Journal of Plant Development Sciences
Meerut, India

RESEARCH

DIVERSITY OF HYMENOPTERA AT THE VOC AGRICULTURAL COLLEGE CAMPUS, KILLIKULAM, TUTICORIN DISTRICT, TAMIL NADU, INDIA

K. Elanchezhyan[1]*, D. Lenin Raja[2], N. Rajinimala[3], L. Allwin[1] and T. Abdul Razak[1]

[1]VOC Agricultural College and Research Institute, TNAU, Killikulam, Vallanadu - 628252, Thoothukudi, Tamil Nadu, India
[2]Dept. of NRM, Horticultural College and Research Institute, TNAU, Periyakulam, Theni, Tamil Nadu, India
[3]Rice Research Station, TNAU, Ambasamudram, Tirunelveli, Tamil Nadu, India
Email: drchezhiyanphd@gmail.com

Received-02.09.2024, Revised-14.09.2024, Accepted-28.09.2024

Abstract: A study was conducted to assess the diversity of Hymenopterans at the VOC Agricultural College and Research Institute, Killikulam, Tamil Nadu, India. A total of 746 individuals of hymenopterans belonging to 20 genera and 24 species within five families were recorded. The Formicidae family contributed the highest number of individuals (419), followed by Apidae with 221, Vespidae with 92, Scoliidae with 13, and Sphecidae, which had just 1 individual, the least represented. The fire ant, *Solenopsis geminata* (Family: Formicidae), was the most abundant species with 186 individuals, accounting for 24.93% of the total hymenopterans recorded. The month of August, 2024 had the highest activity with 348 individuals, while the lowest numbers were observed in June 2024 with 53. Species diversity was highest in the Formicidae family (1.90) and lowest in the Apidae family (1.30).

Keywords: Hymenopterans, Diversity, Diversity indices, Killikulam

INTRODUCTION

The order Hymenoptera is one of the largest order of insects which include more than 100,000 described species (Sachin, 2020). Approximately 1,20,000 species are known globally, with the Indian fauna accounting for around 10,000 species across 65 families. (Alfred *et al*., 1998). Hymenoptera order comprises the minute to medium sized insects such as bees, wasps, carpenter bees, ichneumon flies, saw flies and ants. They are important for the balancing and functioning of most ecosystems in the planet and beneficial for human economy. Some hymenopterans are phytophagous, whereas others are herbivorous, predatory or even parasitic. So far, no comprehensive account of hymenopteran is available at the Agricultural College campus, Killikulam. The main objective of this study was to collect, identity and document diversity and abundance of hymenopterans at the Agricultural College campus, Killikulam. The present study would help to know the diversity and abundance of hymenopterans for the creation of baseline data in the locality of Agricultural College campus, Killikulam. Hence, the present investigation was carried out to document Hymenopteran insects for better understanding the diversity at the Agricultural College campus, Killikulam.

MATERIALS AND METHODS

The study area is located at the foothills of Vallanadu Blackbuck Sanctuary, approximately 35 km from Thoothukudi, Tamil Nadu, Southern India, covering 476.61 hectares. It lies at an altitude of 40 meters above mean sea level, at 8° 46' N latitude and 77° 42' E longitude. The region experiences significant rainfall during the North-East Monsoon (October - November), with temperatures ranging from 21.6°C to 26.8°C at their lowest and 30.1°C to 37.9°C at their highest. The relative humidity varies between 74% and 91%. The study area is covered mainly by agricultural, horticultural and forest ecosystems.

Collections of hymenopteran insects were made from various locations of the college. Insects were collected preferably in the early hours of the day as insects, especially hymenopteran insects, are mostly active at this time. The collected insects were killed by ethyl acetate. The insects were pinned, preserved and identified with the help of taxonomic keys.

The percentage distribution of various species in the survey area was determined using the following formula.

$$\text{Per cent distribution} = \frac{\text{Number of species}}{\text{Total number of species collected}} \times 100$$

*Corresponding Author

DIVERSITY INDEX ANALYSIS

Diversity Index was computed by following the Simpson's Index (D), Simpson Diversity Index (1-D), Simpson's Reciprocal Index (1/D), Shannon - Wiener Diversity index (H) along with its equitability component, Berger-Parker Dominance Index, Margalef's Richness Index (d), Menhinick Index, Buzas and Gibson's Index by using the software 'Biodiversity Calculator' (http://www.alyoung.com/labs/biodiversity_calculator.html).

Table 1. Species richness, composition and status of Hymenopterans at the V.O.C Agricultural College Campus, Killikulam

Genus	Scientific Name	Common Name	June '24	July '24	Aug '24	Total
Family: Apidae						
Amegilla	*Amegilla cingulata*	Blue banded bee	05	02	-	07
Apis	*A. cerena indica*	Asian honeybee	-	51	108	159
	A. dorsata	Rock bee	-	1	10	11
	A. mellifera	European honeybee	-	-	01	01
Thyreus	*Thyreus nitidulus*	Cuckoo bee	02	-	-	02
Xylocopa	*Xylocopa fenestrata*	Carpenter bee	03	09	25	37
	X. pubescens	Carpenter bee	-	-	04	04
		Sub Total (A)	**10**	**64**	**147**	**221**
Family: Formicidae						
Camponotus	*Camponotus compressus*	Black ant	11	78	47	136
Meranoplus	*Meranoplus bicolor*	Bicolored shield ant	-	13	-	13
Paratrechina	*Paratrechina longicornis*	Black crazy ant	-	16	-	16
Solenopsis	*Solenopsis geminata*	Fire ant	-	98	88	186
	S. invicta	Red ant	11	07	-	18
Tetraponera	*Tetraponera rufonigra*	Bicoloured arboreal ant	12	13	25	50
		Sub Total (B)	**34**	**225**	**160**	**419**
Family: Scoliidae						
Campsomeris	*Campsomeris plumipes*	Feather legged scoliid wasp	-	-	01	01
Scolia	*Scolia* spp.	Scoliid wasp	-	01	03	04
Liacos	*Liacos erythrasoma*	Scoliid wasp	-	01	01	02
Megacampsomeris	*Megacampsomeris reticulata*	Scoliid wasp	-	02	04	06
		Sub Total (C)	**-**	**04**	**09**	**13**
Family: Sphecidae						
Sceliphron	*Sceliphron caementarium*	Black waisted mud dauber wasp	-	-	01	01
		Sub Total (D)	**-**	**-**	**01**	**01**
Family: Vespidae						
Delta	*Delta esuriens*	Thread waisted wasp	-	01	-	01
Eumenes	*Eumenes latreilli*	Potter wasp	01	01	06	08
Phimenes	*Phimenes flavopictus*	Potter wasp	-	-	01	01
Polistes	*Polistes dorsalis*	Paper wasp	06	32	04	42
Ropalidia	*Ropalidia brevita*	Thread waisted wasp	-	02	03	05
Vespa	*Vespa tropica*	Yellow banded wasp	02	16	16	34
		Sub Total (E)	**09**	**52**	**31**	**92**
		Sub Total(A+B+C+D+E) = Total	**53**	**345**	**348**	**746**

Table 2. Relative abundance of Hymenopterans at the College Campus, Killikulam

Family	Number of genus (%)	Number of Species (%)	Number of Individuals (%)
Apidae	04 (20.00)	07 (29.16)	221 (29.62)
Formicidae	05 (25.00)	06 (26.08)	419 (56.16)
Scoliidae	04 (20.00)	04 (17.39)	13 (1.74)
Sphecidae	01 (05.00)	01 (4.34)	01 (0.13)
Vespidae	06 (30.00)	06 (26.08)	92 (12.33)
Total	**20 (100)**	**24 (100)**	**746 (100)**

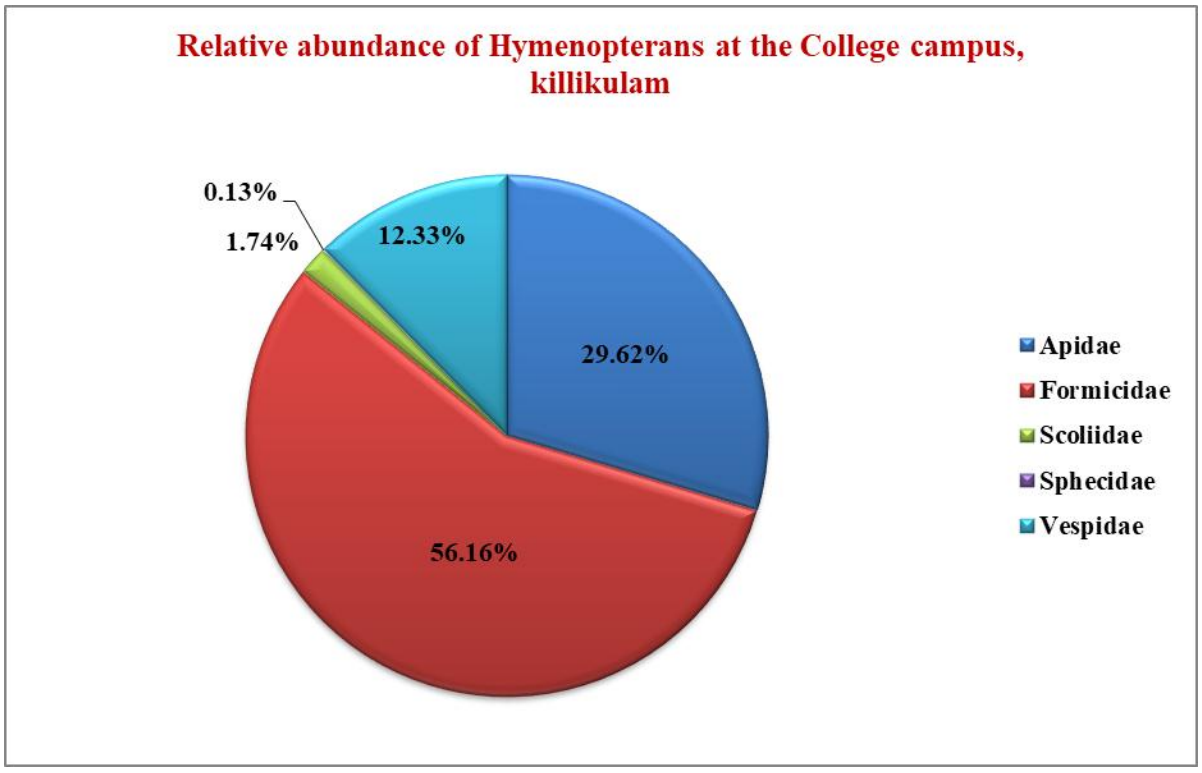

Fig. 2. Relative abundance of Hymenopterans at the College Campus, Killikulam

Table 3. Relative Abundance of Hymenopteran species at Agricultural College campus, Killikulam

S.No	Family	Species	No. of Individuals	Abundance (%)
1.	Apidae	*Amegilla cingulata*	07	0.94
2.		*Apis cerana*	159	21.31
3.		*A. dorsata*	11	1.47
4.		*A. mellifera*	01	0.13
5.		*Thyreus nitidulus*	02	0.27
6.		*Xylocopa fenestrate*	37	4.96
7.		*X. pubescens*	4	0.54
8.	Formicidae	*Camponotus comppressus*	136	18.23
9.		*Meranoplus bicolor*	13	1.74
10.		*Paratrechina longicornis*	16	2.14
11.		*Solenopsis geminata*	186	24.93
12.		*S. invicta*	18	2.41
13.		*Tetraponera rufonigra*	50	6.70

14.	Scoliidae	*Campsomeris plumipes*	01	0.13
15.		*Campsomeriella* spp.	04	0.54
16.		*Liacos erythrasoma*	02	0.27
17.		*Megacampsomeris reticulata*	06	0.80
18.	Sphecidae	*Sceliphron caementarium*	01	0.13
19.	Vespidae	*Delta eusriens*	01	0.13
20.		*Eumenes latreilli*	08	1.07
21.		*Phimenes flavopictus*	01	0.13
22.		*Polistes dorsalis*	42	5.63
23.		*Ropalidia brevita*	05	0.67
24.		*Vespa tropica*	34	4.56
		Total	**746**	

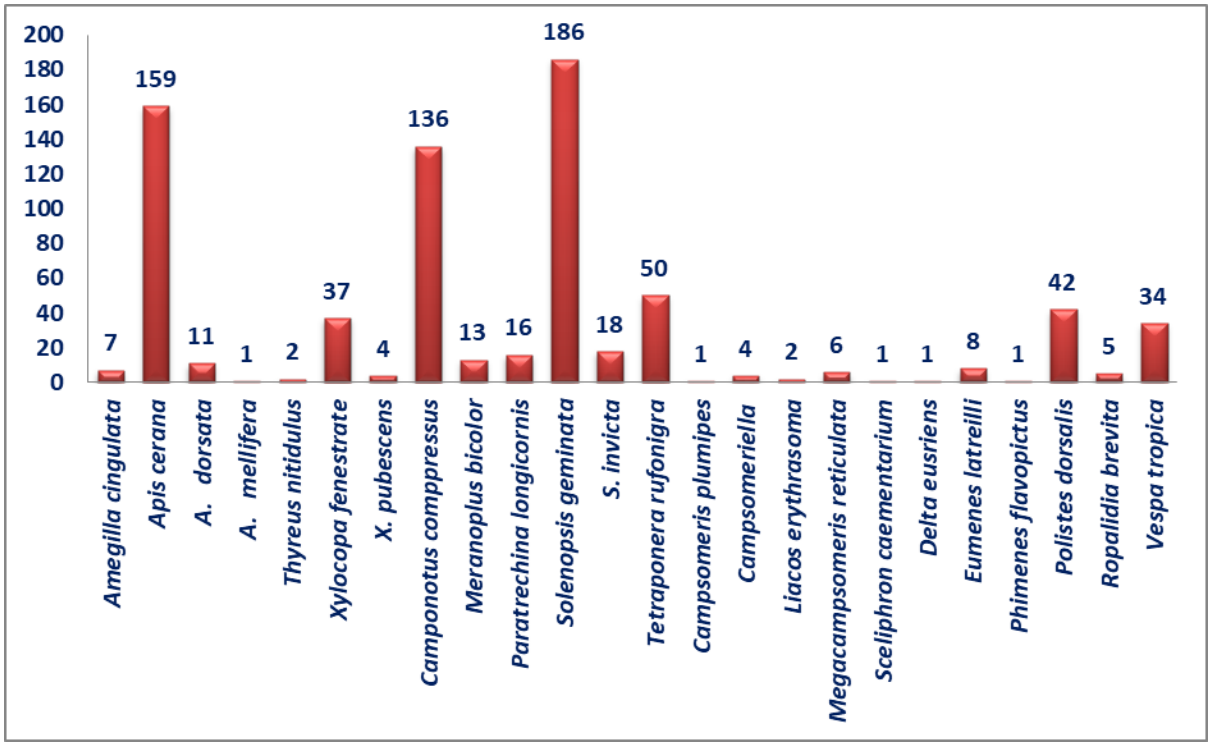

Fig. 3. Abundance of Hymenopteran species at the Agri College Campus, Killikulam

Table 4. Monthwise abundance of Hymenopterans at the Agricultural College campus, Killikulam

S.No	Family	June, 2024	July, 2024	August, 2024	Total
1.	Apidae	10	64	147	221
2.	Formicidae	34	225	160	419
3.	Scoliidae	-	04	09	13
4.	Sphecidae	-	-	01	01
5.	Vespidae	09	52	31	92
	Total	**53**	**345**	**348**	**746**

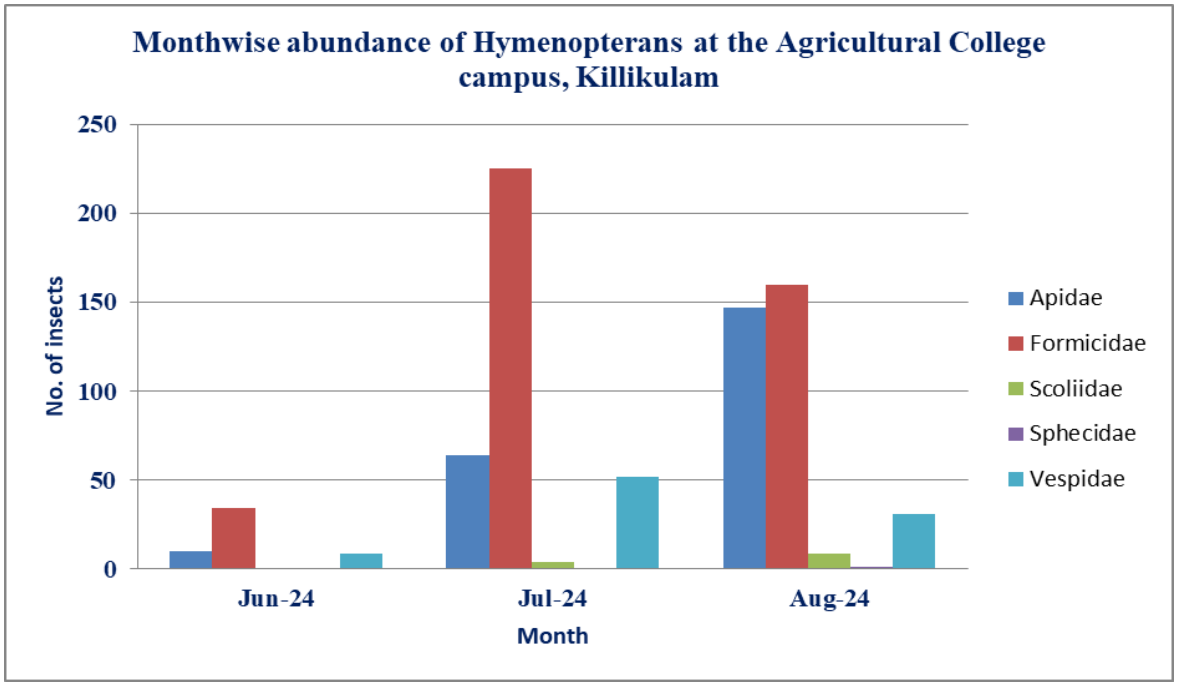

Fig. 4. Monthwise abundance of Hymenopterans at the Agri College campus, Killikulam

Table 5. Diversity Indices of different Hymenopteran species at the VOC Agricultural College Campus, Killikulam

S. No	Family	No. of Genus	No. of species	No. of individuals	Shannon-Wiener Diversity Index (H)	Shannon's Equitability Index (J)	Simpson's Index (D)	Simpson's Index of Diversity (1-D)	Simpson's Reciprocal Index (1/D)	Berger-Parker Dominance Index	Margalef Richness Index (d)	Menhinick Index	Buzas and Gibson's Index
1.	Apidae	04	07	221	1.30	0.48	0.55	0.45	1.80	0.72	1.10	0.47	0.36
2.	Formicidae	05	06	419	1.90	0.75	0.32	0.68	3.10	0.44	0.83	0.29	0.64
3.	Scoliidae	04	04	13	1.70	0.87	0.28	0.72	3.50	0.46	1.20	1.10	0.83
4.	Vespidae	06	06	92	1.70	0.67	0.36	0.64	2.80	0.46	1.10	0.63	0.55

RESULTS AND DISCUSSION

During the study, a total of 746 Hymenopterans from 20 genera and 24 species across five families were recorded (Table 1). In a similar study, Aland *et al.* (2010) documented 82 species from 47 genera belonging to 17 families in the Amba Reserve Forest of Kolhapur district, Maharashtra. Naidu and Kumar (2011) documented 47 species of bees and wasps belonging to 29 genera from 15 families at Vadodara, Gujarat. Kannagi *et al.* (2013) reported 38 species of Hymenoptera in a deciduous forest from South India. Anita *et al.* (2013) reported 36 species belonging to 21 genera and 9 families in a deciduous forest from South India. Rajkumari (2014) reported 50 species of Hymenoptera from Jorhat, Assam. Anbalagan *et al.* (2015) stated 100 species and 37 families of Hymenoptera in Tiruvallur district, Tamil Nadu. Veeramuthu *et al.* (2015) revealed the presence of 100 species and 37 families of Hymenoptera in vegetable crops in North-Eastern District of Tamil Nadu. Hiremath and Ganesh (2016) documented 30 species of Hymenopterans, out of which 18 species were wasps, 8 species of bees and 4 species of ants. Rashmi and Ganesh (2016) recorded a total of 30 hymenopterans, representing 30 genera and 28 species across 9 families, on the University of Agricultural Sciences Campus in Dharwad. Bhumi and Pragna (2018) reported the diversity of Hymenoptera of 145 species belonging to 20 families and 83 genera in Gujarat. Muhammad (2018) documented 24 species of wasps from Karak district of Pakistan. Balachandar *et al.* (2020) reported 15 species and 3 families of Hymenoptera in Tenkasi district, Tamil Nadu. Sachin *et al.* (2020) recorded 25 species belonging to 19 genus and 11 families of Hymenoptera in Nashik, Maharashtra. Sandeep and Nita (2020) catalogued a total of 44 species belonging to 19 genus including 8 subfamilies of 4 families in the forest area Kota, Rajasthan. Sandesh *et al.* (2022) reported 231 individuals belonging to 19 species, 12 genera and 4 subfamilies in Western Ghats in Goa. Priyanka *et al.* (2023) reported a total of 45 ant species under 6 sub families in Kolkata.

The Formicidae family was the most dominant, contributing 419 individuals, followed by Apidae with 221, Vespidae with 92, Scoliidae with 13, and Sphecidae being the least represented with 1

individual (Table 2). The family Formicidae was dominant with 39 species followed by Eumenidae with 11 species (Aland *et al*., 2010). Formicidae was the dominant family followed by Bracinidae, Encyritidae, Eulophidae and Platygastridae (Veeramuthu *et al*., 2015). The results are in accordance with the findings of Kishore *et al*. (2023) who reported that the most abundant family was Formicidae (29.29%) followed by Platygasteridae (8.15%) and Braconidae (7.59%). Formicidae members consistently dominate tropical regions due to the presence of undisturbed vegetation and well-maintained agricultural and horticultural ecosystems. Among the 5 families, Vespidae was the dominant family with 6 genera (30.00%), followed by Formicidae with 5 genera (25.00%), whereas, incase of species composition Apidae was the most dominant family with 7 species, followed by Formicidae and Vespidae (6 species) (Table 2 & 3) (Fig. 2).

The fire ant, *Solenopsis geminata* (Family: Formicidae) was recorded as the most abundant species which represented 24.93 per cent of the total recorded individuals (n=186), followed by *Apis cerana indica* (Family: Apidae) (n=159) constituting 21.31 per cent of the total Hymenopterans collected. In the present study, the results are also similar with the findings of Balachandar *et al*. (2020) who reported that the honeybee, *A. indica*, ant, *Camponotus compressus*, *Monomorium minimum*, wasps, *Polistes* sp. and *Ropalidia marginata* were recorded in the bhendi and cotton ecosystem.

The common black ant or Indian black ant, *Camponotus compressus* (Family: Formicidae) was the third most dominant species (18.23%), followed by *Tetraponera rufonigra* (Family: Formicidae) (6.70%), *Polistes dorsalis* (Family: Vespidae) (5.63%), *Xylocopa fenestrata* (Family: Apidae) (4.95%) and *Vespa tropica* (Family: Vespidae) (4.55%). Balachandar *et al*. (2020) reported that the ant species *Camponotus compressus*, *Tetraponera rufonigra*, the honeybee *Apis indica*, wasp, *Polistes* and *Vespa tropica* were common in coconut and sunflower ecosystem.

The abundance of Hymenopterans varied significantly throughout the months, with August being the most active (n=348) and the lowest numbers observed in June 2024 (n=53) (Table 4) (Figure 3). The peak in August was primarily due to the high number of Formicidae members (n=419), followed by Apidae (n=221). These findings align with Veeramuthu *et al*. (2015), who reported seasonal fluctuations in hymenopteran populations, with a peak from July to December. During this period, temperatures dropped below 25°C, and monsoon rains helped plants in agricultural and horticultural ecosystems flourish, providing abundant nectar and host insects, which led to an increase in hymenopteran numbers.

The calculated values of various diversity indices are presented in Table 5. The first index used in this study is the Shannon-Wiener Diversity Index (H), with the highest species diversity observed in the Formicidae family (1.90) and the lowest in the Apidae family (1.30). The Simpson Index (D) and Shannon's Equitability Index (J) indicated that species were unevenly distributed during the study period, showing that some species were more abundant than others. Species abundance at any given time depends on various biotic and abiotic factors. The Simpson Index of Diversity (1-D) was highest in Scoliidae (0.72), followed by Formicidae (0.68), and lowest in Apidae (0.45). The Berger-Parker Dominance Index ranged from 0.44 in Formicidae to 0.72 in Apidae. Scoliidae had the highest Margalef's Species Richness Index at 1.20, while Formicidae had the lowest at 0.83. The Menhinick Index values ranged from 0.29 (Formicidae) to 1.10 (Scoliidae), and the Buzas and Gibson's Index ranged from 0.36 (Apidae) to 0.83 (Scoliidae) (Table 5). Overall, these indices suggest that the area is rich in hymenopteran abundance.

The present study provides preliminary information on the hymenopteran fauna of the study area. From the above study, it was concluded that the Agricultural College campus, Killikulam have rich insect fauna, climatic factors of Agricultural College campus are suitable for hymenopteran fauna. The present study revealed that the order Hymenoptera is highly diverse and abundant in the Agricultural College campus, Killikulam. This is an indication of healthy ecosystem and availability of rich resources essential for Hymenopteran life stages and survival.

REFERENCES

Aland, S. R., Mamlaya, A. B., Gaikwad, S. M., Bharmal, D. L. and Bhawane, G. P. (2010). Diversity of insects with special reference to order Hymenoptera in Amba reserved forest of Kolhapur district, Western Ghats, Maharashtra, India. *Biological Forum- An International Journal*, **2**(2), 59-64.

Google Scholar

Alfred, J. R. B., Das, A. K. and Sanyal, A.K. (1998). Faunal diversity in India ENVIS Centre. Zoological Survey of India, Kolkata, Pp. 495.

Google Scholar

Anbalagan, V., Paulraj, M. G and Ignacimuthu, S. (2015). Diversity and abundance of Hymenoptera families in vegetable crops in North-Eastern district of Tamil Nadu, India. *International Journal of Fauna and Biological Studies*, **2**(3), 100-104.

Google Scholar

Anita, V., Sivakumar, V., Santhi, V. and Jemima, F. B. (2013). Hymenopteran diversity in a deciduous forest from South India. *International Journal of Biodiversity and Conservation*, **5**(10), 666-670.

Google Scholar

Balachandar, M., Karthick, M., Raja, M. and Raj, R. A. (2020). Diversity of Hymenoptera families in Sankarankovil Taluk, Tenkasi District, Tamil Nadu, India. *Sciencia Acta Xaveriana*, **11**(1), 01-05.
Google Scholar

Bhumi, T. and Pragna, P. (2018). An Inventory on Diversity and Distribution Pattern of Hymenopteran Insects in Gujarat, India. *International Journal of Research in Applied, Natural and Social Sciences*, **6**(6), 19-32.
Google Scholar

Hiremath, R. and Ganesh, C.B. (2016). A preliminary study of Hymenopteran diversity in University of Agricultural Sciences campus, Dharwad. *Journal of Entomology and Zoology Studies*, **4**(4), 1271-1274.
Google Scholar

Kannagi, A., Sivakumar, V., Santhi, V. and Borgia, J.F. (2013). Hymenopteran diversity in a deciduous forest from South India. *International Journal of Biodiversity and Conservation*, **5**(10), 666-670.
Google Scholar

Kishore, C.S., Sunitha, V., Rao, V. V. and Chary, D. S. (2023). Diversity of hymenoptera at agri biodiversity park, Hyderabad. *Indian Journal of Entomology*, **85,** 132-134 (Special Issue).
Google Scholar

Muhammad, A., Arshad, A., Shafi, G. U., Hameed, U. R., Sahibzada, M. J., Wahid, S. and Arshad, M. (2018). Biodiversity of wasps species collected from district Karak, KP, Pakistan. *Journal of Entomology and Zoology Studies*, **6**(2), 21-23.
Google Scholar

Naidu, B. and Kumar, D. (2011). Diversity and distribution of social apocrites of Vadodara, Gujarat, Western India. *Halteres*, **3**, 65-70.
Google Scholar

Rajkumari, P., Sharmah, D., Rahman, A. and Patgiri, P. (2014). Diversity and Distribution Pattern of Hymenopteran Insects in Jorhat District, Assam, India. *International Journal of Science and Research*, **3**(2), 1938-1941.
Google Scholar

Sachin, A. G, Tushar, A. J. and Jyoti, H. G. (2020). Hymenoptera fauna inhibiting K. T. H. M College Campus, Nashik, Maharashtra. *Flora and Fauna*, 26(1), 149-155.
Google Scholar

Veeramuthu, A. G, Micheal, P. and Savarimuthu, I. (2015). Diversity and Abundance of Hymenoptera families in vegetable crops in north- eastern District of Tamil Nadu, India. *International Journal of Fauna and Biological Studies*, **2**(3), 100-104.
Google Scholar