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Taxonomy of Insects in San Juan, Ilocos Sur, Philippines

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ABSTRACT

Considered the most diverse animal group on the planet, insects play significant roles in the production of essential seeds, fruits, and vegetables through pollination, decomposition of organic matter, control of populations of other organisms, and provision of food for other taxa, including humans. This study aimed to conduct a taxonomic study of insects in San Juan, Ilocos Sur, Philippines, and classify them as to order family, scientific name, common name, and species richness between the two study areas, Barbar and Immayos Sur. One hundred forty-one (141) adult insects were collected and taxonomically classified employing the latest classification schemes and identification keys from authoritative individuals and databases from credible websites, as well as catalogs, checklists, synopses, and other reliable published references. Of these 141 specimens, which the researchers purely identified, some still need to be adequately identified, including those fifty-six (56) species identified at the family level, sixty-five (65) valid genera, and thirty-two (32) species that were marked 'INDET' (indeterminable) but were identified at least at the family level or tribal level. Twenty-four (24) species are suspected to be new, and a comparison of these with the collections in Natural History Museums is highly recommended for their verification. A tabulated classification of insects occurring in San Juan, Ilocos Sur is presented. In terms of species richness, there are more insect species in the forests and water ecosystems of Barbar than in Immayos Sur, San Juan, Ilocos Sur.

Keywords: species, order, scientific name, species richness

INTRODUCTION

Over a million different kinds of insects have been described and named, and many more certainly remain to be discovered (Chinery, 2007: 3). This account captivates the interest of so many naturalists in studying these organisms that stand unrivaled in their worth. Nevertheless, conservationists are being mobilized not merely for this reason. Entomologists fear the possible extinction of numerous insect species yet to be named. They believe abundance is being impacted by climate change, habitat destruction and the introduction of industrial agribusiness with its heavy pesticide use (Hance, 2019). Also, the estimated several million of these arthropods, which have outnumbered the rest of the living animal phyla combined, might abruptly decrease. More than 40% of insect species are declining and a third are endangered (Carrington, 2019). Without exhaustive studies beforehand, no proper protection could be given.

It is challenging to appreciate entirely the ecological, medical, and economic significance of insects, as Hickman et al. (2008: 443) asserted; certainly, humans are dependent on the services insects provide that eliminating them from our natural world might bring about a more significant problem than the destruction they have caused to man's livelihood and the mortality owing to the diseases they spread. Parallel to this, Gullan and Cranston (2014: 5) stressed that some insects are considered "keystone species" because the loss of their critical ecological functions could lead to the collapse of the wider ecosystem and to affirm, many plants and animals would die out as they depend on them directly or indirectly (Mcgavin, 2000).

Taxonomic studies are essential in monitoring groups of species or endemics, species richness, biogeographical distribution, and ecological diversity. For many years, taxonomy has been viewed as nothing more than an instrumental tool for ecological studies (Wilson, 2004; Agnarsson & Kuntner, 2007). Sunderland (2012) emphasized, taxonomy provides the basic foundations of conservation practice and sustainable management of the world remaining resources.

A large part of the Northern Luzon region is still not open to frequent reconnoiters. There is also an observed lack of full-scale insect studies in the area. Possible endemic species in Ilocos Sur are not being subjected to investigations. While most research in the locality deal with fields like botany, microbiology, and marine biology, insufficient attention goes to entomology. The study of insects serves as the basis for developments in biological and chemical pest control, food and fiber production and storage, pharmaceuticals epidemiology, biological diversity, and a variety of other fields of science. Ecologists, agriculturists, and other related experts cannot begin to study subjects regarding habitat disturbance and fragmentation, population sizes and density, community structure, and behavior of insects due to little or no published information about locally thriving insect sects. According to Warburton (1967) as cited in Romoser and Stoffolano

(1998), classifications will provide a system of information retrieval and may serve as summarizing and predicting devices.

San Juan, Ilocos Sur, Philippines, has areas where a diversity of insect species abound. Foreseeing that this study can elevate the attention of environmentalists concerning the condition of its ecosystems and fully augment the appreciation of the value of insects, the researchers launched the initiative to study the areas mentioned extensively. The study's results will serve as baseline information that will help provide a framework for systematic conservation planning for managing biological diversity and natural resources.

Thus, it is crucial to integrate the science of taxonomy to develop an accurate insect biodiversity evaluation. Hence the researchers deemed this study necessary to lay out efficient ecological measures for preserving and protecting insects in San Juan, Ilocos Sur, Philippines.

OBJECTIVES OF THE STUDY

This study aimed to conduct a taxonomic study of insects in San Juan, Ilocos Sur, Philippines, and classify them as to order family, scientific name, common name, and species richness between the two study areas.

MATERIALS AND METHODS

Research Design

This study used the descriptive type of research in actual field observations and data gathering. These data were analyzed for content in an inductive manner to reach the conclusions.

Collection of Insects

This phase employed active (use of beating sheet, brush, tweezers/forceps, aspirator, aerial net, beating/sweeping nets, aquatic nets, and hand capturing) and passive collection methods (use of colored pan traps, light trap, malaise traps, stick, and pitfall traps) to address different types of habitat collection and time of day.

Killing of Insects

Ethyl acetate killing containers were made by pouring a thick mixture of plaster of Paris and water into a jar to a depth of 15–20 mm. The plaster was completely dried before using it. To "charge" a killing bottle, a small amount of ethyl acetate was poured into the plaster covered with tissue or cellulose wadding (Gullan and Cranston, 2014). Ethyl acetate was used for killing all insects apart from Lepidopterans (Krogmann & Holstein, 2010). A jar containing potassium cyanide was constructed to poison Lepidopterans. Ammonium chloride was injected into larger butterflies and moths for faster killing and softening rigor mortis.

Taxonomic Classification

Borror and Delong's Introduction to the Study of Insects by Triplehorn and Johnson (2005) was used as a reference, and to check for the validity of a taxon, the researchers consulted several classification websites like GBIF, ITIS, and TAXONOMICON. Pure use of identification keys, jumping identification, stub identification, specimen comparison, and image comparison were likewise employed to arrive at the proper identification.

Preservation of Voucher Specimen

Dry mounting employing direct pinning, micro-pinning, pointing, spreading, and the setting was utilized for bigger species. Fluid fixation was likewise employed for tiny insects using ethanol of different concentrations, lactic alcohol for aphids, and acetic acid-glycerol-alcohol solution for thrips. Microscope slide mounting for tiny insects in which some features need to be viewed under high magnification of a microscope for proper identification was also employed.

Curation

A unique lettering-numbering system was constructed for the consistency of labeling. A three-letter coding was used to abbreviate the name of an insect order: Archaeognatha (Arc), Zygentoma (Zyg), Ephemeroptera (Eph), Odonata (Odn), Plecoptera (Plc), Der- maptera (Drm), Zoraptera (Zrp), Orthoptera (Ort), Embioptera (Emb), Phasmatodea (Phs), Grylloblattodea (Gry), Mantophasmatodea (Mpm), Mantodea (Man), Blattodea (Blt), Pso- codea (Psc), Thysanoptera (Thy), Hemiptera (Hem), Raphidioptera (Rph), Megaloptera (Meg), Neuroptera (Nrp), Coleoptera (Col), Strepsiptera (Stp), Diptera (Dip), Mecop- tera (Mec), Siphonaptera (Sph), Trichoptera (Tch), Lepidoptera (Lpd) and Hymenoptera (Hym). Labels for both dry and fluid-fixed specimens contained the following data: scientific name, three-letter code, the date and time of collection, place of collection, zip code of the town (2731), the country abbreviation (PHL for Philippines), and the type of ecosystem where it was collected.

Statistical Treatment of Data

The Sørensen's coefficient (also known as Sørensen's index, Dice's coefficient, and Sørensen–Dice index) was applied to indicate the presence/absence of data to calculate similarities between the two sampling areas. Sorensen's coefficient gives a value between 0 and 1. The closer the value is to 1, the more the sampling areas have in common. Complete overlap is equal to 1, while complete dissimilarity is equal to 0. The equation is:

$$QS = \frac{2C}{A+B} = \frac{2|A \cap B|}{|AUB||}$$

where QS = quotient of similarity,
A = number of species in area 1
B = number of species in area 2
C = species in common

In deriving the conclusions, the following ranges with equivalent descriptive designations were used: 0 = not similar, 0.1-0.3 = slightly similar, 0.4-0.0.6 = similar, 0.7-0.9 = quite similar, and 1 very similar.

RESULTS AND DISCUSSION

One hundred forty-one (141) species of insects were identified and classified in San Juan Ilocos Sur (Table 1). These were distributed in eleven (11) orders, in fifty-six (56) families, sixty-five (65) valid genera and in fifty-one (51) valid species. Thirty-two (32) species were indeterminable (INDET) Furthermore, twenty-five (25) specimens were identified up to the genus level. Species marked with INDET (indeterminable) are species identified at the family, subfamily, or tribal level. Species shaded in yellow indicate suspected new species, and those with asterisks are confined only to this area. Findings imply potential micro endemism as eleven (11) species are confined in this area.

Table 1

Taxonomic classification of insects in San Juan Ilocos Sur

Order	Family	Scientific Name	English Name	Local Name
Blattodea	Blaberidae	*Pynocelus surinamensis*	Surinam Cockcroach	Sipet
	Ectobiidae	*Blatella germanica*	German Cockcroach	Sipet
	Blattidae	*Neostylopyga rhombifolia*	Wood Roach	Sipet
		Periplaneta americana	American Cockroach	Sipet
		1 species INDET*	River Roach	Sipet
	Rhinotermitidae	1 species INDET	Subterranean Termites	Anay
	Termitidae	3 species INDET (1 species area-	Nasute Termites	Anay
	Anthicidae	*Anthelephila sp.**	Ant-like Flower Beetle	
Coleoptera	Bruprestidae	*Acmaeodera sp.**	Metallic Wood-Boring Beetlle	Sammi-sammi
		*Chrysobothris sp.**	Metallic Wood Boring Beetle	Sammi-Sammi
		*Chrysodema sp.**	Metallic Wood Boring Beetle	Sammi-Sammi
	Carabidae	1 species INDET	Ground Beetle	
	Cerambycidae	*Xystrocera globosa*	Long-horned Beetle	Mangngelteb
		1 species INDET*	Longhorned Beetle	
	Chrysomelidae	*Chrysochus auratus**	Dogbane Leaf Beetle	
		*Chrysochus sp.**	Dogbane Leaf Beetle	
		Hoplasoma unicolor	Longhorned Leaf Beetle	
		*Laccoptera nepalensis**	Tortoiseshell Beetle	
		*Neolema sp.**	Criocerine Leaf beetle	
	Coccinellidae	*Coccinellidae 1 species INDET*	Ladybeetle	
		Coccinella transversalis	Ladybird	
		Synoncha grandis	Giant Bamboo Ladybird	
	Curculionidae	*Mecopus sp.**	Snout Beetle	
		Otiorhynchus sp.	Snout Beetle	
		Pachyrhynchus sp.	Snout Beetle	
	Elateridae	*Oxynopterus mucronatus*	Click Beetle	
		species 2 INDET	Small Click Beetle	
	Lycidae	1 species INDET*	Net-winged Beetle	
		Catharsius aethiops	Scarab Beetle	
	Scarabaeidae	2 species INDET	Dung Beetles	Abal-Abal
		Leocopholis irrorata	June beetle	Abal-Abal
		Lepidiota sp.	June Beetle	Aros-Aros
		Onitis sp.	Scarab Beetle	
		Oryctes rhinocerus	Rhinocerus Beetle	Barrairong
		*Protaetia sp.**	Bumble Flower Beetle	
		Xylotrupes gideon	Siamese Rhinoceros Beetle	Barrairong
Diptera	Asilidae	2 species INDET**	Robber Fly	Bugaw-bugaw
	Calliphoridae	*Lucilia sp.*	Blow Fly	Dingraw
	Muscidae	*Musca domestica*	House Fly	Ngilaw

Table 1 continued.

Order	Family	Scientific Name	English Name	Local Name
	Sarcophagidae	*Sarcophaga sp.*	Flesh Fly	
Hemiptera	Cicadellidae	*Nepothetix viriscens*	Leafhopper	Talakitik
		Xyphon sagittifera	Leafhopper	Talakitik
		4 species INDET	Leafhopper	Talakitik
	Cicadidae	*Platypleura sp.*	Cicada	Andidit
		1 species INDET	Cicada	Andidit
	Cixiidae	2 species INDET**	Froghoppers	
	Coreidae	*Leptoglossus australis**	Citron Bug	
		1 species INDET*		
	Cynidae	*Microporus sp.*	Burrower Bug	
	Gerridae	*Gerris sp.**	Water Strider	
		*Limnometra tiomanensis**	Water Strider	
		*Metrobates sp.**	Water Strider	
	Membracidae	*Nasunnia sp.**	Treehopper	Talakitik
	Pentatomidae	*Trichopepla atricornis**		
	Plataspididae	*Brachyplatys sp.**	Kudzu Bug	
	Pyrrhocoridae	*Dindymus sp.**	Red Bug, Cotton Stainer	Baka-Baka
		Dysdercus sp.	Red Bug, Cotton Stainer	Baka-Baka
	Reduviidae	*Ectrychotes sp.* *	Assassin Bug	
		*Lisarda pallidispina**	Assasin Bug	
		Ectrychotes sp. *	Assasin Bug	
	Scutelleridae	*Tectocoris sp.*	Cotton Harlequin Bug	
Hymenoptera	Apidae	*Apis mellifera*	Honey Bee	Uyukan
		Xylocopa caffra	Carpenter Bee	Alimbubuyog
		Xylocopa sp.	Carpenter Bee	Alimbubuyog
	Chrysididae	*Chysis sp.*	Small Cuckoo Wasp	
		Stilbum cyanurum	Large Cuckoo Wasp	
	Formicidae	4 species INDET (1 species area-confined)*		
		*Diacamma rugosum**	Queenless Ant	
		*Odontomachus sp.**	Trap Jaw Ant	Ammimisay (Ilk)
		Oecophylla smaragdina	Weaver Ant	Buos/Abuos/Buhos
		Paratrechina longicornis	Sugar Runner	Taray-Taray
		Pheidole sp. 1	Big-Headed Ant	Bunar
		Pheidole sp. 2	Big-Headed Ant	Mangngubet
		*Polyrhachis sp. 1**	Spiny Ant	
		*Polyrhachis sp. 2**	Spiny Ant	
		*Polyrachis sp. 3**	Spiny Ant	
		*Polyrhachis sp. 4**	Spiny Ant	
		Polyrhachis sp. 5	Spiny Silver Ant	

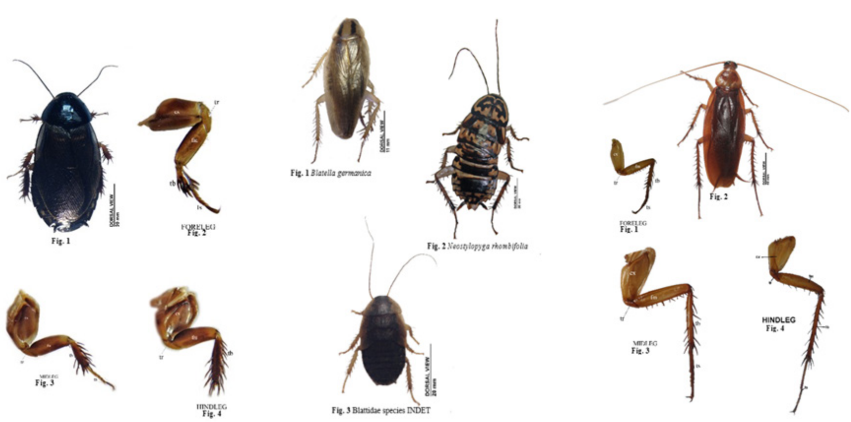
Table 1 continued.

Order	Family	Scientific Name	English Name	Local Name
		Solenopsis invicta	Red Imported Fire Ant	
	Sphecidae	*Chalybion sp.*	Thread-waisted wasp	Akot-Akot
		Sceliphron caementarium	Thread-waisted wasp	Akot-Akot
	Stephanidae	1 species INDET	Crown Wasp	
	Vespidae	*Delta pyriforme philippinensis*	Potter Wasp	
		Delta pyriforme	Potter Wasp	
		Eumenes sp.	Paper Wasp	Mangngakab
Lepidoptera	Arctiidae	*Utetheisa pulchella*	Crimson-speckled Flunkey	
	Hesperiidae	1 species INDET*		
	Nymphalidae	*Athyma selenophora*	Staff Sergeant	
		Hypolimnas bolina	Great Eggfly, Common Eggfly	
		Ideopsis juventa	Wood Nymph, Gray Glassy Tiger,	Kulibangbang
		Junonia hedonia	Brown Pansy	Kulibangbang
		Libythea labdaca	African Snout Butterfly	Kulibangbang
		Tirumala limniace	Blue Tiger	Kulibangbang
	Noctuidae	*Apantesis sp.* *	Tiger moth	
		*Eudocima homaena**	Fruit piercing moth	
		*Alypia sp.**	Tiger Moth	
		*Cyligramma sp.**		
	Papilionidae	*Euphloea sp.*	Crow Butterfly/ Milkweed butter-	Kulibangbang
		*Graphium aristeus**	Chain Swordtail	Kulibangbang
		Graphium decolor	Yellow Green Swalllowtail	Kulibangbang
		*Graphium doson**	Blue Green Swallowtail	Kulibangbang
		Papilio clytia	Common Mime	Kulibangbang
		Papilio demoleus	Cime Swallowtail	Kulibangbang
		Papilio polytes	Common Mormon	Kulibangbang
	Pieridae	*Appias albina**	Common Albatross	Kulibangbang
		Appias nephele	Yellow hindwing Albatross	Kulibangbang
		*Appias nero**	Orange Albatross	Kulibangbang
		Delias hyparete	Painted Jezebel	Kulibangbang
		Delias pasithoe	Red base Jezebel	Kulibangbang
		Eurema andersonii	Grass yellow Butterfly	Kulibangbang
		Eurema lacteola	Grass yellow Butterfly	Kulibangbang
		Leptossia nina	The Psyche	Kulibangbang
		Pareronia boebera	Powder Blue Butterfly	Kulibangbang
	Sesiidae	*Albuna oberthuri*	Golden Dearwing	Kulibangbang
Mantodea	Mantidae	*Hierodula sp. 1*	Praying Mantis	Wasay-Wasay
		Hierodula sp. 2	praying Mantis	Wasay-Wasay
Neuroptera	Myrmeleontida	*1 species INDET* *	Antlion	
Odonata	Aeshnidae	*Oligoaeschna sp.*	Darner	

Table 1 continued.

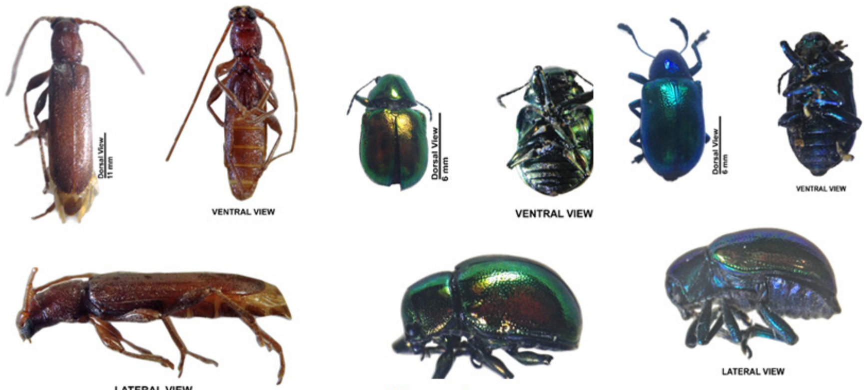
Order	Family	Scientific Name	English Name	Local Name
	Calopterygidae	*Euphaea sp.**	Gossamer wings	
		*Neurobasis luzoniensis**	Luzon Demoislle	
		*Rhynocypha sp.**	Damselfly	
	Coenagrionidae	2 species INDET		Tuwwa-it
	Libellulidae	*Camacinia gigantea*	Sultan	Tuwwato
		Diplacina bolivari		Tuwwato
		Orthetrum pruinosum clelia	Crimsou-tailed Marsh Hawk	Tuwwato
		Orthetrum sabina sabina	Slender Skimmer/Green Marsh	Tuwwato
		Trithemis annulata	Violer Dropwing	Tuwwato
		Trithemis festiva	Indigo Dropwing	Tuwwato
		Trithemis pallidinervis	Long Legged Marsh Glider	Tuwwato
Orthoptera	Acrididae	*Melanoplus sp.*	Spur-throated Grasshopper	Dodon
		2 species INDET	Spur-throated Grasshopper	Dodon
	Gryllidae	*Gryllus sp. 1*	Field Cricket	Kuryat
	Gryllotalpidae	*Gryllotalpa orientalis*	Mole Cricket	Arrarawan
	Pyrgomorphida	*Atractomorpha sp. 1*	Toothpick Grasshopper	
		Atractomorpha sp. 2	Toothpick Grasshopper	
	Tetrigidae	*Parattetix sp.**	Pygmy grasshopper	
Psocodea	Haematopinidae	*Haematopinus tuberculatus*	Carabao Louse	Kuto ti Nuang

Below are illustrations of some insects under the different orders which were collected and cured.



Pynocelus surinamensis

Blattodea

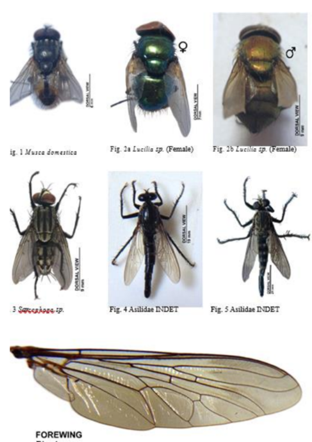


Cerambycidae species INDET

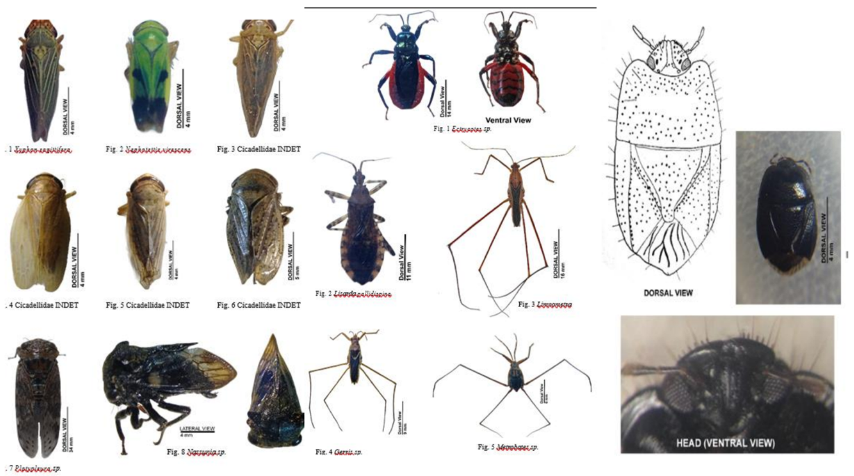
Chrysochus auratus

Chrysochus sp

Coleoptera



Diptera

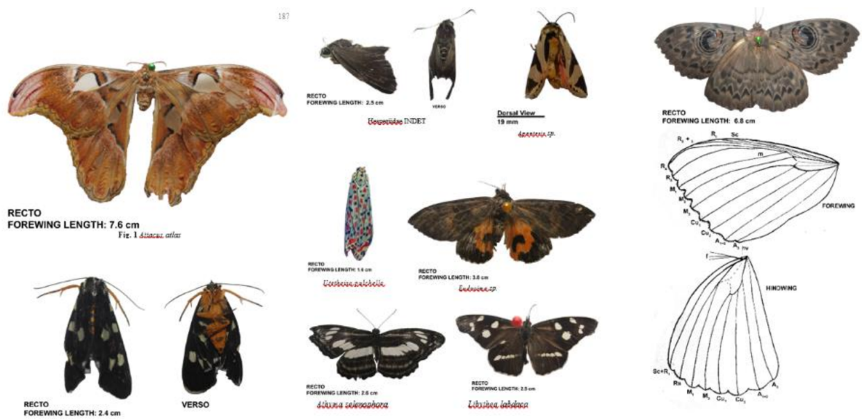


Hemiptera

Chrysis sp.

Apis mellifera

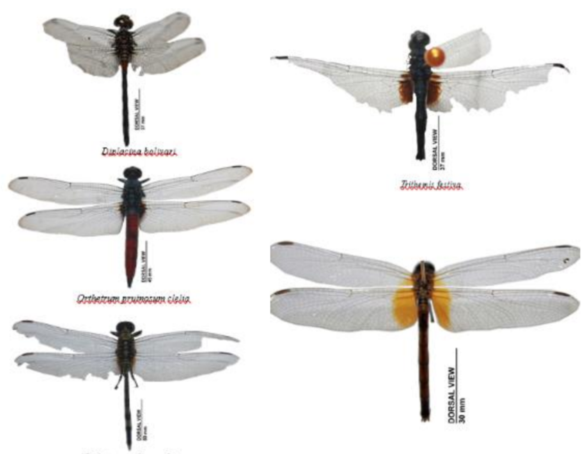
Hymenoptera



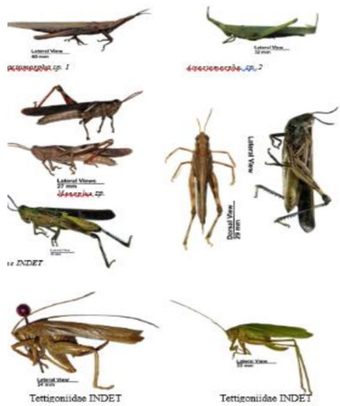
Cyligramma venturaa

Lepidoptera

Orthoptera



Odonata



Psocodea

Mantodea

Table 2

Species Richness of the Locales of the Study

Ecosystem	Barbar	Immayos Sur
Freshwater Systems	17	3
Croplands	37	50
Forests	117	77

The study revealed more insect species in the forests and water ecosystems of Barbar than in Immayos Sur, San Juan, Ilocos Sur. However, in croplands, it was found that species of insects are more diverse in Barbar, San Juan. The distribution of these insects may be attributed to the level of disturbance, which may affect the stability of their habitats. Freshwater ecosystems and croplands have relatively lower insect diversity because these ecosystems are mainly venues for most livelihood and commercial activities such as fishing and farming. Forests are essential habitats for insects as they provide a conducive environment to survive and reproduce.

The main causes of the differences on the richness of species leading to insect decline in some areas are attributed to habitat destruction, land use changes, deforestation, intensive agriculture, urbanization, pollution, climate change, introduction of invasive insect species, application of pesticides, mass trapping of insects using pheromones and light traps, pathological problems (Dar et al., 2021)

Table 3

Area Similarity/ Dissimilarity

ORDER	BARBAR (A)	IMMAYOS SUR (B)	COMMON SPECIES ©	QS	REMARKS
Blattodea	10	8	8	0.9	quite similar
Coleoptera	45	28	25	0.7	quite similar
Diptera	3	5	3	0.8	quite similar
Hemiptera	22	12	10	0.6	similar
Hymenoptera	29	22	22	0.9	quite similar
Lepidotera	36	31	27	0.8	quite similar
Mantodea	2	2	2	1.0	very similar
Neuroptera	0	1	0	0.0	not similar
Odonata	11	8	7	0.7	quite similar
Orthoptera	11	10	10	1.0	very similar
Psocodea	1	1	1	1.0	very similar

Remarks: 0= not similar; 0.1-0.3=slightly similar; 0.4-0.6= similar, 0.7-0.9=quite similar 1=very similar

The Sorensen's Coefficient (QS) was calculated by multiplying 2 by the number of common species occurring in both areas of study divided by the total number of species collected in these areas. The average was obtained among the values and gave the coefficient of 0.8, indicating commonness or similarity between the species of insects found in Barangay Barbar and Immayos Sur, San Juan, Ilocos Sur.

CONCLUSIONS

The ecosystems of Barbar and Immayos Sur, San Juan, and Ilocos Sur are favorable for the growth and development of insects under the Orders Blattodea. Coleoptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Mantidea, Neuroptera, Odonata, Orthoptera, and Psocodea. True to both areas of study, a large percentage of insects belong to the orders Lepidoptera, Hymenoptera, Hemiptera, and Coleoptera; a Moderate number of species occur within Odonata, Orthoptera, and Blattodea and; Diptera, Pscodea, Mantodea, and Neuroptera occupy relatively low species richness. Barangay Barbar and Immayos Sur, San Juan, Ilocos Sur have similarities; hence, they can support many common species. Insects from Barbar, San Juan, Ilocos Sur may find asylum at Immayos Sur, San

Juan, Ilocos Sur, when the environmental stresses in the area are high or vice versa. The Sorensen's Coefficient (QS) mean value of 0.8, suggesting similarity, rejects the null hypothesis that there is no significant similarity between the locales of study.

RECOMMENDATIONS

The thirty-two (32) species suspected as new are highly recommended to be compared with collections in Natural History museums in the country for their verification. Future taxonomic studies should concentrate on specific taxon (e.g., subfamily or tribe). Moreover, the indeterminable specimens must be studied adequately. Using the descriptions provided in this paper, future studies may construct dichotomous keys for the insect fauna of San Juan, Ilocos Sur. Biodiversity studies on each properly identified species or of a particular taxon, especially at the genus level, can be started as scientific names and/or valid identities are already available. A similar study must be conducted in different areas in the province.

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