International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 17-08-2024, Accepted: 16-09-2024, Published: 01-10-2024
Volume 9, Issue 10, 2024, Page No. 4-8

Abundance of predatory Heteropteran water bugs in rice agro-ecosystem in Vidarbha, India

Arti A Salwe, Deepak D Barsagade
Department of Zoology, S. N. Mor College of Arts, Commerce and Smt. G. D. Saraf Science College, Tumsar, Maharashtra, India

Abstract
Study on predatory heteropteran water bugs from four different sites of rice fields in east Vidarbha during Rabi and kharif seasons from 2021 to 2023 by quadrant method. These were *Limnogonus fossarum* (Fabricius), *Hydrometra* species, *Microvelia douglasi* (Scott) and *Anisops ogasawarensis* (Matsumura). These water bugs were first recorded in the field at about 15 DAT (day after transplantation) and high abundance were found at 30 DAT during Rabi and kharif seasons. Density of all water bugs was high in both the kharif and Rabi season in all study sites. Among four water bugs, *A. ogasawarensis* was found to be the most abundant in all study sites of rice fields of east Vidarbha.

Keywords: Abundance, heteropteran water bugs, Vidarbha, rice crop, kharif and rabi seasons

Introduction
Heteroptera is a diverse group of insects that have adapted to a wide variety of habitats, including terrestrial, aquatic and semi-aquatic environments. (Richards and Davies, 1979) [12].

Heteroptera are major predators on crop pests and are useful biological control agents (Schaefer and Panizzi, 2000 and Triplehorn and Johnson, 2005) [14, 15]. Predatory bugs feed on the eggs, immature stages, and adults of injurious pest insects and control pest populations naturally (Schaefer, 1996; De Clercq, 2000) [3, 13]. In recent years predatory bugs received more attention due to naturally controlled pest populations in fields. Some attempts have been made to study population fluctuation of predatory water bugs in different regions of India like Tamil Nadu (Kandiben *et al.*, 2007). Rice is the most important staple food crop for more than 65% of world population and two third of India populations. The rice crop is infested by various pests, causing low yield (Mathur *et al.*, 1999) [7]. To know naturally available rice pest enemies, an attempt has been made and studied the abundance of predatory heteropteran water bugs in rice fields in east Vidarbha.

Materials and methods
The present study was carried out in the east Vidarbha region of Maharashtra state, India. East Vidarbha lies between the latitudes $19^0.56'$ and $21^0.38'$ north and longitudes $79^0.17'$ and $80^0.42'$ east and includes four districts namely Gondia, Bhandara, Gadchiroli and Chandrapur

Samples were collected during both rabi (February- May) and kharif (July- November) crop seasons of rice fields from 2021 to 2023 by frequent field visit at an interval of 15 days. Total four sites, from east Vidarbha Maharashtra, were selected for study. Fields selected with a common variety of rice in this region. About one hectare fields were fixed for study of bug abundance. Morning hours were preferred for sample collection in all experimental fields. From 15 days after transplantation (DAT) observation was started and continued till up to the harvesting of crops.

For the study of abundance, the quadrat method was used, 1×1 m quadrat placed in a selected field in 5 different spots (four in the corner and one in the center of the field) and each quadrat was observed properly. The collected insects were placed in a plastic container and brought to the laboratory for counting and preserved in 70% alcohol. Collected bugs were counted and data noted in the prepared table. The species diversity, abundance and evenness were calculated by using Past software.

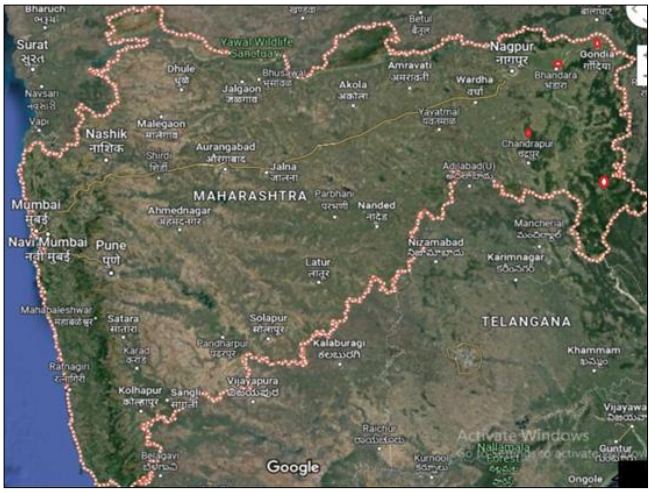


Fig 1: Map showing study sites in east Vidarbha region, Maharashtra

Results
Predatory heteropteran water bugs *Limnogonus fossarum*, *Hydrometra species*, *Microvelia douglasi* and *Anisops ogasawarensis* were collected from four sites of rice fields in east Vidarbha during rabi and kharif seasons from 2021 to 2023. Water bugs *L. fossarum*, *Hydrometra* sp., *M. douglasi* and *A. ogasawarensis* were first recorded in the field at about 15 DAT during both the seasons (rabi and kharif) and high abundance of these water bugs was found at 30 DAT in both the seasons. After that the population of bugs started to decline. Among four water bugs, *A. ogasawarensis* was found to be the most abundant in all

study sites of rice fields of east Vidarbha. All water bugs show higher abundance in kharif season than rabi season except *Hydrometra* species, which show high abundance in rabi season. Predatory water bugs *L. fossarum* and *M. douglasi* feed on rice major pests, brown planthoppers, leafhoppers and moths. *Hydrometra* sp., and *A. ogasawarensis* feed on dipteran flies and their larvae. Among these four predatory water bugs *L. fossarum* and *M. douglasi* have more economic importance in the rice field.

Water bug *L. fossarum* (Family: Gerridae) recorded the highest number during kharif season 4.6 ± 0.9 bugs/ m^{222} and 4 ± 0.05 bugs/ m^{222} during rabi season in Gadchiroli district. In kharif season *Hydrometra* species (Family: Hydrometridae) was recorded highest population 3.2 ± 0.8 bugs/ m^{222} at about 30 DAT in Gondia district and in rabi season the highest number was recorded 6 ± 0.08 bugs/m^{22} in Chandrapur district. In kharif season water bug *M. douglasi* (Family: Veliidae) the highest number was recorded approximately, 15.9 ± 0.8 bugs/ m^{222} in Gadchiroli district and in rabi season the highest number was recorded 8.4 ± 0.01 bugs/ m^{222} in Bhandara district. In kharif season abundance of water bug *A. ogasawarensis* (Family: Notonectidae) were highest and recorded 22.3 ± 0.7 bugs / m^{222} in Gondia district while, in rabi season the highest number was about 14.8 ± 0.5 bugs/m^2 in Bhandara district. The number of water bugs was directly proportional to availability of water in the rice field. The abundance of heteropteran bugs in rice fields during kharif and rabi season was summarized in Tables (1 to 4) and (Figure 1, 2).

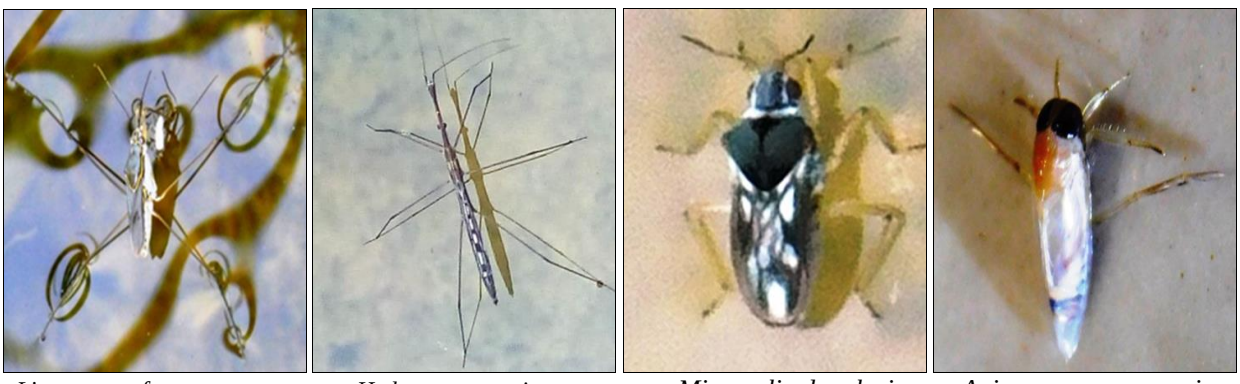
During the present study, Simpson index of diversity, Shannon diversity index and Evenness were used to assess diversity, abundance and evenness of heteropteran bugs in rice fields of four different sites of east Vidarbha during rabi and kharif seasons (Table 5). The Simpson index of diversity, the Shannon diversity index and Evenness of different species of predatory heteropteran bugs in rice fields during kharif season were between 0.52 ± 0.04 to 0.64 ± 0.05, 0.99 ± 0.15 to 1.18 ± 0.01 and 0.67 ± 0.06 to 0.81 ± 0.01 respectively in 4 districts of east Vidarbha. Similarly, the Simpson index of diversity, the Shannon diversity index and Evenness of different species of predatory heteropteran bugs in rabi season were between 0.69 ± 0.01 to 0.70 ± 0.02, 1.23 ± 0.03 to 1.31 ± 0.12 and 0.89 ± 0.05 to 0.91 ± 0.01 respectively in 4 districts of east Vidarbha.

Discussion

During the present study, four water bug species *Limnogonus fossarum*, *Hydrometra* species, *Microvelia douglasi* and *Anisops ogasawarensis* were first recorded in rice fields at about 15 DAT (day after transplantation) during both seasons (rabi and kharif). According to Ponraman *et al.*, (2016) [11], The abundance of Hemiptera was high in the 2nd week of plantation and reduced gradually onwards towards the harvesting of crops. Odum (1971) [10] recorded that diversity of insects was high during the early phase of plantation. Adequate amounts of water in the paddy fields show high abundance of aquatic insects, especially from July to August (Nakanishi *et al.*, 2009) [6]. In present study the highest abundance is recorded in the month of August in kharif season and in the month of February during rabi season 30 DAT. Diversity of predatory bugs were slightly different in both crop seasons of rice (kharif and rabi).

According to Batzer and Wissinger (1996) [2], the population of aquatic insects in rice fields tends to extend with the hydro-period. Major responsible factor behind the decrease in aquatic insects inhabiting rice fields was the quick increase of midsummer drainage (Aoda *et al*., 2013; Ichikawa, 2008) [1, 4]. Similar observations were recorded in present study and found decreased number of aquatic insects after February as summer onset in east Vidarbha. According to Kandiben *et al.*, (2007), among four aquatic predatory heteropteran bugs *L. fossarum* was the most dominant species in the rice field of Tamil Nadu. Similarly, Family Gerridae reported the highest abundance during the maturity stage (Norazliza *et al.*, 2016) [9]. In the present study, 4 aquatic bugs were noticed and among them *A. ogasawarensis* was found most abundant and dominated on other predator species in both the seasons of rice crop may be due to different climatic conditions of east Vidarbha favorable to *A. ogasawarensis*. Abundance of water insects in paddy fields is highly interrelated with water parameters (physical and chemical properties of water) instead of abundance of insect pests, climatic factors and plant traits (Norazliza *et al.*, 2016) [9].

It concluded that the field research showed that all water bug densities were high in both kharif and rabi season in east Vidarbha. These predatory bugs feed on various pests of rice crops and manage insect pest populations naturally through their relative density and abundance. If we introduce bugs as pest control agents, it will be one of the best examples of naturally controlling pest populations without using harmful pesticides and insecticides that are hazardous for our environment.



Limnogonus fossarum *Hydrometra* species *Microvelia douglasi* *Anisops ogasawarensis*

Fig 2: Predatory heteropteran water bugs in rice field during survey

Table 1: Abundance of heteropteran bugs in rice fields during kharif seasons in Gondia and Bhandara districts

M	W	DAT	Mean population of bugs/m^2(Gondia)				Mean population of bugs/m^2(Bhandara)			
			Lim	Hyd	Mic	Ani	Lim	Hyd	Mic	Ani
Aug.	I	15	3.1 ± 0.04	1.8 ±0.06	3.7 ± 0.2	10.8 ± 0.2	2.4 ±0.08	2.4 ±0.05	9.3 ± 0.4	15.4 ±0.9
Aug.	III	30	4.1 ±0.01	3.2 ± 0.8	12.2 ±0.4	22.3 ± 0.7	2.7 ±0.04	2.7 ±0.08	11.8 ± 0.3	19.7 ±0.7
Sep.	I	45	3.6 ± 0.06	1.7 ± 0.01	8.1 ±0.21	11.5 ± 0.1	1.1 ±0.28	0.8 ±0.09	1.5 ± 0.05	7.4 ±0.11
Sep.	III	60	2.2 ± 0.05	0.9 ± 0.04	3.2 ±0.16	6.1 ± 0.30	1.5 ±0.26	0.5 ±0.02	0.9 ± 0.04	5.8 ±0.05
Oct.	I	75	1.1 ± 0.09	0.5 ±0.02	2.6 ±0.09	2.7 ±0.32	1.3 ±0.01	0.5 ±0.01	0.9 ± 0.12	4.8 ±0.01
Oct.	III	90	0.7 ± 0.03	0.5 ±0.05	1.0 ±0.12	1.7 ±0.08	0.9 ±0.05	0.4 ±0.06	0.8 ± 0.07	3.5 ±0.12
Oct.	V	105	0.4 ± 0.01	0.4 ±0.05	0.6 ± 0.08	1.1 ±0.05	0.6 ±0.02	0.2 ±0.08	0.15 ±0.03	1.2 ±0.01
Nov.	II	120	00	00	00	00	0.1± 0.01	00	00	00

Abr: M- Month, **W-** Week, **DAT-** Days after transplantation, **Lim-** *Limnogonus fossarum*, **Hyd-** *Hydrometra sps*.**, Mic-** *Microvelia douglasi* and **Ani-** *Anisops ogasawarensis*

Table 2: Abundance of heteropteran bugs in rice fields during kharif seasons in Gadchiroli and Chandrapur districts

M	W	DAT	Mean population of bugs/m^2(Gadchiroli)				Mean population of bugs/m^2(Chandrapur)			
			Lim	Hyd	Mic	Ani	Lim	Hyd	Mic	Ani
Aug	III	15	2.4 ± 0.06	0.8 ± 0.01	3.4 ± 0.3	5.5 ±0.06	2.0 ± 0.01	1.4 ±0.06	2.3 ± 0.2	14.1 ±0.7
Aug	V	30	4.6 ± 0.9	1.8 ± 0.14	15.9 ±0.8	19.4 ±0.2	2.8 ± 0.08	1.3 ±0.14	9.3 ±0.12	15.6 ±0.06
Sep	III	45	3.4 ± 0.01	1.4 ± 0.31	14.3 ±0.8	16.1 ±0.5	0.9 ± 0.14	0.4 ±0.08	1.9 ±0.05	11.9 ±0.03
Sep	V	60	3.2 ± 0.12	0.6 ± 0.04	2.5 ±0.06	10.8 ±0.3	3.4 ± 0.16	0.7 ±0.02	1.4 ±0.01	11.3 ±0.08
Oct	III	75	1.6 ± 0.10	0.5 ± 0.08	1.8 ±0.04	5.2 ±0.07	1.1 ± 0.05	0.5 ±0.01	1.3 ±0.28	5.3 ±0.05
Oct	V	90	2.0 ± 0.08	0.7 ± 0.01	1.2 ±0.08	4.4 ±0.05	1.2 ± 0.06	0.6 ±0.07	00	3.1 ± 0.05
Nov	II	105	1.6 ± 0.14	00	0.7 ±0.09	1.6 ± 0.01	00	00	00	00
Nov	IV	120	0.4 ± 0.08	00	00	00	00	00	00	00

Table 3: Abundance of heteropteran bugs in rice fields during rabi seasons in Gondia and Bhandara districts

M	W	DAT	Mean population of bugs/m^2(Gondia)				Mean population of bugs/m^2(Bhandara)			
			Lim	Hyd	Mic	Ani	Lim	Hyd	Mic	Ani
Feb.	II	15	1.4 ±0.01	2.0 ± 0.08	2.8 ±0.02	8.8 ±0.1	2.0 ±0.02	3.2 ±0.05	3.2 ±0.4	8.0 ±0.4
Feb.	IV	30	2.8 ±0.03	4.4 ±0.01	7.2 ±0.33	10.4±0.1	2.8 ±0.01	4.2 ±0.14	8.4 ±0.01	14.8 ±0.5
Mar.	II	45	1.2 ±0.05	2.8 ±0.04	5.2 ± 0.05	7.4 ±0.01	0.8 ±0.04	4.4 ±0.06	5.6 ±0.05	10.2 ±0.4
Mar.	IV	60	1.2 ±0.02	1.8 ±0.03	2.6 ±0.02	3.2 ±0.04	2.2 ±0.06	3.8 ±0.02	1.4 ±0.10	8.0 ±0.8
Apr.	II	75	0.8 ±0.03	1.6 ±0.05	1.2 ±0.01	1.2 ±0.02	1.0 ±0.01	2.6 ±0.01	1.2 ±0.12	2.2 ±0.25
Apr.	IV	90	1.0 ±0.04	0.8 ±0.01	0.6 ±0.04	1.2 ±0.03	1.2 ±0.05	1.4 ±0.05	0.8 ±0.05	0.6 ±0.05
May	II	105	0.6 ±0.01	00	00	00	0.2 ±0.08	0.6 ±0.03	00	00
May	IV	120	00	00	00	00	00	00	00	00

Table 4: Abundance of heteropteran bugs in rice fields during rabi seasons in Gadchiroli and Chandrapur districts

M	W	DAT	Mean population of bugs/m^2(Gadchiroli)				Mean population of bugs/m^2(Chandrapur)			
			Lim	Hyd	Mic	Ani	Lim	Hyd	Mic	Ani
Feb.	II	15	3.2 ± 0.01	3.0 ± 0.4	4.0 ±0.2	7.8 ±0.3	1.6 ± 0.05	2.8 ± 0.6	2.8 ±0.05	7.2 ± 0.2
Feb	IV	30	4.0 ±0.05	4.8 ± 0.3	6.2 ±0.15	12.6 ±0.2	2.6 ± 0.01	6.0 ± 0.08	5.4 ± 0.1	12.4 ±0.2
Mar.	II	45	2.0 ± 0.05	3,2 ± 0.01	4.2 ±0.08	8.2 ±0.04	1.0 ± 0.08	5.2 ± 0.01	3.2 ± 0.24	6.2 ± 0.01
Mar.	IV	60	2.0 ± 0.02	3.2 ± 0.05	2.4 ±0.04	6.6 ±0.12	0.8 ± 0.14	1.6 ± 0.05	1.6 ± 0.04	3.2 ± 0.05
Apr.	II	75	1.2 ± 0.01	2.8 ± 0.05	2.4 ±0.05	2.4 ±0.08	0.8 ± 0.16	1.2 ± 0.02	0.6 ± 0.08	1.0 ± 0.01
Apr.	IV	90	0.8 ± 0.04	2.2 ± 0.08	1.2 ±0.01	0.8 ±0.05	0.4 ± 0.24	1.2 ± 0.08	00	0.8 ± 0.02
May	II	105	0.2 ± 0.08	0.6 ± 0.04	00	00	0.4 ±0.01	0.8 ± 0.14	00	00
May	IV	120	00	00	00	00	00	00	00	00

Table 5: Diversity indices applied on different study sites during rabi and kharif seasons

Diversity indices	Gondia District		Bhandara District		Gadchiroli District		Chandrapur District	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
Simpsons Index of diversity (1-D)	0.64 ± 0.05	0.70 ± 0.02	0.61 ± 0.01	0.70 ± 0.05	0.64 ± 0.05	0.70 ± 0.01	0.52 ± 0.04	0..69 ± 0.01
Shannon diversity index (H)	1.18 ± 0.01	1..31 ± 0.12	1.12 ± 0.11	1.29 ± 0.08	1.16 ± 0.05	1.28 ± 0.03	0.99 ± 0.15	1.23± 0.03
Evenness (J)	0.81 ± 0.01	0.91 ± 0.01	0.76 ± 0.08	0.90 ± 0.02	0.79 ± 0.02	0.90± 0.05	0.67 ± 0.06	0.89 ± 0.05

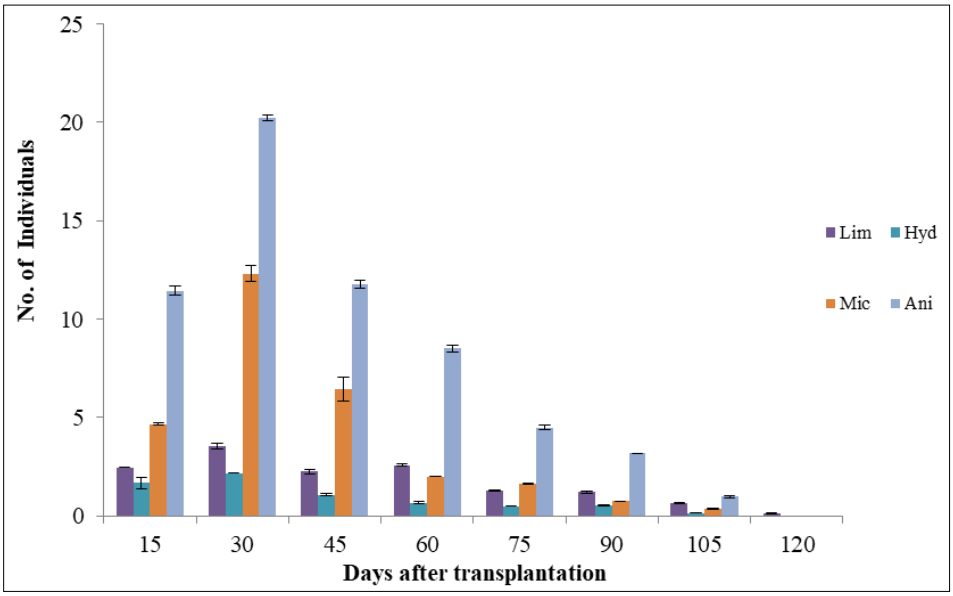


Fig 2: Abundance of heteropteran bugs in rice fields during kharif seasons in east Vidarbha

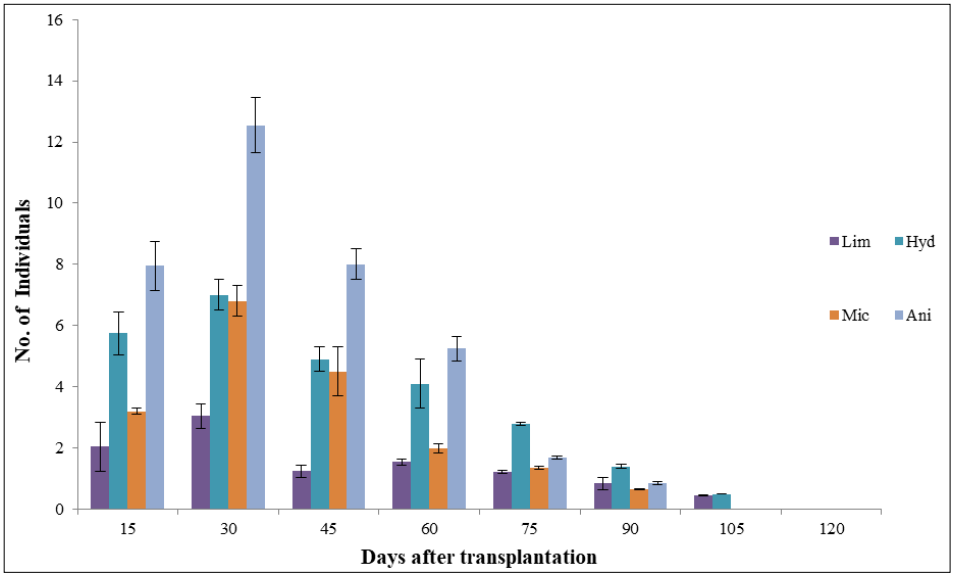


Fig 3: Abundance of heteropteran bugs in rice fields during Rabi seasons in east Vidarbha

References

1. Aoda T, Katano K, Toyama K, Jinguji H. Assessment of paddy environment using emergence husks of red-dragonfies with civic participation. Bull Facul Agric Niigata Univ,2013:65:131–135.
2. Batzer DP, Wissinger SA. Ecology of insect communities in nontidal wetlands. Annu. Rev. Entomol,1996:41:75-100.
3. De Clercq P. Predaceous stinkbugs (Pentatomidae: Asopinae). In Heteroptera of Economic Importance; Schaefer, C.W., Panizzi, A.R., Eds.; CRC Press: Boca Raton, FL, USA, 2000, 737–789.
4. Ichikawa N. The present condition and the preservation of pond insects lived in village. Jpn J Environ Entomol Zool,2008:19:47–50.
5. Kandibane M, Raguraman S, Mahadevan NR. Diversity and Community Structure of Aquatic Arthropods in an Irrigated. Asian J. Plant Sciences,2007:6(5):741-748.
6. Nakanishi K, Tawa K, Kanbara B, Noma N, Sawada H. Comparisons of macro-aquatic animal communities among paddy fields under different cultivation management systems. Jpn J Environ Entomol Zool,2009:20:103–114.
7. Mathur KC, Reddy PR, Rajamali S, Moorthy B T S. Integrated pest management of rice to improve productivity and sustainability. *Oryza*,1999:36(3):195-207.
8. Norazliza R, Fauziah I, Mohd RZ, Fairuz K, Ismail R. Comparison and relationship between water parameter and abundance of insects in field and irrigation system of paddy area of Sungai Burong, Tanjung Karang, Selangor, Malaysia. Journal of Agriculture, Forestry and Fisheries,2014:3(4):249-256.
9. Norazliza R, Mohd RZ. Fauziah I, Ismail R. Ecological Interaction Between Insect Pests, Climatic Factors And Plant Traits On Abundance Of Beneficial Insects In Paddy Field. Asian Journal of Agriculture and Rural Development,2016:5(4):68-75.
10. Odum EP. Fundamentals of Ecology. Third Edition, W.B. Saunders Co., Philadelphia, 1971, 1-574.
11. Ponraman G, Sankarappan A, Dinakaran S. Diversity of aquatic insects in irrigated rice fields of South India with reference to mosquitoes (Diptera: Culicidae). Journal of Entomology and Zoology Studies,2016:4(4):252-256
12. Richards OW, Davies RG. Imms' general textbook of entomology tenth edition Volume 2: Classification and Biology. Chapman and Hall Ltd., I I New Fetter Lane, London, 1979, 729 -747.
13. Schaefer CW. Bright Bugs and Bright Beetles: Asopine Pentatomids (Hemiptera: Heteroptera) and Their Prey. In: Alomar, O., Wiedemann, R.N. (Eds.), Zoophytophagous

Heteroptera: Implications for the Life History and Integrated Pest Management. Proceeding of the Thomas Say Publications in Entomology. Entomological Society of America, Lanham, Maryland, 1996, 18–56.
14. Schaefer CW, Panizzi AR. Heteroptera of economic importance. CRC Press, 2000, 856-857.
15. Triplehorn CA, Johnson NF. Borror, DeLong's Introduction to the study of insects (7th Edition). Peter Marshall Publication, 2005, 864- 865.