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Community structure of arthropods in Agusan del Norte lowland ricefields

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ABSTRACT

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The structure of insect pests and natural enemies associated with white stem borer (*Scirpophaga innonata* Walker) in the irrigated and rainfed lowland ricefields in Agusan del Norte was studied for two cropping seasons. Sweep net method was used to sample the populations of the various arthropods. More species of arthropods were sampled in rainfed lowland ricefields than in irrigated ricefields, however, difference in the diversity was not significant. Number of species and populations of arthropods were affected by cropping husbandry practices particularly weeding and application of pesticides. Climate did not significantly affect the arthropod diversity due to the erratic climatic conditions at the onset of the El Niño phenomenon.

Keywords: community structure, arthropods, lowland rice fields

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INTRODUCTION

Integrated Pest Management (IPM) is a knowledge-based technology. In applying this technology, various information concerning the pest and the agroecosystem are needed in order to come up with the proper decision in managing pest populations. Information on the bio-ecology of pests is essential in IPM planning. The structure and diversity of the community, which are used to describe functions and interrelationships of species within the ecosystem, are helpful information for effective pest management. Such information can help the farmers to decide whether or not to apply control measures or leave the field for natural control, and to select appropriate control measures, whenever necessary.

In the Philipines, IPM campaign has become intensive in rice farming due to the fact that rice is the staple crop. Dale (1994) reported that rice is host to many insects because all of its parts are vulnerable to insect feeding from sowing to harvest. Chandler (1979) mentioned that it is subject to attacks from dozens of insects which can cause severe damage. In the Philippines, Bangladesh, India and thailand, the most serious insect pests of rainfed lowland rice are yellow stem borer, armyworm, cutworm, leaffolder, green leafhopper, brown planthopper and the whitebacked planthopper (Heinreiches *et al.*, 1986). Heinreiches *et al.* (1986) reported that the collective yield loss due to stem borer and rice bugs is estimated at 30%. In Mindanao, Philippines, white stem borer (*Scirpophaga innonata*) is considered the most important pest of rice. It can reduce rice yields considerably especially for susceptibe varieties.

Chemical control is still heavily used against insect pests, particularly white stem borer, despite the problems on pest resurgence, development of resistance and killing of non-target organisms. Thus, the Philippine Rice Research Institute promoted the ecological and natural approach in managing white stem borer populations (PhilRice, 1988). However, this approach requires information on the ecology of the insect pest, which includes the structure of arthropods associated with it, how it relates with other insect pests and the natural enemies, and how the community structure is affected by the cropping husbandry practices and climate. This study, therefore, was conducted in order to describe the community structure of natural enemies and other arthropods associated with white stem borer in lowland ricefields of Agusan del Norte, and to identify factors that influence the arthropod commnunity structure.

MATERIALS AND METHODS

Sampling

Four lowland ricefields having an area of approximately 500 sq. meters were selected in Agusan del Norte, Mindanao, Philippines. Two ricefields (Loksohon and Layaw, Los Angeles. Butuan City) represented the irrigated, while another two ricefields (Camagong-1 and Camagong-2, Nasipit, Agusan del Norte) represented the rainfed.

Sampling was done biweekly for two cropping seasons (July-December 1996 and January-June 1997). Samples were taken by sweeping ten times in two locations of the experimental field along the zigzag pattern drawn across the field (Elazeguo *et al.*, 1990).The arthropods collected in this manner were placed in separate collecting jars containing 70% alcohol.

Processing of specimens

The specimens collected from each experimental field were sorted according to species. The number of individuals per species of insect pests and their natural enemies were counted and recorded and the species were identified. Those that were not identified were sent to the Philippine Rice Research (PhilRice) in Muñoz, Nueva Ecija for proper identification.

Study on community structure of natural enemies and other associated arthropods

The basic data on the numbers of individuals for each species of natural enemies and other associated arthropods contained in each of the sweep net samples taken from every site were used to calculate the indices for describing community structure. The indices used were: species richness (d), evenness index (e), diversity index (H), and index of dominance (c). In computing for these indices, Ecostat software was used. Jaccard's and Sorenson's indices ot similarity were used in computing for the similarity between arthropod diversity in irrigated and rainfed lowland ricefields.

RESULTS AND DISCUSSION

Distribution of arthropods

The majority of the arthropods collected using the sweep method were insect pests other than white stem borer (WSB). They comprised about one-half of the total arthropods sampled in both irrigated and rainfed ricefields (Figures 1 and 2). This group was followed in descending order of distribution by the spiders (about one-forth of the total collections),insect predators (approximately 15%) and the parasitoids. This distribution was true for the first and second cropping seasons, although there were slight differences between locations.

The rice-feeding insects (herbivores) constituted the highest number since they fit into the primary consumers in the food chain of the community. The natural enemies followed the pattern set by the herbivores since they corresponded to the secondary consumers, which are dependent on the abundance of the primary consumers. This condition can be explained by the theory that food (in this case rice) has the organizing influence in the community and that it influences the structure of the community (Price, 1984).

Species diversity patterns

Species richness

An average of 11.14 and 10.83 species of natural enemies and other insect pests associated with WSB were sampled in four lowland ricefields for the first and second croppings, respectively. The temporal patterns of the species richness in all sites for the first and second cropping seasons are shown respectively in Fig. 3a and 4a. The species richness fluctuated from transplanting up to harvest in both croppings. The fluctuations were only slight,particularly in the second cropping, indicating no significant differences between sites (Table 1). There were species of natural enemies collected in only two sites such as the reduviid bug, *Polytoxus fuscovittatus* in Camagong-1 and Camagong-2 (rainfed fields) and the chalcid wasp in Loksohon and Layaw (irrigated fields), yet, the difference of species richness remained insignificant. In all sites, fewer

Table 1. Mean values of species richness, diversity indices and indices of dominance for insect pest and natural enemies associated with *Scirpophaga innonata* in four lowland ricefields in Agusan del Norte

	July -December 1996 cropping (Wet Season)			January-June 1997 Cropping (Dry season)		
Sites	Species richness	Index of diversity	Index of dominace	Species richness	Index of diversity	Index of dominance
Irrigated						
Loksohon	10.44	1.98	0.16	10.33	2.05	0.14
Layaw	10.22	1.90	0.21	10.00	2.00	0.14
Rainfed						
Camagong-1	11.33	2.09	0.14	11.11	2.03	0.16
Camagong-2	12.56	2.10	0.15	11.89	2.12	0.14
Fc	1.20ns	0.77ns	1.00ns	1.15ns	0.43ns	0.52ns
df	3.32	3.32	3.32	3.32	3.32	3.32
P	0.05	0.05	0.05	0.05	0.05	0.05
CV (%)	28.53	14.00	50.71	23.38	7.71	22.11

* - based on 9 sampling periods
ns - not significant at 5% level

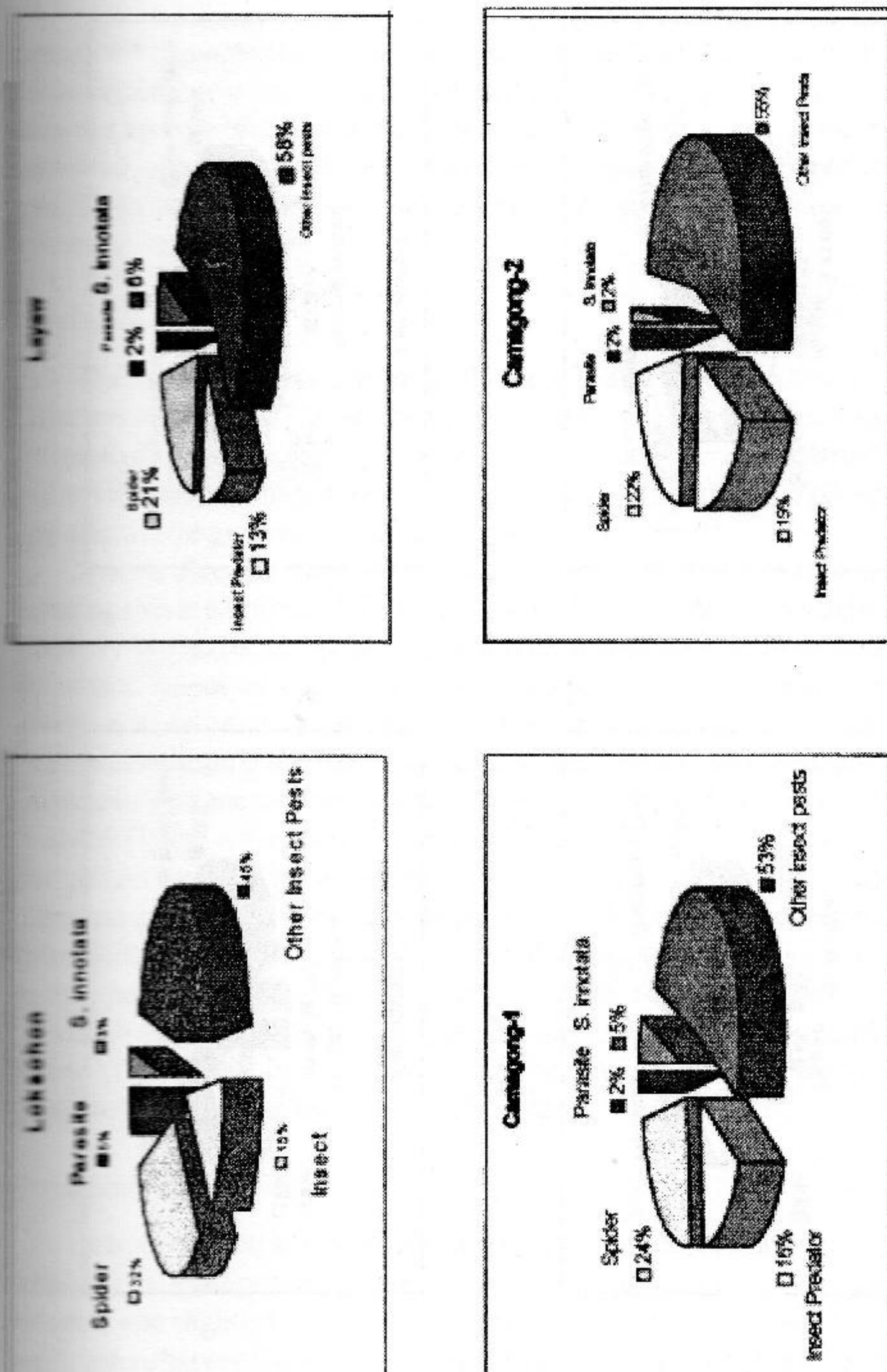

Figure 1. Arthropod distribution in four lowland ricefields in Agusan del Norte (1996 wet season cropping)

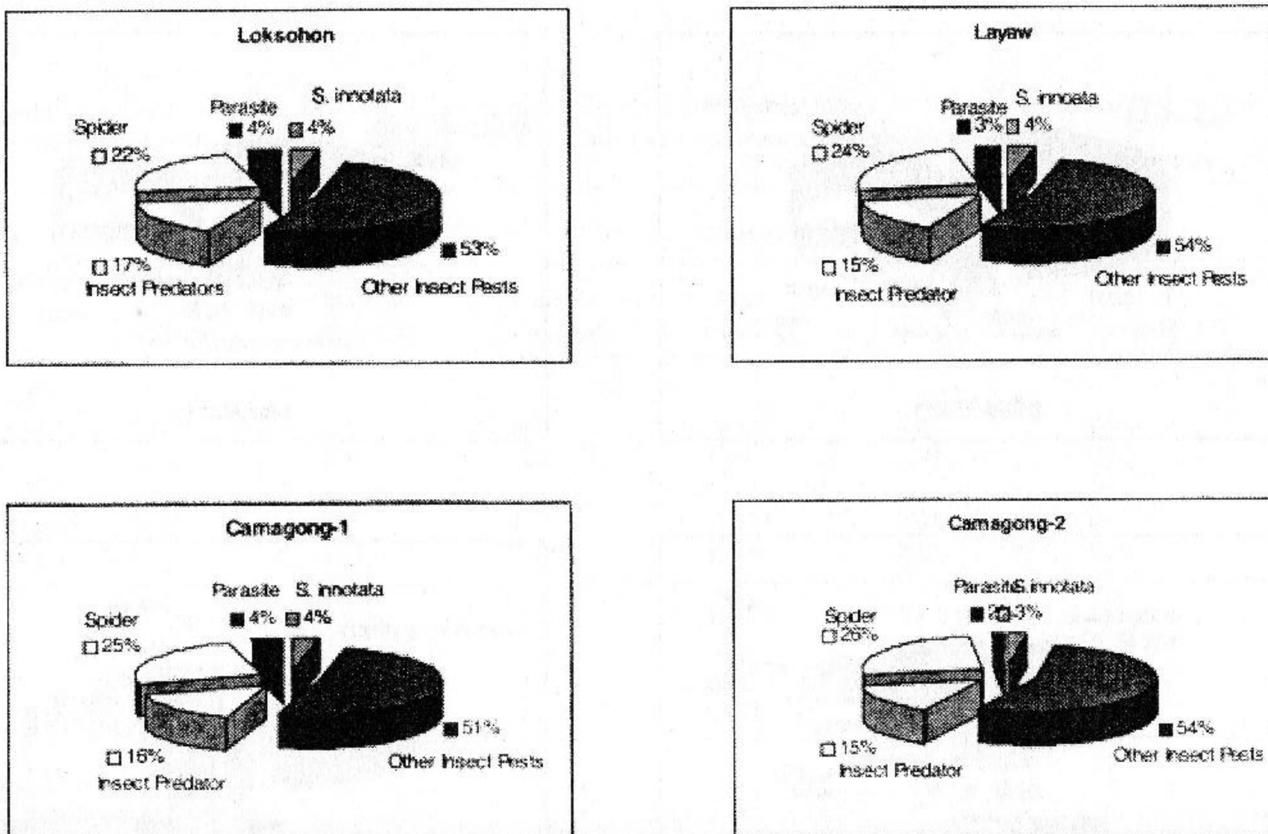

Figure 2. Arthropod distribution in four lowland ricefields in Agusan del Norte (1997 dry season sampling)

species were sampled in the transplanting stage, and , generally increased in the succeeding sampling periods but levelled-off until after harvest. This finding does not agree with the report of Heong *et al.* (191) that species richness increased with crop age. This can be explained by the absence of pesticide spraying in their sampling sites while spraying was allowed in the sites where this study was conducted.

Species diversity

The pattern of species diversity (Figures 3b and 4b) conformed to that of the species richness. The pattern oscillated as the crop matured since various farm activities that caused disturbance in the ecosystem were also carried out (eg. fertilization, weeding, water level management and insecticide application) that affected the presence of both pests and natural enemies.

Species diversity was slightly higher in Camagong-2 than the rest of the sampling sites in the two croppings, although the differences were not significant (Table 1). No herbicide application was done in this area due to the lack of water thus, weeds were abundant. The weeds probably harbored arthropod species not present in the other sites. Altieri (1994) reported that there are evidences indicating influences of weeds on the diversity and abundance of insect herbivore and associated natural enemies in crop systems. Citing Altieri et al. (1977) and Altieri and Whitcomb (1979b, 1980), Altieri (1994) stated that certain weeds (Umbelliferae, Leguminosae and Compositae) play an important ecological role by harboring and supporting a complex of beneficial arthropods that aid in suppressing pest populations. Among the sites, Layaw had the poorest arthropod composition. Intensive chemical spraying (two herbicides and two insecticide applications) was done in this site. As stated by Odum (1971), species diversity tends to be low in physically controlled ecosystems than in biologically controlled ones.

Dominance

In both the first and second croppings, the indices of dominance had relatively the same pattern (Figures 3c and 4c) except in Layaw- first cropping where it was slightly higher at two weeks after transplanting (Aug. 1) and a week before harvest (Nov. 1). In this site, *Hydrella philippina* tend to dominate

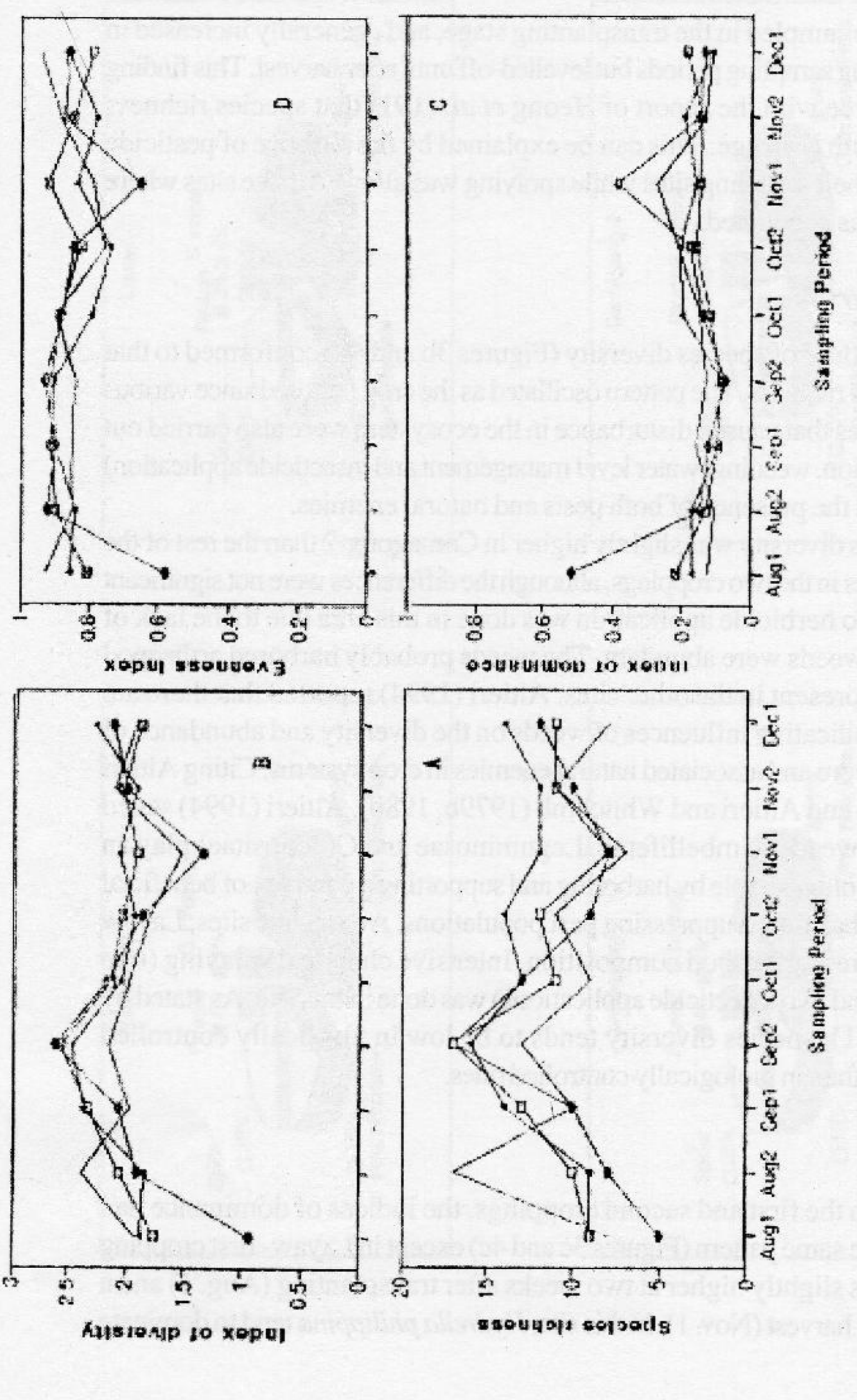

Figure 3. Seasonal fluctuations of the various indices of arthropod diversity in the four lowland ricefields of Agusan del Norte (1996 wet season cropping)

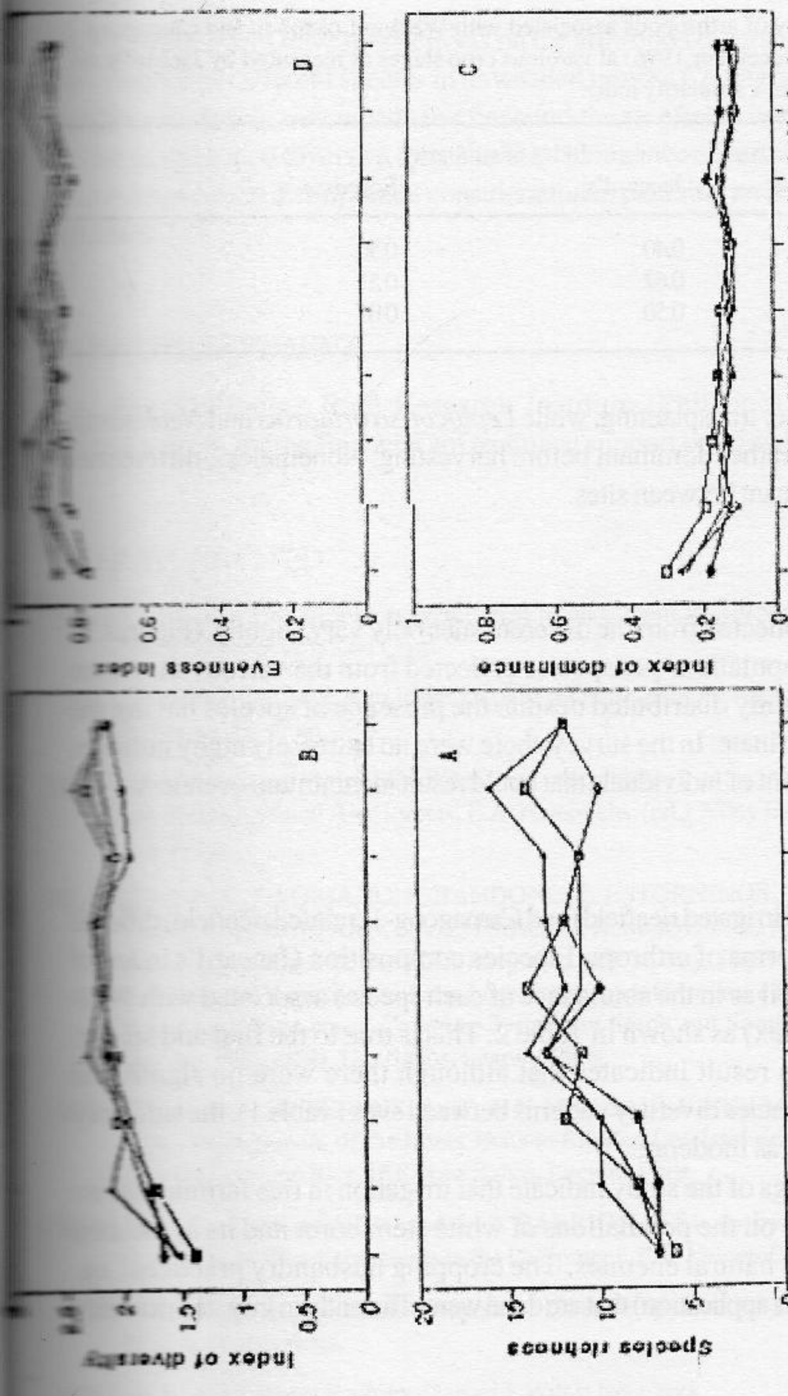

Figure 4. Seasonal fluctuations of the various indices of arthropod diversity in the four lowland ricefields of Agusan del Norte (1997 dry season cropping)

Table 2. Similarity of arthropods associated with WSB in Loksohon and Camagong-1 (July-December 1996) at varoious crop stages as measured by Jaccard's and Sorenson's similarity index

Crop stages	Index of similarity	
	Jaccard's	Sorenson's
Transplanting	0.40	0.50
Panicle initiation	0.62	0.51
Near harvest	0.50	0.63

at two weeks after transplanting, while *Leptocorisa oratorius* and *Nephottetix virescens* were rather dominant before harvesting. Nonetheless, differences were not significant between sites.

Evenness

Species collected from the different sites only vary slightly, (Figures 3d and 4d). The populations per species collected from the various sites were more or less evenly distributed despite the presence of species having the tendency to dominate. In the survey, there were no extremely highy numbers in the appointment of individuals that could result in minimum evenness.

Similarity

Loksohon (irrigated ricefield) and Camagong-1 (rainfed ricefield) differed moderately in terms of arthropod species composition (Jaccard's index of similarity) as well as in the abundance of each species associated with WSB (Sorenson's index) as shown in Table 2. This is true to the first and second croppings. This result indicates that although there were no significant differences in species diveristy patterns between sites (Table 1), the similarity between them was moderate.

The findings of the study indicate that irrigation in rice farming has no direct influence on the populations of white stem borer and its associated insect pests and natural enemies. The cropping husbandry practices (eg. weeding, fertilizer application) that are done were efficiently in irrigated ricefields than in rainfed ones have more effects on the arthropod diversity as shown by the presence of different species in unweeded rainfed Camagong-1 ricefield. Results also imply that weeds in or around the ricefields contribute to the increased arthropod diversity, thus, limiting dominance of certain species.This information can be an important consideration in planning an IPM program in ricefields.

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