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DIVERSITY AND COMPOSITION OF HYMENOPTERA AROUND TIDAL SWAMP RICE IN INDRAGIRI HILIR DISTRICT, INDONESIA

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ABSTRACT

Pest attacks on rice plants can cause a detrimental decrease in production. Hymenoptera has many important roles in ecosystems, including as parasitoids and predators of pests. The purpose of this study was to determine the presence of Hymenoptera around tidal swamp rice in Indragiri Hilir Regency, Indonesia. Sampling used four traps, namely: 1) swing net; 2) yellow pan trap; 3) malaise trap; and 4) pitfall traps. The analysis was carried out by calculating the Shannon-Wiener diversity index (H'), the Margalef species richness index (D), the Pielou species evenness index (J). Hymenoptera found around tidal swamp rice areas of Indragiri Hilir Regency were 15.253 Hymenoptera insects consisting of 11 superfamilies, 37 families, and 304 morphospecies. Hymenoptera parasitoid had the highest diversity index value (4,80), followed by Hymenoptera pollinator (3,13) and Hymenoptera predator (3,11). The number of species of Hymenoptera parasitoid, pollinator, and predator obtained was 243; 31 and 76 species. The high diversity of Hymenoptera around tidal agricultural land optimizes its ecological role in the rice plantation ecosystem.

Keywords: Diversity, Hymenoptera, Tidal swamp rice

INTRODUCTION

One of the main limiting factors for increasing rice productivity is pest attacks. Pest attacks on rice plants can cause a significant decrease in production. The emergence of pest attacks on rice plants makes farmers carry out control, both using insecticides and with integrated pest management strategies. This will automatically increase the cost of rice production.

Most pests come from the insect group. In terms of species richness, insects are the largest group of animal groups. 1,023,430 insect species have been found (IISE, 2012) . However, of the ± 1 million species, not more than 1% are potentially harmful to farmers. The rest are useful insects that can act as parasitoids, predators, pollinators, decomposers, and industrial insects (Buchori, 2014). One of the insect groups that are beneficial to farmers is the order Hymenoptera.

Hymenoptera is one of the four largest insect orders. The other three are the orders Coleoptera, Diptera, and Lepidoptera. Hymenoptera is divided into two suborders, namely Symphyta and Apocrita, and consists

of 132 families, 9.108 genera, and 155.517 species that have been identified (Aguiar *et al.,* 2013). A total of 32.410 species are found in Indonesia (Bappenas, 2016).

Hymenoptera has many important roles in ecosystems, namely as parasitoids, predators, pollinators, detritivores, and phytophages (Borror *et al.*, 1996; Anderson *et al.*, 2011). Hymenoptera is dominated by parasitoid species. About 80% of Hymenoptera are parasitoid (Quick, 1997; Saputra *et al.*, 2017) . For example, several species from the family Braconidae are used as parasitoids to control various pests on agricultural crops (Lv, J., Wilson *et al.* , 2011; Tomanović *et al,*, 2013), several species from the family Ichneumonidae as parasitoids on larvae and pupae of Lepidoptera pests in the agroecosystems (Nelly *et al.*, 2005; Mason, P. G., 2013), and some species from the family Trichogrammatidae as parasitoids to control pests in agroecosystems (Hidrayani *et al.*, 2013; Sharma *et al.*, 2019).

Hymenoptera is scattered in all agricultural vegetation, forests, or other places where there are food sources such as flowering plant vegetation and vegetable gardens. The diversity and abundance of Hymenoptera in an agricultural habitat can be influenced by the landscape structure and habitat conditions (Ikhsan *et al.*, 2020; Susilawati, 2016). The existence of Hymenoptera around rice fields can provide benefits for rice plants. Based on this, research has been carried out on the diversity and composition of Hymenoptera around tidal swamp rice in Indragiri downstream district, Indonesia. The purpose of this study was to determine the presence of Hymenoptera around tidal swamp rice in Indragiri Hilir district, Indonesia.

EXPERIMENTAL SECTION

The research is in the form of a survey. Observation of the diversity and composition of Hymenoptera was carried out by trapping Hymenoptera around tidal swamp rice fields in the Indragiri Hilir district. Trapping was carried out using four devices, namely malaise trap, yellow pan trap, swing net, and pitfall trap.

Materials

The materials used in this study were label paper, photo paper, detergent, water, insect glue, gauze, 96% alcohol, and plastic.

Instrumentation

The tools used in this research are swing net, yellow pan trap, malaise trap, pitfall trap, drone, boots, collection box, tissue rolls, water container, magnifying glass, tweezers, knife, rope, collection bottle, 2 ml Eppendorf tube, binocular microscope, small brush, rubber band, filter, hand counter, stationery, camera, and applications for measuring altitude and coordinate points.

Procedure

Determination of location and sample points

Research in the form of surveys and sampling was carried out using the purposive sampling method. The study was conducted in four sub-districts in the tidal swamp rice of Indragiri Hilir Regency. At each

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study site, two-line transects were made with a length of ± 1.000 m. Along the transect line, ten sampling points were determined, ± 100 m apart. So, there are 20 sample plots at each research location.

Sample Collection

Insect sampling in each sample plot on the line transect was carried out using pitfall trap, yellow pan trap, swing nets, and malaise trap. Insects caught in each trap are cleaned of dirt. Furthermore, it is stored in a collection bottle containing 96% alcohol to be identified in the laboratory.

Identification of Hymenoptera

Identification was carried out on imago. All insects obtained were separated according to their order. Insects of the order Hymenoptera were further identified to the family and species level (coded). Identification was carried out using a microscope at the Insect Bioecology Laboratory, Faculty of Agriculture, Andalas University, Ecology Laboratory, Faculty of Mathematics and Natural Sciences, Padang State University, and the Zoology Laboratory of the Cibinong Biology Research Center-LIPI.

Data Analysis

The identification data is tabulated in a pivot table in Microsoft Excel software to become a database. Data processing was carried out to see the diversity of Hymenoptera based on their classification and ecological function. The diversity observed in this study was the Shannon-Wiener diversity index (H'), the Margalef species richness index (D), the Pielou species evenness index (J). Calculations and data analysis were carried out using the V5.2 Primary and the EcoMethods V7.2 Application (Colwell *et al.*, 1994; Colwell *et al.*, 2014).

RESULTS AND DISCUSSION

Indragiri Hilir Regency is located between 00 36' North Latitude and 10 07' South Latitude, and between 1040 10'-1020 32' East Longitude (BPS, 2020). The study was conducted on four fields in four sub-districts in the tidal swamp rice of Indragiri Hilir Regency. Two fields have monoculture farming systems and two polycultures. The description of the research location can be seen in Table 1.

Table 1. Study location description

No.	Sub-district	Agriculture system	Coordinates and altitude
1	Batang Tuaka	Monoculture	0°20'19" S, 103°2'53" E 1-6 m asl
2	Reteh	Monoculture	0°40'04" S, 103°08'06" E 1-6 m asl
3	Keritang	Polyculture	0°42'29" S, 103°0'28" E 2-6 m asl
4	Tembilahan Hulu	Polyculture	0°23′37″ LS, 103°4′52″ BT 1-2 m asl

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The results of this study revealed that tidal swamp rice at four study areas in Indragiri Hilir District had a high Hymenoptera parasitoid diversity index, while Hymenoptera pollinators and predators were had moderate diversity index (Table 2). The high diversity of Hymenoptera parasitoid is a potential that must be maintained in order to suppress pest attacks on tidal swamp rice. Based on the literature, Hymenoptera insects are dominated by parasitoid species. About 80% of Hymenoptera are parasitic (Quick, 1997; Saputra *et al.*, 2017). Therefore, Hymenoptera parasitoid plays an important role in sustainable agriculture through its ability to control pest populations.

Table 2. Hymenoptera diversity index at around tidal swamp rice in Indragiri Hilir District

Indicator	**Parasitoid**	**Pollinator**	**Predator**
Total of morphospecies	243	31	76
Individual abundance	4.841	688	9.724
Richness species index (D)	28,52	4,60	8,17
Evenness index (J)	0,87	0,91	0,72
Diversity index (H')	4,80	3.13	3.11

We found 15.253 Hymenoptera insects consisting of 11 superfamily, 37 families, and 304 morphospecies trapped at four studied areas around tidal swamp rice in Indragiri Hilir District, Riau Province. Batang tuaka sub-district had the highest number of individuals (4.593) and the second-largest number of morphospecies (197). Tembilahan Hulu sub-district had the second largest number of individuals (4.237) and the largest number of morphospecies (245). Reteh sub-district has the least number of individuals and the number of morphospecies compared to other sub-districts (Table 3). The high abundance of Hymenoptera in the tidal swamp agroecosystem can be caused by the presence of natural plant vegetation around the agroecosystem.

In this study, Braconidae, Ichneumonidae, Scelionidae and Formicidae were Hymenoptera family with the highest number of morphospecies (Figure 1). In addition, Formicidae, Scelionidae, Sphecidae, and Braconidae were Hymenoptera family with the highest number of individuals (Figure 2). Ichneumonidae and Braconidae are the families with the largest and most abundant members found worldwide. These two families have the highest number of species compared to other families and almost dominate the entire ecosystem (Goulet *et al.,* 1993). In other studies, monoculture and polyculture agroecosystems, Ichneumonidae and Braconidae are families that have the highest relative abundance (> 15%) (Hariyanti *et al.*, 2017). Another study also found that Braconidae and Ichneumonidae were the dominant parasitoid Hymenoptera families in vegetable agriculture ecosystems in West Sumatra (Yaherwandi, 2012).

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Table 3. The detailed results of Hymenoptera around tidal swamp rice

Superfamily	Family	Batang tuaka		Keritang		Reteh		Tembilahan Hulu		Role in Ecosystems
		NoM	NoI	NoM	NoI	NoM	NoI	NoM	NoI	
Apoidea	Ampulicidae	1	2	1	5	0	0	1	8	Predator
	Apidae	1	51	1	2	1	25	1	25	Polinator
	Colletidae	1	9	1	7	0	0	3	42	Polinator
	Crabronidae	3	11	1	5	0	0	5	45	Predator
	Halictidae	5	49	8	69	5	43	5	58	Polinator
	Megachilidae	1	5	0	0	0	0	0	0	Polinator
	Sphecidae	9	285	8	159	4	91	9	382	Predator
Ceraphronoidea	Ceraphronidae	6	24	5	37	1	2	5	27	Parasitoid
	Megaspilidae	1	3	0	0	0	0	1	5	Parasitoid
Chalcidoidea	Aphelinidae	1	4	2	32	1	4	2	7	Parasitoid
	Chalcididae	1	5	4	34	0	0	9	86	Parasitoid
	Elasmidae	1	3	1	4	0	0	0	0	Parasitoid
	Encyrtidae	6	31	2	13	1	44	3	33	Parasitoid
	Eulophidae	14	154	10	69	6	95	13	87	Parasitoid
	Eupelmidae	0	0	1	4	0	0	1	3	Parasitoid
	Eurytomidae	1	2	2	16	0	0	1	4	Parasitoid
	Leucospidae	1	8	0	0	0	0	1	2	Parasitoid
	Mymaridae	4	16	1	20	2	25	4	40	Parasitoid
	Pteromalidae	3	12	4	13	1	16	8	30	Parasitoid
	Torymidae	1	5	1	11	1	59	2	10	Parasitoid
Chrysidoidea	Bethylidae	2	11	1	8	1	13	2	12	Parasitoid
	Chrysididae	1	4	0	0	0	0	2	8	Parasitoid
	Drynidae	1	6	0	0	0	0	0	0	Parasitoid
Cynipoidea	Eucoilidae	4	26	1	2	2	33	2	11	Parasitoid
	Figitidae	0	0	1	31	0	0	0	0	Parasitoid
Diaprioidea	Diapriidae	8	47	13	167	4	55	9	116	Parasitoid
Evanioidea	Evaniidae	2	123	3	127	1	92	4	161	Parasitoid
Ichneumonoidea	Braconidae	20	270	22	286	8	62	30	259	Parasitoid
	Ichneumonidae	14	79	16	102	4	49	32	245	Parasitoid
Mymarommatoidea	Mymarommatidae	1	2	0	0	0	0	0	0	Parasitoid
Platygastroidea	Platygastridae	1	6	3	16	0	0	1	7	Parasitoid
	Scelionidae	29	223	22	391	7	165	27	391	Parasitoid
Vespoidea	Formicidae	32	2.997	34	2.085	22	1.417	30	1.797	Predator
	Pompilidae	5	27	11	99	5	28	14	149	Polinator
	Scoliidae	2	16	3	8	0	0	2	41	Parasitoid
	Tiphiidae	1	4	3	37	1	7	2	23	Parasitoid
	Vespidae	13	73	5	60	5	179	14	123	Predator
Total		**197**	**4.593**	**191**	**3.919**	**83**	**2.504**	**245**	**4.237**	

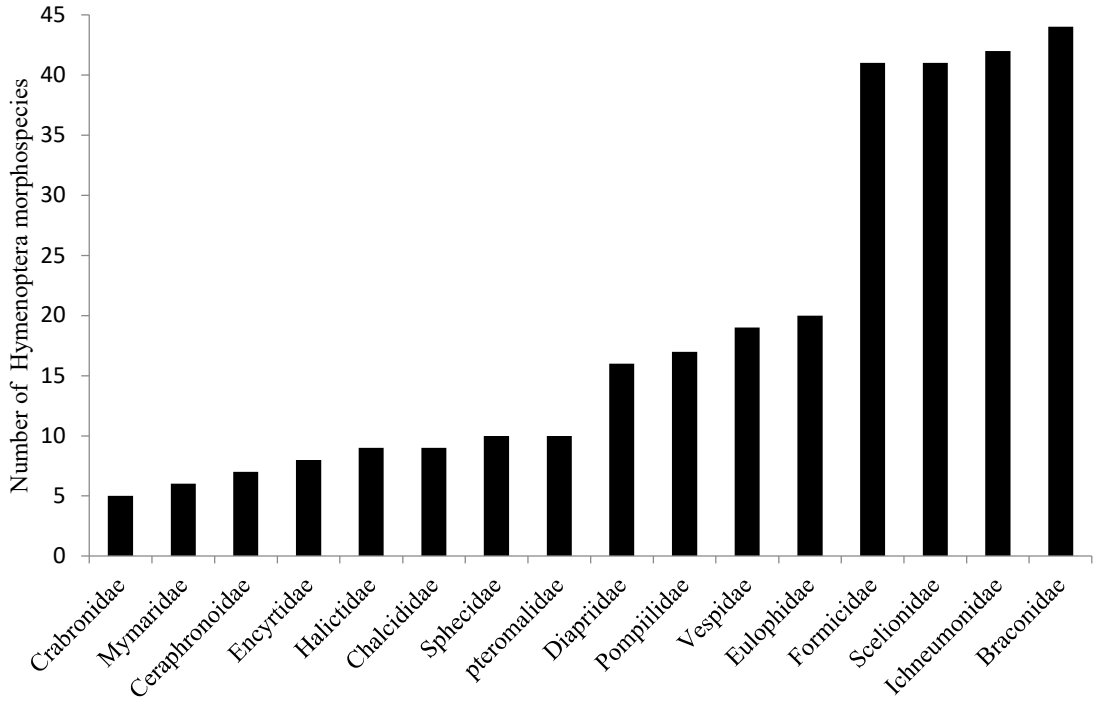

Figure. 1. Total of morphospecies of each Hymenoptera family around tidal swamp rice

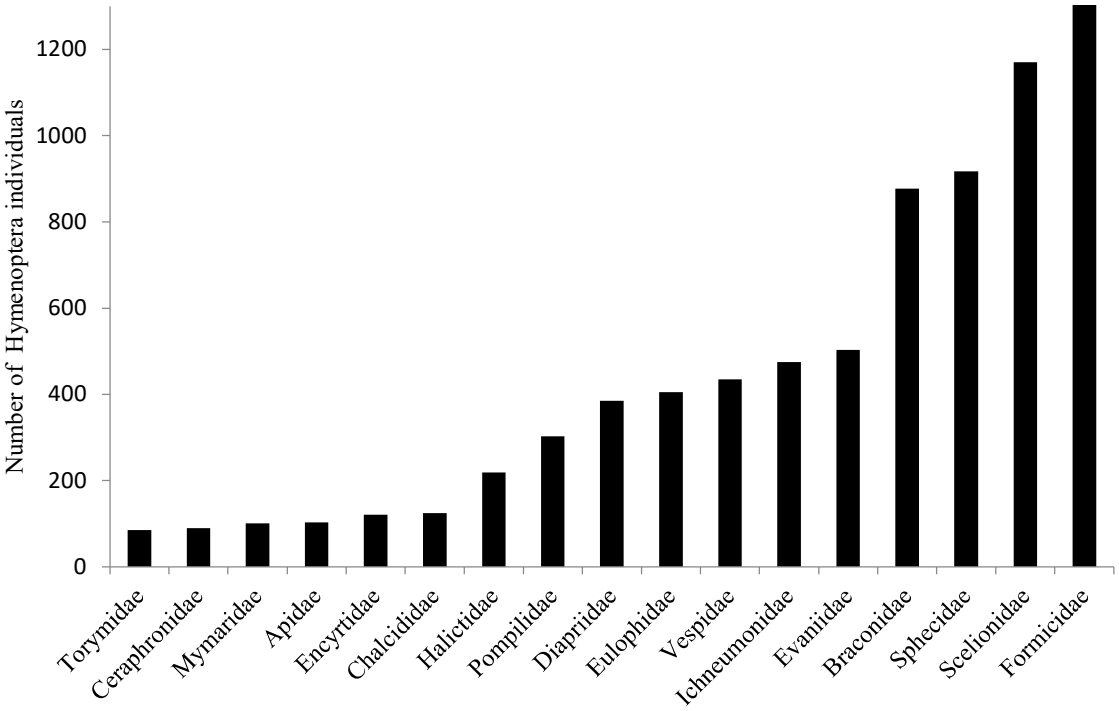

Figure. 2. Total of individuals of each Hymenoptera family around tidal swamp rice

CONCLUSION

1. Hymenoptera found around rice fields in tidal swamp rice, Indragiri Hilir Regency were 15.253 Hymenoptera insects consisting of 11 superfamily, 37 families, and 304 morphospecies.
2. Hymenoptera parasitoid has the highest diversity index value (4,80), followed by Hymenoptera pollinator (3,13) and Hymenoptera predator (3,11). The number of species of Hymenoptera parasitoid, pollinator, and predator obtained was 243; 31 and 76 species.
3. The high diversity of Hymenoptera around tidal rice fields needs to be conserved to optimize its ecological role in the rice plantation ecosystem.

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