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To prepare distribution map of white grub species in Western Maharashtra

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Abstract
The present investigation was undertaken during 2025–26 to prepare distribution maps of white grub species in Western Maharashtra using geographical coordinates recorded during field surveys. Five districts namely Kolhapur, Sangli, *Satara*, Pune and Solapur, were surveyed, and the coordinates of collection localities together with species information were compiled and mapped using Quantum Geographic Information System (QGIS). A total of nineteen white grub species belonging to five subfamilies of Scarabaeidae were recorded. The species-wise distribution map revealed that the recorded species were not uniformly distributed across Western Maharashtra. The highest concentration of collection localities and species diversity was observed in Kolhapur, followed by Sangli and *Satara*, whereas comparatively fewer collection sites were recorded in Pune and Solapur. Several species occurred at the same sampling locations, indicating coexistence of different white grub species under similar ecological conditions. The subfamily-wise map showed that Melolonthinae had the widest geographical distribution and occurred in all surveyed districts. Rutelinae was also comparatively widespread, whereas Dynastinae, Cetoniinae and Hybosorinae occurred at fewer localities. Kolhapur contained representatives of all major subfamilies and showed comparatively high taxonomic diversity. The maps provide a spatial baseline for documenting white grub diversity, identifying areas of species occurrence and supporting future biodiversity assessment, monitoring and location-specific management in Western Maharashtra.

Keywords: White grub, Distribution map, QGIS, Geographical coordinates, Scarabaeidae, Melolonthinae, Western Maharashtra

Introduction

White grubs are an important component of the scarabaeid fauna associated with agricultural and natural ecosystems. Their distribution is influenced by environmental conditions, host plants, soil characteristics and the availability of suitable habitats. Because several species can occur together within the same geographical region, documenting their spatial occurrence is essential for understanding regional diversity and identifying areas where economically important species are established.

Maharashtra supports a rich diversity of white grub beetles. Bhawane *et al.* (2012) [1] documented considerable scarabaeid diversity in the Northern Western Ghats of Maharashtra, while Gite *et al.* (2015) [2] reported sixteen white grub species from Western Maharashtra. Such findings indicate that species composition can vary geographically and that systematic mapping can provide a clearer understanding of the distribution of white grub species across different agro-climatic regions.

Geographical Information System (GIS) provides an effective approach for representing species occurrence spatially. When field observations are associated with geographical coordinates, GIS-based maps can display the locations of collection sites and permit comparison of species occurrence among districts. Species-wise and subfamily-wise mapping is particularly useful for identifying areas of greater diversity, regions where particular taxonomic groups are widespread and localities where multiple species coexist.

Western Maharashtra contains contrasting environmental conditions and a range of agricultural landscapes. The present investigation therefore focused on preparing species-wise and subfamily-wise distribution maps of white grub species recorded from Kolhapur, Sangli, *Satara*, Pune and Solapur districts. The objective was to document the geographical occurrence of the recorded species and provide a spatial baseline for future ecological studies and management planning.

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Materials and methods

Study area and survey districts

The study was conducted in five districts of Western Maharashtra, namely Kolhapur, Sangli, *Satara*, Pune and Solapur, during 2025–26. Field surveys were conducted in selected tehsils and localities of each district. Sampling sites were selected on the basis of cropping pattern and the presence of suitable host trees near roadsides and agricultural fields.

Collection of white grub beetles

Adult scarabaeid beetles were collected during the evening and night emergence period following rainfall. White grub pheromone lures and light traps fitted with ultraviolet or LED bulbs were used at selected field locations. Hand collection was also undertaken after pre-monsoon showers by shaking branches of commonly occurring host trees and collecting the adults. The collected beetles were pinned and submitted to the All India Network Project on White Grub and Other Soil Arthropods, Bengaluru, *Karnataka*, for identification.

Recording of geographical coordinates

The geographical coordinates of each collection locality were recorded during the field survey using the GPS Map Camera application. Latitude and longitude data were recorded along with the species information for the corresponding collection site. The coordinate data and species details were compiled in Microsoft Excel before being used for spatial mapping.

Preparation of distribution maps

The distribution maps were prepared using Quantum Geographic Information System (QGIS) software. The geographical coordinates and species information compiled in Microsoft Excel were imported into QGIS. Collection locations were plotted on the map of Western Maharashtra and separate species-wise and subfamily-wise maps were generated using suitable symbols and colours. The resulting maps were used to visualise the geographical occurrence of white grub species across the five surveyed districts.

Data interpretation

The distribution pattern was interpreted from the presence or absence of each recorded species at the surveyed district/locality level. The total number of recorded species and the concentration of collection localities were compared among districts. The taxonomic distribution of the recorded species was also examined at the subfamily level. No inference was made beyond the surveyed localities.

Results and discussion

Species-wise distribution of white grub species

A total of nineteen white grub species belonging to five subfamilies of Scarabaeidae were recorded from the five surveyed districts. The species-wise distribution map prepared in QGIS demonstrated that white grub species were not uniformly distributed throughout Western Maharashtra. The distribution pattern showed clear differences in the occurrence of species among the surveyed districts and localities.

The highest concentration of collection localities was observed in Kolhapur district, followed by Sangli and *Satara*, whereas comparatively fewer collection sites were recorded in Pune and Solapur. Several collection localities contained more than one species, resulting in overlapping occurrences. Such co-occurrence indicates that different white grub species can occupy similar geographical locations and persist under comparable local ecological conditions.

District	No. of species recorded	Total adults collected	Relative distribution pattern
Kolhapur	19	2,001	Highest species richness and collection concentration
Sangli	14	798	High concentration of collection localities
Satara	12	531	Intermediate species richness and collection concentration
Pune	4	539	Fewer species and collection localities
Solapur	4	473	Fewer species and collection localities

The greater concentration of collection localities and species diversity in Kolhapur indicates that this district represented an important centre of white grub diversity within the surveyed region. The occurrence of multiple species at individual sites further demonstrates spatial overlap and coexistence. The comparatively lower number of recorded species in Pune and Solapur should be interpreted in relation to the surveyed collection localities and should not be taken as evidence that other species are absent from the districts as a whole.

Table 1. District-wise occurrence of white grub species in Western Maharashtra

Sr.	Species	Pune	*Satara*	Sangli	Kolhapur	Solapur	No. of individuals
1	*Holotrichia serrata*	+	+	+	+	+	1104
2	*Holotrichia farinosa*	+	+	+	+	+	321
3	*Holotrichia fissa*	+	+	+	+	+	610
4	*Holotrichia ruboflava*	+	+	+	+	+	35
5	*Sophrops karschi*	–	–	–	+	–	24
6	*Apogonia sp.*	+	+	–	–	–	82
7	*Maladera (Maladera) sp.*	–	+	–	+	–	49
8	*Alissonotum piceum*	–	+	+	+	–	197
9	*Phyllognathus dionysius*	–	+	+	+	+	632
10	*Protaetia (Indoprotaetia) alboguttata*	–	–	+	+	–	34

(continued on next page)

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Sr.	Species	Pune	*Satara*	Sangli	Kolhapur	Solapur	No. of individuals
11	*Hybosorus illigeri*	–	+	+	+	–	88
12	*Anomala bengalensis*	–	+	+	+	–	471
13	*Anomala dorsalis*	–	–	+	+	–	131
14	*Anomala rugosa*	–	–	–	+	–	22
15	*Anomala sp. 1*	–	–	+	+	–	155
16	*Anomala sp. 2*	–	+	+	+	–	213
17	*Adoretus (Adoretus) sp. 1*	–	+	+	+	–	87
18	*Adoretus (Adoretus) sp. 2*	–	+	+	+	–	81
19	*Parastasia rufopicta*	–	–	–	+	–	6

Note: (+) indicates presence and (–) indicates absence, as reported in the supplied distribution table.

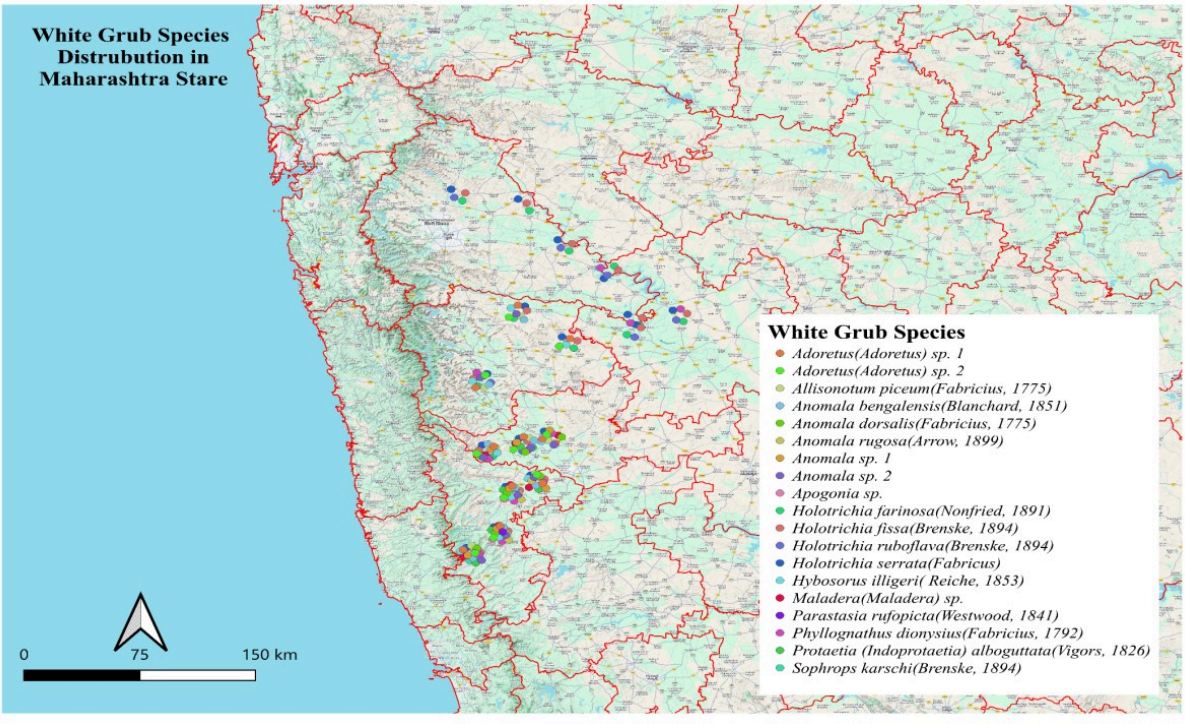


Figure 1. Species-wise distribution map of white grub species in Western Maharashtra

The species-wise map represents the geographical occurrence of all nineteen recorded white grub species across the five surveyed districts. The map is based on the geographical coordinates collected during the field survey and provides a spatial representation of the sampling localities and species occurrence.

Subfamily-wise distribution of white grub species

The recorded nineteen species belonged to five subfamilies, namely Melolonthinae, Rutelinae, Dynastinae, Cetoniinae and Hybosorinae. The subfamily-wise distribution map revealed marked differences in geographical spread among these taxonomic groups. Melolonthinae exhibited the widest distribution and occurred in all five surveyed districts. Rutelinae was also comparatively widespread, whereas Dynastinae, Cetoniinae and Hybosorinae were recorded from fewer localities.

Subfamily	Geographical distribution	Interpretation
Melolonthinae	All five surveyed districts	Widest distribution and predominant subfamily
Rutelinae	Several surveyed districts	Comparatively widespread distribution
Dynastinae	Restricted localities	Comparatively restricted occurrence
Cetoniinae	Restricted localities	Comparatively restricted occurrence
Hybosorinae	Restricted localities	Comparatively restricted occurrence

Melolonthinae was therefore the most widely distributed white grub subfamily in the study area. Its occurrence in all surveyed districts indicates broad geographical representation across the contrasting environments of Western Maharashtra. Kolhapur showed representatives of all major subfamilies, reflecting comparatively high taxonomic diversity within the surveyed localities.

The subfamily-wise map provides a visual comparison of the geographical spread of the five recorded scarabaeid subfamilies. The wider occurrence of Melolonthinae and the comparatively restricted occurrence of the other subfamilies are evident from the mapped collection localities.

Spatial concentration of collection localities

The distribution map showed that the collection localities were concentrated most strongly in Kolhapur, followed by Sangli and *Satara*. Pune and Solapur contained comparatively fewer collection localities. The concentration of sampling sites in Kolhapur and adjoining areas

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may be associated with favourable rainfall, moderate temperature, diverse cropping systems and suitable habitats supporting scarabaeid beetles, as indicated in the supplied results.

The presence of multiple species at individual sampling locations is an important feature of the spatial pattern. It indicates that white grub species were not necessarily segregated geographically and that several species could coexist within the same local environment. Such overlapping occurrence is particularly relevant for pest surveillance because a single locality may contain more than one economically important scarabaeid species.

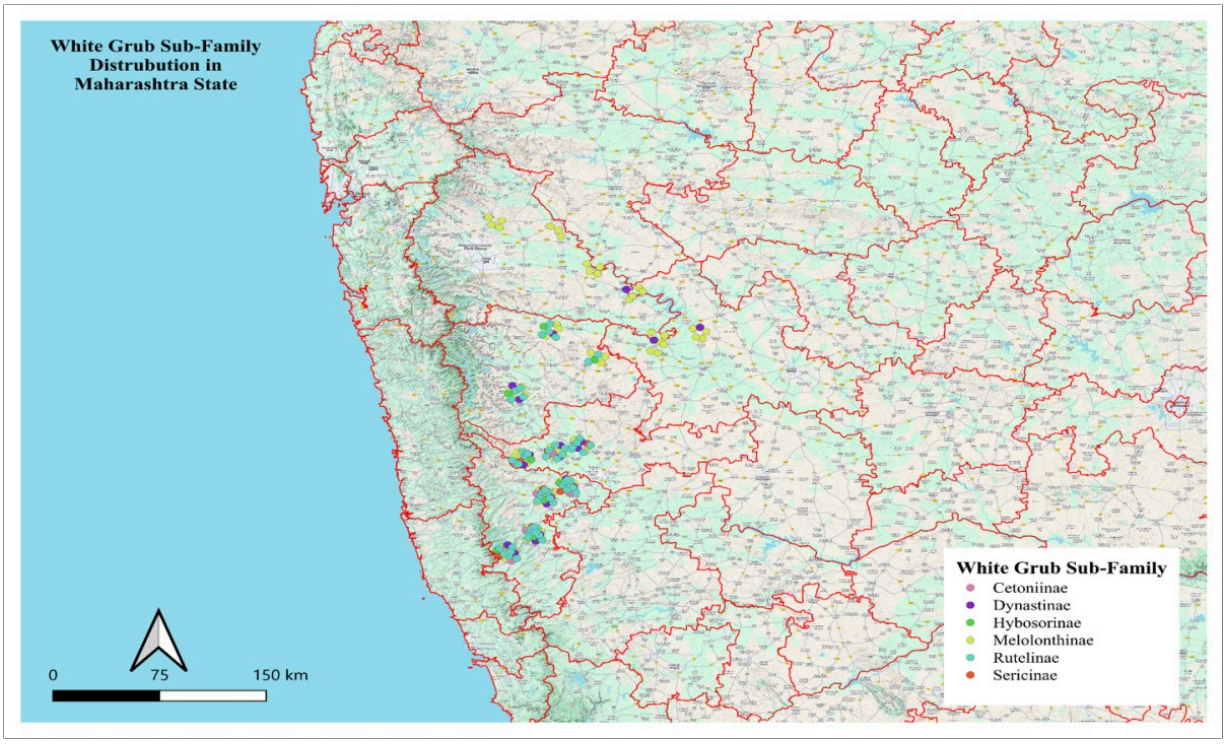


Figure 2. Subfamily-wise distribution map of white grub species in Western Maharashtra

Geographical distribution of important species

The species occurrence matrix provides a clear interpretation of the major geographical patterns. *Holotrichia serrata, H. farinosa, H. fissa* and *H. ruboflava* were recorded from all five districts. Their presence across the complete surveyed district range indicates that these species had the broadest district-level distribution among the recorded species.

Phyllognathus dionysius was recorded from *Satara*, Sangli, Kolhapur and Solapur but was not recorded from Pune. *Anomala bengalensis* was recorded from *Satara*, Sangli and Kolhapur, while *Anomala* dorsalis occurred in Sangli and Kolhapur. Several species, including *Sophrops karschi, Anomala rugosa* and *Parastasia rufopicta*, were restricted to Kolhapur in the supplied district-level data.

Apogonia sp. occurred in Pune and *Satara*, while *Maladera (Maladera) sp*. occurred in *Satara* and Kolhapur. *Alissonotum piceum* was recorded from *Satara*, Sangli and Kolhapur. The restricted distribution of several species compared with the widespread occurrence of *Holotrichia* species demonstrates considerable variation in geographical occurrence within the white grub complex.

Species/group	Districts recorded	Distribution status
H. serrata	Pune, *Satara*, Sangli, Kolhapur, Solapur	Widespread
H. farinosa	Pune, *Satara*, Sangli, Kolhapur, Solapur	Widespread
H. fissa	Pune, *Satara*, Sangli, Kolhapur, Solapur	Widespread
H. ruboflava	Pune, *Satara*, Sangli, Kolhapur, Solapur	Widespread
P. dionysius	*Satara*, Sangli, Kolhapur, Solapur	Widespread but absent from Pune in survey
A. bengalensis	*Satara*, Sangli, Kolhapur	Intermediate
A. piceum	*Satara*, Sangli, Kolhapur	Intermediate
A. dorsalis	Sangli, Kolhapur	Restricted
S. karschi	Kolhapur	Restricted
A. rugosa	Kolhapur	Restricted
Parastasia rufopicta	Kolhapur	Restricted

Discussion

The spatial distribution recorded in the present investigation demonstrates that Western Maharashtra supports a diverse white grub fauna with marked differences in geographical occurrence. The highest species concentration in Kolhapur and the presence of multiple species at common collection sites indicate that environmental heterogeneity and habitat availability may support a complex scarabaeid assemblage. Bhawane *et al.* (2012) [1] similarly documented rich scarabaeid diversity in the Northern Western Ghats of Maharashtra.

The widespread distribution of Melolonthinae is an important feature of the present maps. Its occurrence across all surveyed districts suggests broad ecological representation. The comparatively restricted distribution of Dynastinae, Cetoniinae and Hybosorinae may indicate narrower habitat occurrence or lower abundance within the surveyed collection localities. The predominance of Melolonthinae agrees with the observations of Bhawane *et al.* (2012) [1] and Gite *et al.* (2015) [2], who reported Melolonthinae as an important scarabaeid group in Maharashtra.

The species-wise map also demonstrates that distribution was not uniform even within the same district. Some species were recorded at many localities, whereas others were restricted to fewer sites. This spatial variation provides useful baseline information for subsequent ecological studies. It also indicates that district-level descriptions

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alone may not fully represent local species occurrence, making georeferenced field observations and GIS mapping valuable for future surveillance.

Relation of mapped distribution with agro-climatic conditions

Although the second objective was primarily spatial, the mapped distribution can be interpreted alongside the climatic and ecological conditions documented during the survey. Kolhapur, which showed the highest concentration of collection localities and species diversity, also represented a comparatively favourable environment with higher rainfall and moderate temperatures. Sangli and *Satara* showed intermediate-to-high diversity and collection concentration. Pune and Solapur had fewer recorded species and comparatively fewer collection sites.

The spatial pattern should, however, be interpreted as the distribution observed from the surveyed collection localities rather than as a complete inventory of every locality within each district. The supplied methodology indicates that sampling sites were selected on the basis of cropping pattern and the presence of host trees near roadsides and agricultural fields. Therefore, sampling intensity and site selection form part of the observed spatial pattern.

The maps are particularly useful for establishing a baseline against which future surveys can be compared. Repeated mapping using the same geographical framework can help identify changes in the occurrence, expansion or contraction of species distributions. Such comparisons would be valuable for examining possible shifts in distribution under changing environmental conditions, provided that future surveys use comparable sampling coverage and georeferenced observations.

Table 2. Summary of spatial distribution pattern

Parameter	Observation
Total species recorded	19
Subfamilies recorded	5
Districts surveyed	5
Highest species diversity	Kolhapur
Second-highest collection concentration	Sangli
Next collection concentration	*Satara*
Comparatively fewer collection sites	Pune and Solapur
Widest subfamily distribution	Melolonthinae
Species recorded in all five districts	*H. serrata, H. farinosa, H. fissa* and *H. ruboflava*
Multiple species at same localities	Observed

Significance of the distribution maps

The prepared species-wise and subfamily-wise maps provide a visual baseline for understanding the geographical occurrence of white grub species in Western Maharashtra. They can assist in identifying areas with higher species richness, recognising widely distributed species and identifying species with comparatively restricted occurrence. Such information is useful for planning future sampling, biodiversity documentation and location-specific monitoring.

The maps also provide a framework for integrating future observations with climatic, cropping and habitat information. Periodic updating of the maps can help document temporal changes in geographical occurrence. The present results therefore establish an initial spatial reference for future studies of white grub ecology and distribution in Western Maharashtra.

Summary and conclusion

Distribution maps of white grub species and their subfamilies were prepared using QGIS based on geographical coordinates recorded during field surveys in Kolhapur, Sangli, *Satara*, Pune and Solapur districts. Nineteen species belonging to five subfamilies were recorded. The species-wise distribution pattern showed that white grub species were not uniformly distributed throughout the surveyed region.

Kolhapur showed the highest concentration of collection localities and species diversity, followed by Sangli and *Satara*, whereas comparatively fewer collection sites were recorded in Pune and Solapur. Several species occurred at the same collection locations, indicating coexistence. Melolonthinae showed the widest geographical distribution and occurred in all five districts, while Rutelinae was also comparatively widespread and Dynastinae, Cetoniinae and Hybosorinae were more restricted.

The distribution maps provide baseline information on the geographical occurrence and taxonomic distribution of white grub species in Western Maharashtra. They can support future biodiversity assessment, repeated spatial monitoring and location-specific management planning. Because the maps represent the surveyed collection localities, continued georeferenced sampling will be important for detecting future changes in species distribution.

Conclusion

The present investigation successfully documented the spatial distribution of nineteen white grub species across five districts of Western Maharashtra using QGIS and field-recorded geographical coordinates. The distribution was heterogeneous, with the greatest concentration of species and collection localities in Kolhapur. Melolonthinae was the most widely distributed subfamily and occurred throughout the surveyed region. The resulting species-wise and subfamily-wise maps provide a useful baseline for future ecological studies, biodiversity documentation and monitoring of white grub distribution in Western Maharashtra.

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