Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(4): 902-908

Received: 01-05-2020
Accepted: 03-06-2020

KC Sahoo
M.Sc. Student, Dept. of Entomology, College of Agriculture, Rajendranagar, PJTSAU, Hyderabad, Telangana, India

V Sunitha
All India Network Project on Vertebrate Pest Management, PJTSAU, Rajendranagar, Hyderabad, Telangana, India

V Vasudeva Rao
All India Network Project on Vertebrate Pest Management, PJTSAU, Rajendranagar, Hyderabad, Telangana, India

D Srinivasa Chary
Dept. of Statistics and Mathematics, College of Agriculture, Rajendranagar, PJTSAU, Hyderabad, Telangana, India

Corresponding Author:
KC Sahoo
M.Sc. Student, Dept. of Entomology, College of Agriculture, Rajendranagar, PJTSAU, Hyderabad, Telangana, India

Diversity and abundance of coleopteran fauna at agri-biodiversity park of Professor Jayashankar Telangana state agricultural University, Hyderabad, Telangana, India

KC Sahoo, V Sunitha, V Vasudeva Rao and D Srinivasa Chary

Abstract
The abundance and diversity of Coleoptera (Insecta: Animalia) at Agri-biodiversity park of Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana, India was studied from September 2019 to January 2020. Using five different collection methods (pitfall trap, yellow pan trap, manual collection, light trap and yellow sticky trap), 5,580 individuals under 21 families of Coleoptera were recorded. The most abundant family was Staphylinidae with 31.27% species followed by Scarabaeidae (21.72%). Among the collection methods employed, the light trap method yielded the maximum number of individuals (3,558) besides as many as 18 representative families. The Shannon-Weiner diversity Index, Margalef's species richness index and Pielou's evenness index for coleopteran fauna of the study area were 2.231, 2.318 and 0.732, respectively. The present study indicates a great diversity of beetles in the area and provides preliminary data for future works.

Keywords: Coleoptera, diversity, species richness, evenness, abundance, Hyderabad

Introduction
Insects are the most successful group of animals on earth with 1,020,007 known species constituting 66% animals and 82% arthropod diversity. Amongst the insects, Coleoptera is the most successful order possessing 387,100 species worldwide, representing 38% of insect species [1]. Within Coleoptera, the majority of the species belong to six hyper-diverse families, viz. Curculionidae, Staphylinidae, Chrysomelidae, Carabidae, Scarabaeidae and Cerambycidae. The Indian insect fauna is represented by 63,760 species grouped in 658 families of 27 order among these, the order Coleoptera is the most diverse having 17,455 species under 114 families [2].

The Coleopterans, commonly called 'beetles', possess a unique character, *i.e.* the highly sclerotized forewings (elytra). The elytra are not capable of flight, but they act as a shield to protect these tiny creatures from any kind of circumstance in its environment, making them the most successful forms of animal life on earth. The diversity of coleopterans is not just in number but also in ecological functions. Some of these are general predators on other arthropods, some others predate on crop pests. These as crops pest attack various plant parts from root to seeds and more importantly, the stored grains. Some coleopterans are decomposers, feeding on dead and decaying matter. Most of them are terrestrial though some are aquatic, playing important roles in aquatic ecosystems.

Professor Jayashankar Telangana State Agricultural University (PJTSAU), Hyderabad, is the first Agricultural University in India to initiate the establishment of Agri-Biodiversity Park (ABP) in August 2008, in 60 ha area with natural ecosystem and half of it is occupied by a pond [3]. The existing flora of this habitat includes tree species like *Tectona grandis*, *Butea monosperma*, *Syzygium cumini*, *Ficus* spp., *Pongamia pinnata*, *Madhuca longifolia*, *Albizia lebbeck*, *Senna/Cassia* spp., *Dalbergia sissoo*, *Vachellia nilotica*, *Tamarindus indica*, *Annona reticulate*, *Azadirachta indica* and *Prosopis juliflora* besides a diverse species of shrubs, herbs and grasses. There was no documentation of the insect fauna from this habitat both qualitatively and quantitatively. Keeping in view the vast ecological and biological diversity of beetles, it was aimed to investigate the diversity and abundance of the Coleopteran fauna in this unique habitat.

Material and Methods

Study site: The sampling of Coleoptera fauna was were carried out from September 2019 to January 2020 at the Agri-biodiversity Park of PJTSAU, Rajendranagar, Hyderabad, India, which is located at 17°31' N and 78°42' E and an altitude of 559 m from mean sea level (Fig.1).

Collection methods: The collection of coleopteran fauna was carried out using five traditional sampling methods at weekly intervals. The five collection methods employed were (i) Pitfall traps (N=50), (ii) Yellow pan traps (N=30), (iii) Light traps (N=5),(iv) Yellow sticky traps (N=30) and manual collection. Soap water was used in pitfall traps and yellow pan traps to kill the trapped insects. Manual collections were done by 3 hr active sweeping during day time (9 am–12 noon) by moving in a diagonal path and taking five sweeps at every 50m interval along with the collection of insects on the ground, in leaf litter, grasses, under logs, tree barks and other substrates by hand-picking and using an aspirator. Light traps fitted with collecting bottles (containing 50% alcohol) were operated in evening hours (6 to 9 pm) to collect nocturnal insects. Beetles trapped in yellow sticky trap were counted from the trap directly with the help of a magnifying lens. The specimens were identified up to family level with the help of Triplehorn and Johnson [4].

Fig 1: Map of Agri- biodiversity Park, PJTSAU, Hyderabad

The following diversity indices were computed by using the software; PAST (Paleontological Statistics Tool) version 3.25.

Shannon-Wiener Diversity index: It is a measure of community diversity and it takes into account the number of individuals as well as the number of taxa. It was calculated by the following formula:

$H = -\Sigma Pi \ln Pi$

Where, $Pi = S / N$
S = number of species
N = total number of individuals
In = logarithm to base e

Margalef's species richness index: It is used as a simple measure of species richness to know the number of different taxa or species present in a community. It was estimated by the following formula:

Margalef's index $(R) = (S - 1) / \ln N$

Where, S = total number of species
N = total number of individuals in the sample
In = natural logarithm
In the present study, the taxon used is family instead of species.

Pielou's Evenness Index: It is an index for calculating the evenness of species and the degree of distribution of individuals in the various taxa of a community. It was calculated by the following formula:

Pielou's Evenness Index (e) = H / In S
Where, H = Shannon – Wiener diversity index
S = total number of species (families) in the sample

Besides these three diversity indices, the relative abundance of each coleopteran family was also calculated by the following formula.

Relative abundance (%) = ni × 100/N

Where, N: the total number of individuals in all families
ni: the number of individuals in i^{th} family

Results and Discussion

During the study period in the Agri-biodiverstiy park, 5,580 individuals of Coleoptera were collected which were identified as of 21 families (Plates 1, 2, 3 & 4). The list of the coleopteran families with number of individuals, relative abundance and methods of collection is given in table 1. The decreasing order of coleopteran families with respect to number of individuals is as follows; Staphylinidae (1745) > Scarabaeidae (1212) > Coccinellidae (510) > Hydrophilidae (339) > Chrysomelidae (314) > Curculionidae (267) > Carabidae (226) > Elateridae (200) > Heteroceridae (156) > Dytiscidae (120) > Bostrychidae (82) > Buprestidae (78) > Histeridae (76) > Silvanidae (74) > Cerambycidae (46) > Mordellidae (37) > Brentidae (29) > Erotylidae (25) > Meloidae (23) > Tenebrionidae (15) > Prionoceridae (6) (Fig.2).

The diversity of coleopteran fauna recorded in different parts of India showed a wide variation: 13 families from Thar Desert, Rajasthan [5]; 9 families from Kalatop- Khajjiar Wildlife Sanctuary of Himachal Pradesh [6]; 152 Coleopteran species of 101 genera under 25 families from Amba reserve forest of Kolhapur, Maharashtra [7]; 6 families from Melghat Tiger Reserve, Maharashtra [8]**;** 13 families from Jalgaon district of Maharashtra [9]; 5196 individuals under 32 coleopteran families from Gujarat [10].

Table 1: The methods of collection and the number of individuals of the families of Coleoptera gathered and their relative abundance

Sl. No.	Families	Methods of Collection	No. of Individuals	Relative Abundance (%)
1	Bostrychidae	LT	82	1.47
2	Brentidae	YPT, MC, LT	29	0.52
3	Buprestidae	MC, LT	78	1.40
4	Carabidae	YPT, PFT, MC, LT	226	4.05
5	Cerambycidae	MC, LT	46	0.82
6	Chrysomelidae	YPT, PFT, MC, LT, YST	314	5.63
7	Coccinellidae	YPT, MC, LT, YST	510	9.14
8	Curculionidae	YPT, PFT, MC, LT, YST	267	4.78
9	Dytiscidae	LT	120	2.15
10	Elateridae	YPT, PFT, MC, LT	200	3.58
11	Erotylidae	LT	25	0.45
12	Heteroceridae	LT	156	2.80
13	Histeridae	PFT, LT	76	1.36
14	Hydrophilidae	LT	339	6.08
15	Meloidae	MC	23	0.41
16	Mordellidae	LT	37	0.66
17	Prionoceridae	MC	6	0.11
18	Scarabaeidae	YPT, PFT, MC, LT	1212	21.72
19	Silvanidae	LT	74	1.33
20	Staphylinidae	YPT, PFT, MC, LT, YST	1745	31.27
21	Tenebrionidae	PFT	15	0.27
	Total		5580	

(Light Trap; MC- Manual Collection; PFT- Pitfall trap; YPT- Yellow Pan Trap; YST- Yellow Sticky Trap)

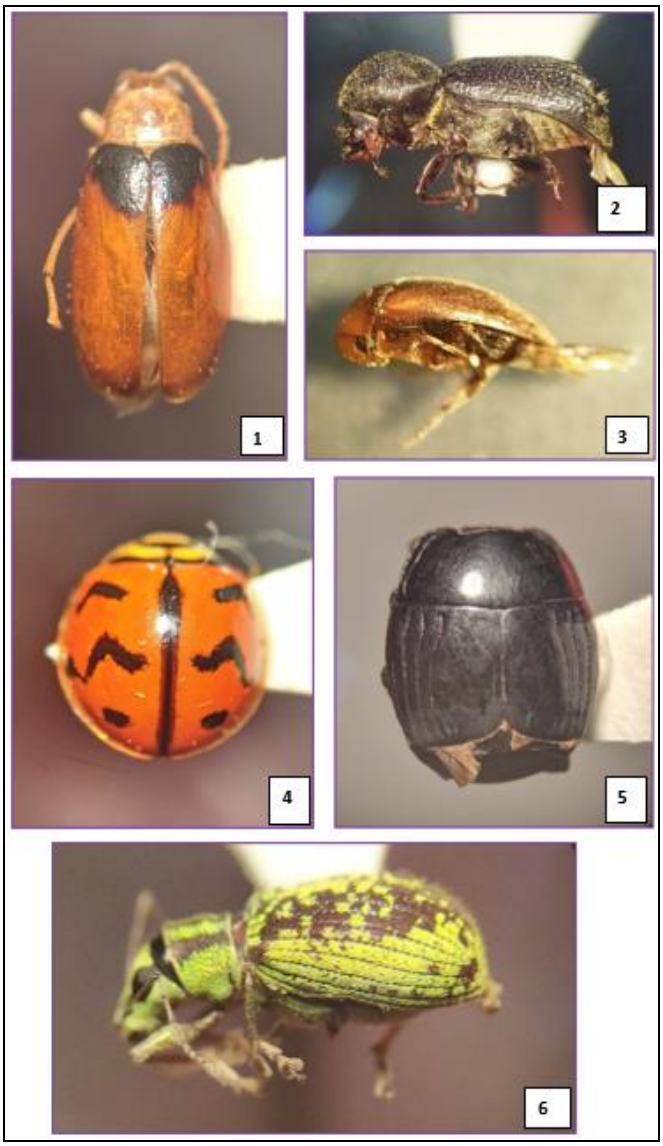

Plate 1: Families of Coleoptera: 1. Chrysomelidae, 2. Bostrychidae, 3. Mordellidae, 4.Coccinellidae, 5. Histeridae, 6. Curculionidae

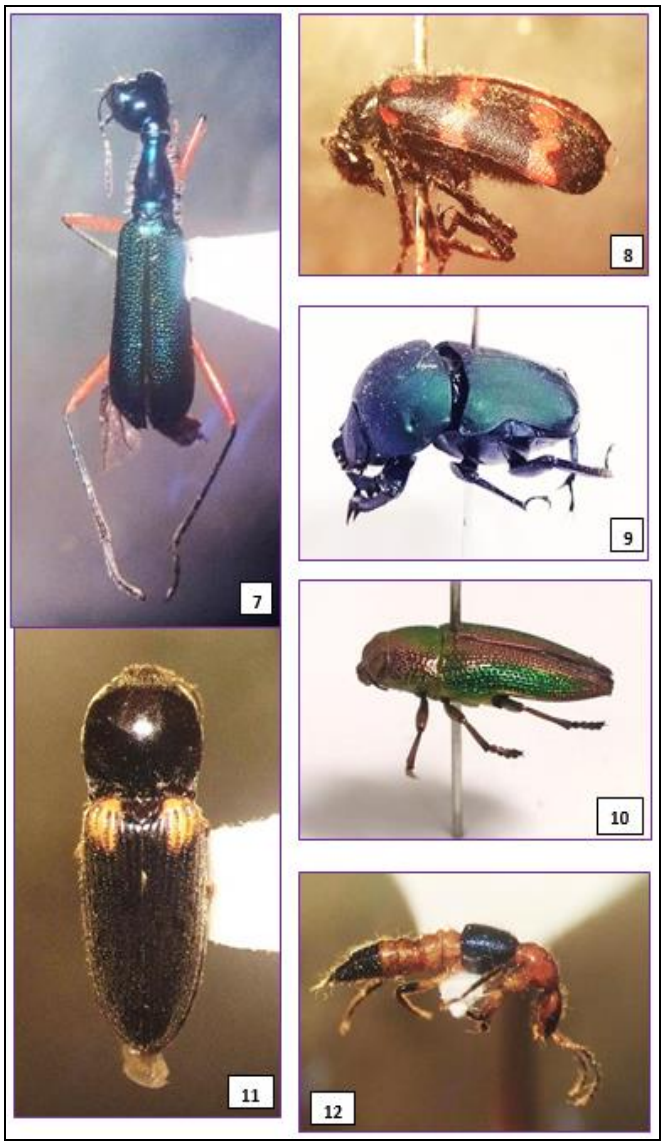

Plate 2: Families of Coleoptera (Contd.): 7. Carabidae 8. Meloidae, 9. Scarabaeidae, 10. Buprestidae, 11. Elateridae, 12. Staphylinidae

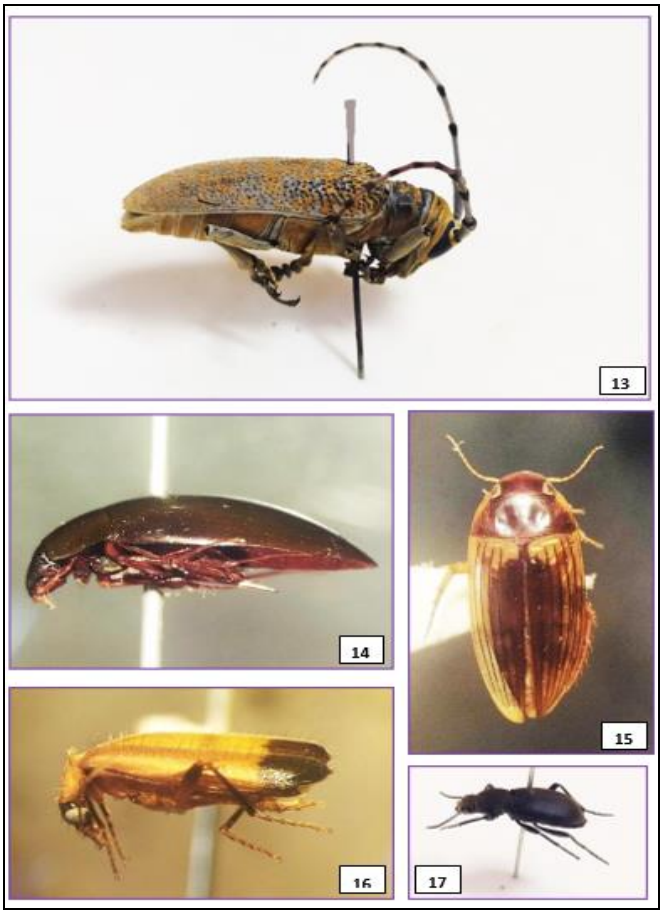

Plate 3: Families of Coleoptera (Contd.): 13. Cerambycidae, 14. Hydrophilidae, 15. Dytiscidae, 16. Prionoceridae, 17. Tenebrionidae

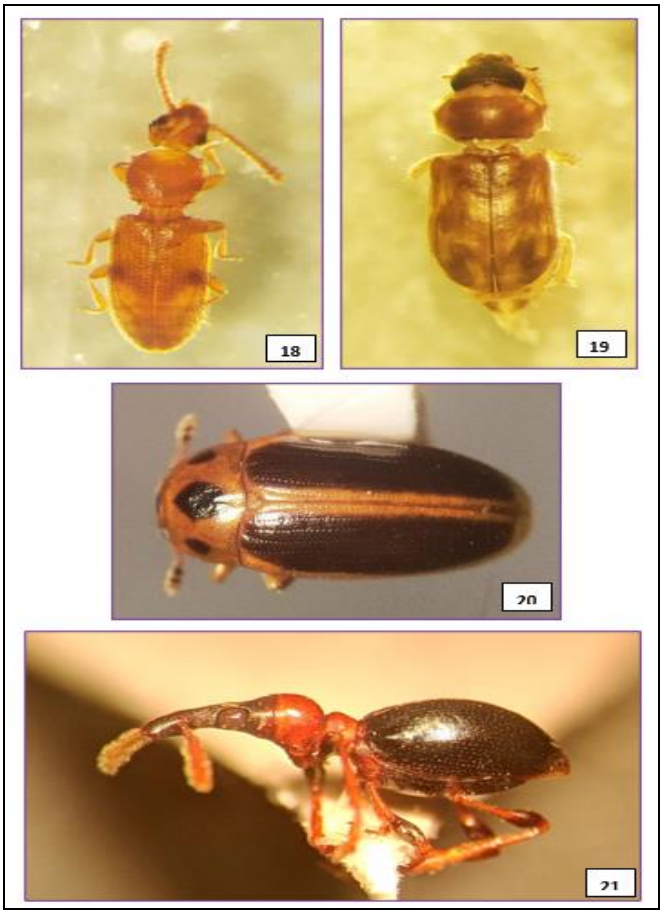

Plate 4: Families of Coleoptera (Contd.): 18. Silvanidae, 19. Heteroceridae, 20. Erotylidae, 21. Brentidae

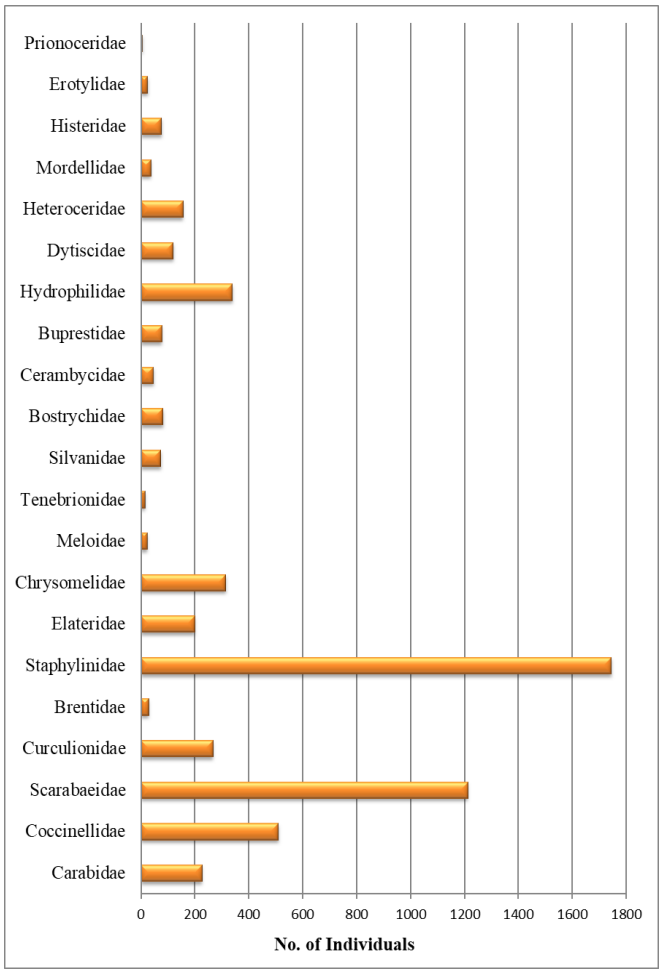

Fig 2: Number of individuals collected in different families of Coleoptera

The highest number of coleopterans were collected by Light trap (3558), followed by Yellow pan trap (754), Pitfall trap (568) and Yellow sticky trap (404). The manual collection yielded the lowest number of individuals (296) but they represented the number of families (12) only next to those from Light trap (18 families) (Figs.3 & 4). The Pitfall trap and Yellow pan trap could help to gather members of eight families each and Yellow sticky trap four families (Fig.4).

Among the 21 recorded families of Coleoptera, the family Staphylinidae was found to be most abundant (31.27%) followed by Scarabaeidae (21.72%), Coccinellidae (9.14%), Hydrophilidae (6.08%), Chrysomelidae (5.63%), Curculionidae (4.78%), Carabidae (4.05%), Elateridae (3.58%), Heteroceridae (2.80%), Dytiscidae (2.15%), Bostrychidae (1.47%), Buprestidae (1.40%), Histeridae (1.36%) and Silvanidae (1.33%). Families such as Cerambycidae, Mordellidae, Brentidae, Erotylidae, Meloidae, Tenebrionidae and Prionoceridae were least abundant (RA <1%) (Fig.5).

Most of the earlier investigations on Coleopteran fauna in different regions of India reported Scarabaeidae to be the most abundant among the coleopteran families [7][9]. However, the present study finds Staphylinidae as the most abundant family followed by Scarabaeidae, together contributing to more than 50% of the total individuals collected from the study area. The greater catch of in Light traps could be the reason for the higher abundance of rove beetles, the Staphylinidae. The Staphylinidae are a large family of Coleoptera with more than 63,657 species under 32 subfamilies and 167 tribes globally. The small, flattened and

flexible body with shortened elytra enables them to inhabit all kinds of crevices in the soil. They live in and prey upon a variety of soil organisms such as soil fungi, collembolans or oribatid mites [11]. In India, more than 3000 species of rove beetles are known but an updated comprehensive of Indian Staphylinidae is not yet available [12].

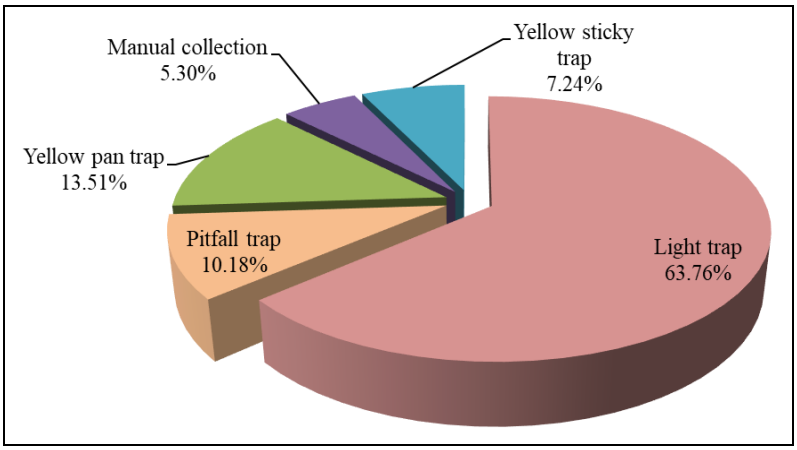

Fig 3: Percentage of total coleopterans recorded in different traps

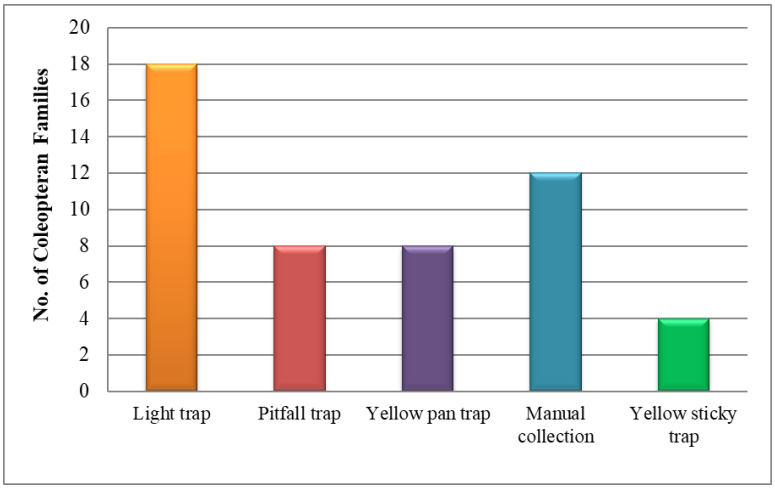

Fig 4: Number of Coleopteran families recorded in different collection methods

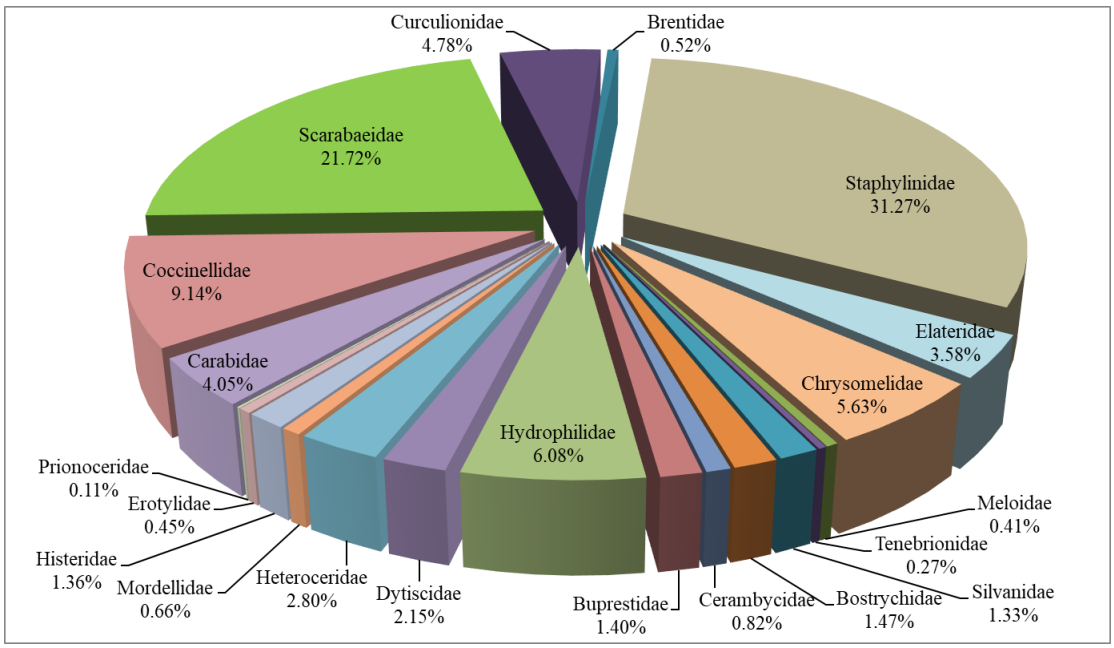

Fig 5: Relative abundance of different families of Coleoptera

The family Scarabaeidae is one of the largest families of Coleoptera. It includes dung beetles, chaffer beetles and white grubs. Dung beetles are coprophagous and act as important scavengers and decomposers. The chaffer beetles and white

grubs are phytophagous and some are regarded as serious pests of economically important crops. The study at Barnawapara Wildlife Sanctuary (Chhattisgarh) listed 43 species of scarab beetles of 25 genera, eight subfamilies in two families [13]. From Achanakamar Wildlife Sanctuary, also from Chhattisgarh, Chandra & Singh [14] reported 22 species of scarab beetles belonging to 11 genera and six subfamilies.

The Coccinellidae are the third most abundant family in the present survey with a relative abundance of 9.14%. The members of this family are predaceous on soft-bodied insects in their larval and adult stages. Next in abundance were the families Chrysomelidae (5.63%) and Curculionidae (4.78%) which are phytophagous and feed plant parts like leaves, stem and roots. The other phytophagous or otherwise plant-associated coleopteran families found were Elateridae, Bostrychidae, Buprestidae, Cerambycidae, Brentidae and Meloidae. The larvae of Elateridae (wireworms) are associated with roots of plants whereas the members Bostrychidae make small holes on the stems of trees and are minor pests. The grubs of Cerambycidae feed by making tunnels inside the tree trunk and can cause severe damage to some economically important tree species. However, in the present study, the abundance of Cerambycidae is very less (0.82%). The grubs of Buprestidae are also borers of plants but not notorious. The straight-snouted weevils (Brentidae) are plant feeders in both larval and adult stage whereas Meloidae, which include blister beetles, are flower feeders and constitute minor pests in instances.

The aquatic beetles recorded were of Hydrophilidae and Dytiscidae, with a relative abundance of 6.08% and 2.15%, respectively. The family Carabidae (ground and tiger beetles), which are generalized predators, were present with a relative abundance of 4.05%. The Carabid beetles serve as bio-indicators of changes in the environmental conditions of a habitat/ ecosystem [15].

The Heteroceridae, Histeridae and Silvanidae showed moderate abundance (<5% each). Members of family Heteroceridae, the variegated mud-loving beetles, inhabit mud or sand along the bank of streams, lakes, rivers or ponds by making shallow tunnels in the damp soil. In the present study, they had a relative abundance of 2.80%. Family Histeridae (1.36%), the clown beetles, have a wide range of habitats (faeces, fungi, tree trunks, roots, decomposing fruit, bird nests, burrows of mammals or reptiles, and in decaying vegetation) and are important predators of eggs and larvae, particularly of Cyclorrhaphan Diptera [16]. The Silvanidae which are flat and minute fungivorous beetles and a few examples of stored product pests had a relative abundance of 1.33%.

The Mordellidae, Erotylidae, Tenebrionidae and Prionoceridae represented with very less abundance (<1%). The family Mordellidae are flower-visiting beetles while their larvae mostly inhabit decaying wood, showed very less abundance (0.66%). The members of Erotylidae (pleasing fungus beetles) are known to inhabit dead and decaying wood where rotting fungi proliferate had a relative abundance of 0.45%. The Tenebrionids, called darkling beetles, feed on a variety of plant material including decaying matter, wood, leaf litter and pollen; some members are pests of stored grains and few others are predaceous. These beetles were found to be 0.27%. The Prionoceridae are a small family of pollen feeders showed up just with six individuals (0.11%).

The present study reveals that Light trap is an effective method for collecting Coleopterans as it helped to gather a maximum number of individuals as well as families. Some families like, Silvanidae, Bostrychidae, Hydrophilidae, Dytiscidae, Heteroceridae, Mordellidae and Erotylidae could be exclusively collected by light traps only though these collections were mostly dominated by rove beetles and scarab beetles. A similar study using Light trap, at Akola vicinity, Maharashtra, showed a rich population of Coleoptera *i.e.* 41.81% and 35.10% during 2011-12 and 2012-13, respectively, with the highest abundance of scarab beetles [17]. Yellow pan trap is good for diurnal coleopterans like Coccinellids and Chrysomelids. Pitfall trap was effective for collecting ground dwellers like dung beetles (Scarabaeidae) and ground beetles (Carabidae). Yellow pan trap and pitfall trap recorded 8 families each and 754 and 568 coleopteran individuals, respectively. Manual collection recorded the lowest number of individuals but it was found to be the second-best collection method, next to light trap, in terms of the number of Coleopteran families. For families like Meloidae and Prionoceridae, it was the only method of collection. Yellow sticky trap helped to record just four families. Although light trap has reported the maximum number of coleopterans, a combination of trapping methods should be employed to collect more diverse coleopteran families.

The Shannon-Weiner diversity, Margalef's species richness and Pielou's evenness indices for the Coleopteran fauna of the study area were 2.231, 2.318 and 0.732, respectively, indicating their good diversity and richness in the study area. The difference in results with earlier studies can be attributed to various reasons like the difference in sampling methods, duration of the study, frequency of sampling, geographical and climatic differences, etc.

Conclusion

The present study indicates a great diversity of beetles in the area with various ecological functions representing a balanced ecosystem. This study will provide preliminary data on the coleopteran families of the area, which may be helpful for future works focusing on individual families and their identification up to species level. Among the different trapping methods used in the present study, Yellow sticky trap had limitations. It is not suitable if the insects are to be identified beyond the family level, as it is difficult to recover the trapped insects from the glue.

Acknowledgements

The authors are thankful to Head, Dept. of Entomology, College of Agriculture, Rajendranagar, Hyderabad, for allowing to do the research work and also extended sincere thanks to Agri –biodiversity park managing authority. We also thank Vatsavaya S. Raju, Retd. Professor, Department of Botany, Kakatiya University, Warangal, Telangana-506009, India, for revising the manuscript.

References

1. Zhang ZQ. Animal biodiversity: an introduction to higher-level classification and taxonomic richness. Zootaxa. 2011; 3148:7-12.
2. Chandra K. Insect fauna of states and union territories in India. ENVIS Bulletin: Arthropods and their Conservation in India (Insects & Spiders). 2011; 14(1):189-218.
3. Khan MAA, Krishna A. Agro-biodiversity park for conservation and preservation of native flora and fauna in

Professor Jayashankar Telangana State Agricultural University, India. Journal of Agricultural Science and Technology. 2017; B7:351-357.
4. Triplehorn CA, Johnson NF. Borror and DeLong's Introduction to the Study of Insects. 7th ed, Thomson Brooks/Cole., Belmont, California, 2005, 864.
5. Kazmi SI, Ramamurthy VV. Coleoptera (Insecta) fauna from the Indian Thar desert, Rajasthan. Zoos' Print Journal. 2004; 19(4):1447-1448.
6. Sharma RM, Mitra B, Chakraborty P. Beetles of Kalatop-Khajjiar Wildlife Sanctuary, Himachal Pradesh. Zoos' Print Journal. 2004; 19(9):1626.
7. Aland SR, Mamlayya AB, Bhawane GP. Diversity of beetles (Insecta: Coleoptera) in and around Amba Reserve Forest, Western ghat, Kolhapur. Avishkar-Solapur University Research Journal. 2012; 2:31-41.
8. Thakare VG, Zade VS. Diversity of Colepteran species in and around Tarubanda village, Gugamal Range, Melghat Tiger Reserve, Central India. Science Research Reporter. 2012; 2(1):78-80.
9. Pawara RH, Patel NG, Pawara, JV, Gavit PJ, Ishi SS. Beetles of Jalgaon district of Maharashtra, India. Biolife. 2014; 2(3):970-973.
10. Thakkar B, Parikh PH. A Study on diversity and abundance of coleopterans in Gujarat, India. Journal of Entomology and Zoology Studies. 2016; 4(5):1082-1089.
11. Betz O, Irmler U, Klimaszewski J. Biology of Rove Beetles (Staphylinidae)- Life History, Evolution, Ecology and Distribution. Springer, New York, 2018, 379.
12. Sar A, Ilango K. New Records of Rove Beetles (Coleoptera: Staphylinidae: Paederinae) from Mizoram, India. Rec. Zool. Surv. India. 2016; 116(3):233-240.
13. Chandra K, Gupta D. Scarab beetles (Coleoptera: Scarabaeoidea) of Barnawapara Wildlife Sanctuary, Chhattisgarh, India. Journal of Threatened Taxa. 2013; 5(12):4660-4671.
14. Chandra K, Singh SP. Scarabaeid beetles (Coleoptera) of Achanakmar Wildlife Sanctuary, Chhattisgarh. National Journal of Life Sciences. 2010; 7(1):71-74.
15. Rainio J, Niemela J. Ground Beetles (Coleoptera: Carabidae) as bio indicators. Biodiversity and Conservation, 2003; 12:487-506.
16. Cajaiba RL, Perico E, Silva WB, Santos M. Seasonal Patterns in the Diversity of Histerid Beetles (Histeridae) are Ecosystem Specific? A Case in Para State, Northern Brazil. Applied Ecology and Environmental Research. 2017; 15(4):1227-1237.
17. Dadmal SM, Khadakkar S. Insect faunal diversity collected through light trap at Akola vicinity of Maharashtra with reference to Scarabaeidae of Coleoptera. Journal of Entomology and Zoology Studies. 2014; 2(2):44- 48.