collected at Amba reserve forest, Ajara, Karveer and Panhala. The grubs were collected in the composting heaps at Karveer and Panhala.

#### **Oryctes rhinoceros L.**

The beetles feed on the *Coccus nucifera* L. and *Ficus* sp. Beetles get freely attracted to light. The species was collected at all the sites. The life cycle was annual. The species was abundant during June to August. The grubs were collected in the composting heaps at Karveer and Panhala.

#### **Phyllognathus dionysius Fab**

Grubs feed on the roots of jowar, bajara, maize and turmeric. The beetles feed on the foliage of *Ficus* sp. Beetles freely attracted to light. The species was collected at all the sites. The life cycle was annual. The species was abundant during June to August. The grubs were collected from the fields of rice, maize and sugarcane at Ajara, Shahuwadi and Panhala. The adults were captured on light trap at all sites.

The cultivators of sugarcane, paddy, jowar, tobacco, maize and chilli are facing the problem of white grubs in Kolhapur district. The principal pest species are *Leucopholis lepidophora*, *Holotrichia karschi*, *Holotrichia fissa*, *Holotrichia serrata*, *Anomala bengalensis* and *Phyllognathus dionysius*. It may perhaps due to large scale cultivation of these crops. This makes the availability of large scale food belt with alternative food plants to the pest species. The unregulated use of insecticides in the intensive cropping patterns and change in physical factors of the environment also play a significant role in the outbreak of pest species (Raodeo and Deshpande, 1987).

Except Cetoniids, the abundance and emergence of beetles was observed during June to second week of August. Perhaps, heavy rainfall in the month of August affected the emergence of beetles. Cetoniids showed different pattern of emergence. Their emergence coincided with flowering period of host plants. The incidence of Cetoniids was observed in hot weather and wet weather conditions. The incidence of *Oxycetonia versicolor* Fab., *Anatona stillata* Newman, *Chiloloba acuta* G & P and *Anthrachophora crucifera* Olivier was recorded from August to September in rainy season. *Clinteria* sp. was observed on the flowers of *Mimusops elengi* and *Mammea suriga* in hot weather during the months March to May. The occurrence of beetles varies in time and space and also with

respect to the food plants. The beetles showed wide distribution in the agriculture ecosystem but in the forests they exhibited different patterns of distribution according to the availability and types of plants. Among the species recorded during the investigation, *H. fissa*, *H. karschi*, *H. serrata*, *A. versutus*, *A. lasiopygus*, *Chiloloba acuta* and *Clinteria* sp. Showed specificity in the distribution within the present study area. *H. karschi* preferred *T. tomentosa* and *T. arjuna* for feeding in Amba reserve forest while in Chandoli National Park the species was recorded on *Acacia auriculiformis*. *H. fissa* was frequently recorded on the *Carissa carandus* in Radhanagari wildlife Sanctuary but in Chandoli National Park it was found on *Embllica officinalis*. *H. serrata* was recorded on the *Azadirachta indica* in suburban areas wherever the Neem exists. In the absence of Neem, beetles feed on the foliage of *Acacia nilotica* and *Tamarindus indica*. *Adoretus versutus* and *Adoretus lasiopygus* feed on the *Terminalia tomentosa* and *Terminalia arjuna*. But in the absence of these food plants these beetles preferred *Zizyphus jujuba*. The beetles were recorded on *Terminalia* in Amba reserve forest, Radhanagari Wildlife Sanctuary and Chandoli National Park while at Karveer the species were recorded on the *Zizyphus jujuba*. *Chiloloba acuta* mainly feed on the jowar, maize and bajara but in the absence of these plants in the grassland this species was recorded on the grasses *Apluda mutica*, *Heteropogon contorum* and *Panicum* sp.

Similar observations were recorded in case of *Clinteria* sp. The species feed on the floral parts of *Mimusops elengi* and *Mammea suriga*. The primary food plant of adult was *Mimusops elengi* in the absence of *M. elengi* beetles feed on the flowers of *Mammea suriga*. In Amba reserve forest, it was recorded on both host plants while in Radhanagari Wildlife Sanctuary and Chandoli National Park, the species feed on the floral parts of *Mammea suriga*. *Mammea suriga* has wide distribution within the present study area. Stebbing (1914) has described the geographical distribution of insect, especially beetles of economic importance, from the Indian forests. The distribution of insects in the woodland is depending upon the type of forest that the area is covered by which type of principle tree species. The shifting of host plants in absence of primary food plants which in turn help these polyphagous insects to adapt under continuously changing systems and start new generation. The present study will help in the management of such polyphytophagous insects from the cultivated and natural stands.

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