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Kyaw Lin Maung
Biotechnology Research Department, Department of Research and Innovation, Ministry of Education (Science and Technology), Kyauk-se, Myanmar

Yin Yin Mon
Biotechnology Research Department, Department of Research and Innovation, Ministry of Education (Science and Technology), Kyauk-se, Myanmar

Myat Phyu Khine
Biotechnology Research Department, Department of Research and Innovation, Ministry of Education (Science and Technology), Kyauk-se, Myanmar

Khin Nyein Chan
Biotechnology Research Department, Department of Research and Innovation, Ministry of Education (Science and Technology), Kyauk-se, Myanmar

Aye Phyoe
Biotechnology Research Department, Department of Research and Innovation, Ministry of Education (Science and Technology), Kyauk-se, Myanmar

Aye Thandar Soe
Biotechnology Research Department, Department of Research and Innovation, Ministry of Education (Science and Technology), Kyauk-se, Myanmar

Thae Yu Yu Han
Biotechnology Research Department, Department of Research and Innovation, Ministry of Education (Science and Technology), Kyauk-se, Myanmar

Wah Wah Myo
Biotechnology Research Department, Department of Research and Innovation, Ministry of Education (Science and Technology), Kyauk-se, Myanmar

Aye Aye Khai
Professor and Head, Biotechnology Research Department, Department of Research and Innovation, Ministry of Education (Science and Technology), Kyauk-se, Myanmar

Corresponding Author:
Aye Aye Khai
Professor and Head, Biotechnology Research Department, Department of Research and Innovation, Ministry of Education (Science and Technology), Kyauk-se, Myanmar

Arthropods diversity as ecological indicators of agricultural sustainability at la yaung taw, Naypyidaw union territory, Myanmar

Kyaw Lin Maung, Yin Yin Mon, Myat Phyu Khine, Khin Nyein Chan, Aye Phyoe, Aye Thandar Soe, Thae Yu Yu Han, Wah Wah Myo and Aye Aye Khai

Abstract
Arthropod diversity was considered as ecological indicators of sustainable agriculture and forest management. High-quality habitats have the relation with healthy ecosystem functioning. In this study, we collected the 101 species of arthropods which consists of 40 species of butterflies, 19 species of flies, 14 species of beetles, 10 species of grasshoppers, 7 species of wasps, 6 species of bugs, 3 species moths, 1 species of millipede and 1 species of centipede at la yaung taw, Naypyidaw union territory, Myanmar. Shannon-Wiener's diversity indexes, Pielou's Evenness Index (Equitability) and relative abundance in arthropods were analyzed. Arthropod's diversity index was observed as 1.717 while the evenness index was 0.372. Importantly, relative abundance of butterflies is the highest as 39.6% among the arthropods. Thus, we suggest that Naypyidaw union territory possesses the sustainable agriculture of healthy ecosystem with high-quality habitats by the evidence of arthropod's diversity index and butterflies assembling.

Keywords: Arthropods, diversity, ecological indicator, sustainable agriculture, Naypyidaw union territory

Introduction
In fauna and biological studies, the occurrence of native arthropods is very important to achieve conservation goals on the healthy ecosystem [1]. Arthropods biodiversity were monitored by the application of surrogate ecological parameters such as ecological land classification and habit classification systems [2]. Maintaining high-quality habitats is very important to enhance arthropod diversity in agriculture and forest management [3]. Host adaptation for arthropod diversity is more active to the relatively cool condition than increasing in temperature and emerging infectious diseases [4].

The spatial abundance of butterflies cannot be predicted from environmental suitability and ecological factors as well as climatic patterns [5]. The relationship between biodiversity and ecosystem functioning, including many points relevant to management of ecosystems is depend on how ecological communities are structured, and the forces driving species extinctions and invasions [6, 7, 8]. Arthropods play vital roles in various ecosystem functions and respond acutely to habitat manipulation [9].

The abundance of many arthropods correlated between forest patches of different sizes and also between forest edges and stand interiors [10]. Arthropods are suitable bio-indicators of organic farming of protected systems [11, 12]. The butterfly communities were disturbed as human's land use effect by comparing the diversity and structure of communities [13]. Biodiversity show the habitat and landscape by means of a multi-indicator concept in different landscape situation [14, 15]. Naypyidaw is the new capital city of Myanmar and the overall changes in ecosystem provisions by symmetrically changing land use in priority areas [16].

Our research is mainly focus on the better understanding of arthropods' diversity on the sustainable agriculture of agro-ecosystem. We observed the diversity of arthropods and abundance of butterflies, flies, grasshoppers, beetles, wasps, bugs, centipede and millipede. Furthermore the Shannon Weiner diversity index, Pielou's Evenness Index (Equitability) and relative abundance of the family were examined at la yaung taw, Naypyidaw union territory, Myanmar.

Materials and Methods

Study area and Specimens Collections

The study site is the la yaung taw agricultural landscaping site, Naypyidaw union territory and it is situated latitude 19° 44' 42.00" N, longitude 96° 07' 46.99" E in the central parts of Myanmar. The location was selected based on the geographically important and abundance of natural host plants and landscaping site with 7,054.37 km2 area. The specimen collections of arthropods were examined by a stratified random sampling design across agricultural landscaping habitats.

Morphological Identification

The research was conducted by co-operation of Biotechnology Research Department, Ministry of Education (Science and Technology), Kyauk-se, 05151, Myanmar and la yaung taw, Daw Khin Kyi foundation, Naypyidaw Union Territory, Myanmar from June to December, 2019. The specimens were identified base on the morphological characteristics with the pattern of colors, shape, size, habitat and behaviors by using the several documented pictures of the different angles [17, 18, 19].

Data analysis

Shannon-Wiener diversity index (H´) with different characteristics were analyzed as the following formula [20, 21].

$$H' = \Sigma Pi\ (lnPi)$$

Here, P*i* = the proportion of the *i*th species in the total sample
Pielou's Evenness Index (Equitability) or J´was conducted with the following formula. The species evenness is the proportion of individuals among the species.

$$J' = H'/Hmax$$

Where

Hmax = *ln*(*S*) is the maximum possible diversity index
S = the number of species present in the site.
The relative abundance of arthropods was determined by the following formula [20, 21].

$$\text{Relative Abundance (\%)} = \frac{n}{N} \times 100$$

Where

n = the numbers of individuals of particular recorded species
N = the total number of individuals of recorded species

Results

Diversity index and Evenness of Arthropods

Diversity index of the Arthropods were estimated with Shannon-Wiener diversity index at la yaung taw, Naypyidaw union territory. H´ (Shannon-Wiener diversity index) was observed as 1.717 which is more than median index while J´ (Pielou's Evenness Index) was suggested as 0.372 (Table 1).

Table 1: Shannon-Wiener diversity index and Pielou's Evenness Index (Equitability) of arthropods at la yaung taw, Naypyidaw Union Territory.

Species	P	Pi	*Ln*(p*i*)	P*i* Ln*(p*i*)	-P*i* Ln*(p*i*)	H´	J´
butterflies	40	0.396	-0.926	-0.366	0.366	1.717	0.372
Flies	19	0.188	-1.671	-0.314	0.314		
Beetles	14	0.138	-1.980	-0.273	0.273		
Grasshoppers	10	0.099	-2.312	-0.228	0.228		
Wasps	7	0.069	-2.673	-0.184	0.184		
Bugs	6	0.059	-2.830	-0.166	0.166		
Moths	3	0.029	-3.540	-0.102	0.102		
Centipede	1	0.009	-4.710	-0.042	0.042		
Millipede	1	0.009	-4.710	-0.042	0.042		

The diversity of butterflies

The totals of 40 species belonging to the 6 families (Nymphalidae, Lycaenidae, Hesperiidae, Pieridae, Papilionidae and Ridodinidae) were observed as high diversity with families Nymphalidae at la yaung taw, Naypyidaw union territory (Table 2). Among them, the representative 6 species in 8 families were shown in Figure 1,2,3 and 4.

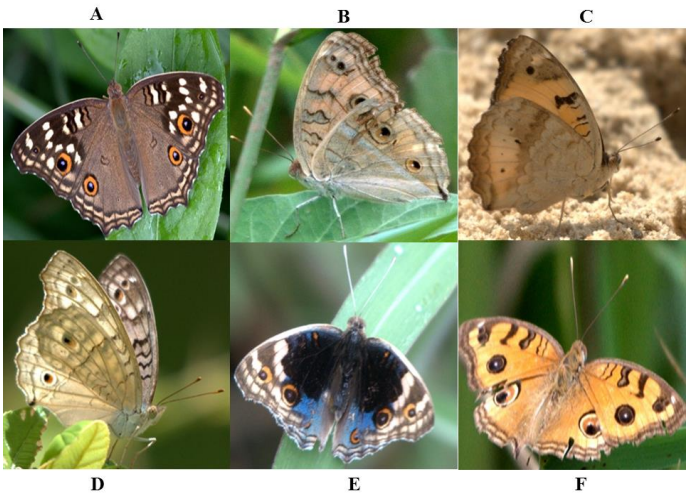

Fig 1: The original six pictures of the selective butterfly species (family Nymphalidae) A. *Junonia orithya*, B. *Junonia lemonias*, C. *Junonia hierta*, D. *Junonia atlites*, E. *Junonia rhadama* and F. *Junonia almanac* at la yaung taw, Naypyidaw union territory.

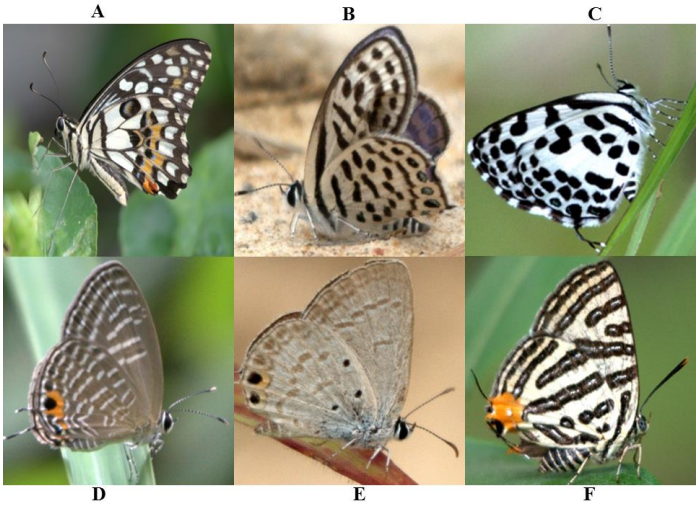

Fig 2: The original six pictures of butterfly species (family Lycaenidae) A. *Papilio demoleus*, B. *Castalius fasciatus*, C. *Castalius rosimon*, D. *Jamides celeno* E. *Catochrysops strabo* and F. *Spindasis syama* at la yaung taw, Naypyidaw union territory.

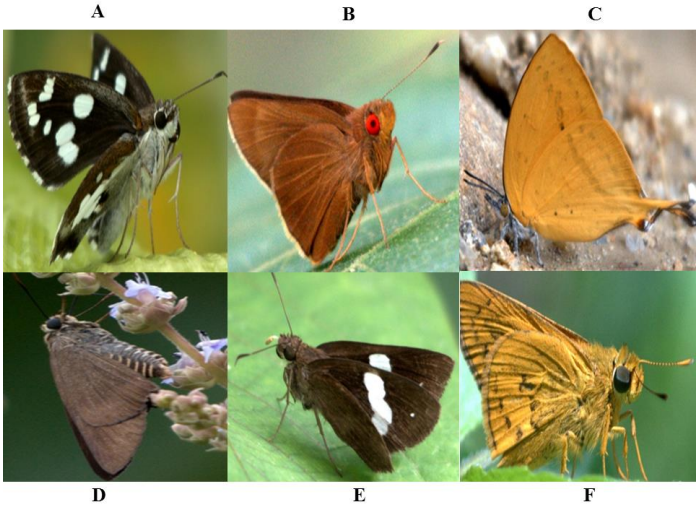

Fig 3: The original six pictures of butterfly species (family Hesperiidae) A. *Udaspes folus*, B. *Matapa aria*, C. *Loxura atymnus*, D. *Badamia exclamationis*, E. *Notocrypta paralysos*, and F. *Telicota augias* at la yaung taw, Naypyidaw union territory.

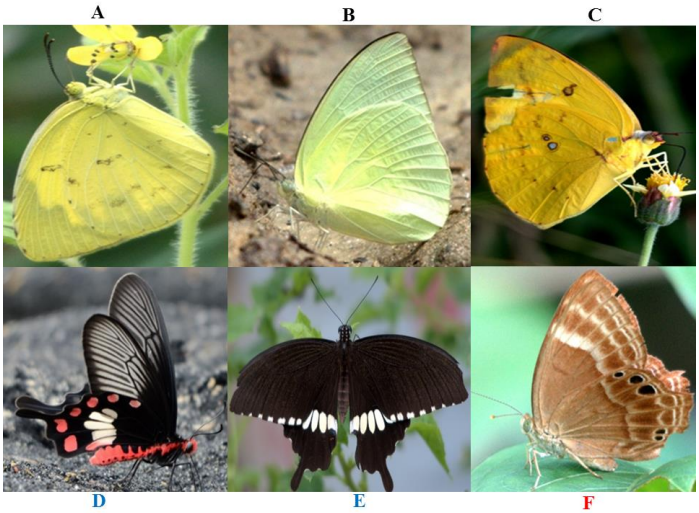

Fig 4: The original six pictures of butterfly species (family Pieridae, Papilionidae and Ridodinidae) A. *Eurema blanda*, B. *Catopsilia pomona*, C. *Catopsilia scylla*, D. *Pachliopta aristolochiae*, E. *Papilio polytes*, and F. *Abisara geza* la yaung taw, Naypyidaw union territory.

Table 2: The diversity of Butterflies (common name, scientific name, order, family, genus, and species) at la yaung taw, Naypyidaw union territory.

No	Common Name	Scientific Name	Order	Family	Genus	Species
1	Blue Pansy	*Junonia orithya wallacei*	Lepidoptera	Nymphalidae	Junonia	orithya
2	lemon pansy	*Junonia lemonias*	Lepidoptera	Nymphalidae	Junonia	lemonias
3	Yellow Pansy	*Junonia hierta*	Lepidoptera	Nymphalidae	Junonia	hierta
4	Gray Pansy	*Junonia atlites atlites*	Lepidoptera	Nymphalidae	Junonia	atlites
5	Brilliant blue	*Junonia rhadama*	Lepidoptera	Nymphalidae	Junonia	rhadama
6	Peacock Pansy	*Junonia almana*	Lepidoptera	Nymphalidae	Junonia	almana
7	Dark Brand Bush Brown	*Mycalesis mineus macromalayana*	Lepidoptera	Nymphalidae	Mycalesis	mineus
8	Dinghy Bush Brown	*Mycalesis perseus cepheus*	Lepidoptera	Nymphalidae	Mycalesis	perseus
9	Tawny Coster	*Acraea terpsicore*	Lepidoptera	Nymphalidae	Acraea	terpsicore
10	Common Leopard	*Phalanta phalantha*	Lepidoptera	Nymphalidae	Phalanta	phalantha
11	Plain Tiger	*Danaus chrysippus chrysippus*	Lepidoptera	Nymphalidae	Danaus	chrysippus
12	Blue Glassy Tiger	*Ideopsis vulgaris macrina*	Lepidoptera	Nymphalidae	Ideopsis	vulgaris
13	Spotted Black Crow	*Euploea crameri bremeri*	Lepidoptera	Nymphalidae	Euploea	crameri
14	Bamboo treebrown	*Lethe europa*	Lepidoptera	Nymphalidae	Lethe	europa
15	Common Five Ring	*Ypthima baldus newboldi*	Lepidoptera	Nymphalidae	Ypthima	baldus
16	Great Egg Fly	*Hypolimnas bolina bolina*	Lepidoptera	Nymphalidae	Hypolimnas	bolina
17	Common Paln Fly	*Elymnias hypermnestra*	Lepidoptera	Nymphalidae	Elymnias	hypermnestra
18	Leopard Lacewing	*Cethosia cyane*	Lepidoptera	Nymphalidae	Cethosia	cyane
19	Common Sailor	*Neptis hylas*	Lepidoptera	Nymphalidae	Neptis	hylas
20	Lime Butterfly	*Papilio demoleus*	Lepidoptera	Lycaenidae	Castalius	demoleus
21	Common Pierrot	*Castalius fasciatus*	Lepidoptera	Lycaenidae	Castalius	fasciatus
22	Common Pierrot	*Castalius rosimon rosimon*	Lepidoptera	Lycaenidae	Castalius	rosimon
23	Common Caerulean	*Jamides celeno aelianus*	Lepidoptera	Lycaenidae	Jamides	celeno
24	Forget-me –not	*Catochrysops strabo strabo*	Lepidoptera	Lycaenidae	Catochrysops	strabo
25	Club Silverline	*Spindasis syama terana*	Lepidoptera	Lycaenidae	Cigaritis	syama
26	Grass Demon	*Udaspes folus*	Lepidoptera	Hesperiidae	Udaspes	folus
27	Common Redeye	*Matapa aria*	Lepidoptera	Hesperiidae	Matapa	aria
28	Yamfly	*Loxura atymnus fuconius*	Lepidoptera	Hesperiidae	Metapa	spra
29	Brown Awl	*Badamia exclamationis*	Lepidoptera	Hesperiidae	Badamia	exclamationis
30	Banded Demon	*Notocrypta paralysos varians*	Lepidoptera	Hesperiidae	Notocrypta	paralysos
31	Palm Dart	*Telicota augias augias*	Lepidoptera	Hesperiidae	Telicota	augias
32	Three Spot Grass Yellow	*Eurema blanda snelleni*	Lepidoptera	Pieridae	Eurema	blanda
33	Lemon Emigrant	*Catopsilia Pomona Pomona*	Lepidoptera	Pieridae	Catopsilia	pomona
34	Orange Emigrant	*Catopsilia Scylla cornelia*	Lepidoptera	Pieridae	Catopsilia	scylla
35	Mottled Emigrant	*Catopsilia pyranthe pyranthe*	Lepidoptera	Pieridae	Catopsilia	pyranthe
36	Striped Albatross	*Appias libythea olferna*	Lepidoptera	Pieridae	Appias	libythea
37	Common Rose	*Pachliopta aristolochiae asteris*	Lepidoptera	Papilionidae	Pachilopta	aristolochiae
38	Tailed Jay	*Graphium agamemnon*	Lepidoptera	Papilionidae	Graphium	agamemnon
39	Common Mormon	*Papilio polytes*	Lepidoptera	Papilionidae	Papilio	polytes
40	The Spotted Judy	*Abisara geza niya*	Lepidoptera	Ridodinidae	Abisara	gesa

The diversity of flies

The totals of 19 species flies and 14 species of beetles were observed as high diversity with family Tephritidae and Buprestidae in flies and beetles respectively at la yaung taw, Naypyidaw union territory (Table 3). The representative 6 species in 5 families in flies were shown in Figure 5.

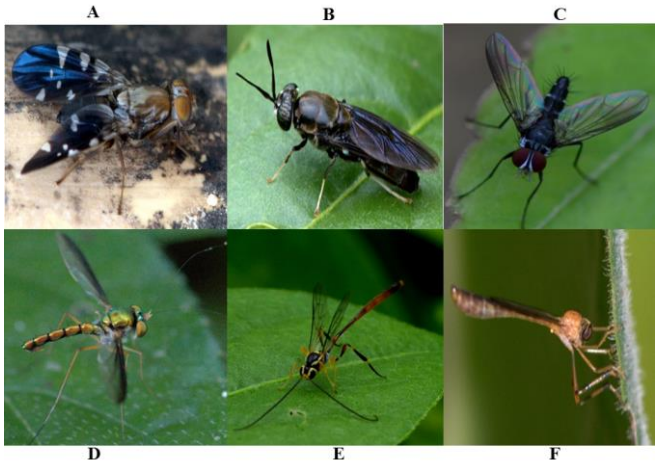

Fig 5: The original six pictures of representative fly species (family Ulidiidae, Stratiomyidae, Tachinidae, Dolichopodidae, Asilidae and Asilidae respectively) A. *Delphinia picta*, B. *Hermetia illucens*, C. *Trigonospila brevifacies*, D. *4. Dolichopodidae*, E. *Dioctria rufipes* and F. *Diogmites crudelis* at la yaung taw, Naypyidaw union territory.

Table 3: The diversity of Flies and Beetles (common name, scientific name, order, family, genus, and species) at la yaung taw, Naypyidaw union territory.

No.	Common name	Scitenfic Name	Order	Family	Genus	Species
Flies						
1	Flesh Fly	*Sarcophaga bercaea*	Diptera	Sarcophagidae	*Sarcophaga*	*bercaea*
2	Long legged Fly	*Austrosciapus sp.*	Diptera	Dolichopodidae	*Austrosciapus*	-
3	Long-Legged Fly	*Chrysosoma sp.*	Diptera	Dolichopodidae	*Chrysosoma sp.*	-
4	Green long-legged flies	*Austrosciapus connexus*	Diptera	Dolichopodidae	*Austrosciapus*	*connexus*
5	Robber Fly	*clephydroneura becker*	Diptera	Clephydroneura	*clephydroneura*	*becker*
6	Marmelade hoverfly	*Episyrphus balteatus*	Diptera	Syrphidae	*Episyrphus*	*balteatus*
7	Black Soldier fly	*Hermetia illucens*	Diptera	Stratiomyidae	*Hermetia*	*illucens*
8	Oriental Latrine Fly	*Chrysomya meqacephala*	Diptera	Calliphoridae	*Chrysomya*	*meqacephal*
9	Red-Legged Robberfly	*Dioctria rufipes*	Diptera	Asilidae	*Dioctria*	*rufipes*
10	-	*Diogmites crudelis*	Diptera	Asilidae	*Diogmites*	*crudelis*
11	Flesh Fly	*Sarcophaga spp*	Diptera	Sarcophagidae	*Sarcophaga*	-
12	Picture wing Fly	*Delphinia picta*	Diptera	Ulidiidae	*Delphinia*	*picta*
13	Thin Tachinid Fly	*Trigonospila brevifacies*	Diptera	Tachinidae	*Trigonospila*	*brevifacies*
14	Beetle Flies	*Celyphus obtectus*	Diptera	Celyphidae	*Celyphus*	*obtectus*
15	beetle Flies	*Celphyus abnormis*	Diptera	Celyphidae	*Celphyus*	*abnormis*
16	Oriental fruit fly	*Bactrocera dorsalis*	Diptera	Tephritidae	*Bactrocera*	*dorsalis*
17	Guava fruit fly	*Bactrocera correcta*	Diptera	Tephritidae	*Bactrocera*	*correcta*
18	Melon fly	*Bactrocera cucurbitae*	Diptera	Tephritidae	*Bactrocera*	*cucurbitae*
19	Common fruit fly	*Drosophila melanogaster*	Diptera	Drosophilidae	*Drosophila*	*melanogaster*
Beetles						
1	Leaf Beetles	*Lemadaturaphila*	Coleoptera	Chrysomelidae	*Lema*	*daturaphila*
2	-	*Sagrafemorata*	Coleoptera	Chrysomelidae	*Sagra*	*femorata*
3	Wood Boring Jewel Bettle	*Belionotaaenea*	Coleoptera	Buprestidae	*Belionota*	*aenea*
4	Jewel Beetle	*Agrilusplanipennis*	Coleoptera	Buprestidae	*Agrilus*	*planipennis*
5	Jewel Beetle	*Sternoceraaequisignata*	Coleoptera	Buprestidae	*Sternocera*	*aequisignata*
6	Jewel Beetle	*Sternocerasp*	Coleoptera	Buprestidae	*Sternocera*	-
7	Round-necked Longhorn Beetle	*Pachyterialambii*	Coleoptera	Cerambycidae	*Pachyteria*	*lambii*
8	Citrus long-horned beetle	*Anoplophorachinensis*	Coleoptera	Cerambycidae	*Anoplophora*	*chinensis*
9	Longhorn Beetle	*Aristobiaapproximator*	Coleoptera	Cerambycidae	*Aristobia*	*approximator*
10	Bess Beetle	*Odontotaeniusdisjunctus*	Coleoptera	Passalidae	*Odontotaenius*	*disjunctus*
11	Ladybird Beetle	*Diomus terminates*	Coleoptera	Coccinellidae	*Diomus*	*terminatus*
12	Ladybird Beetle	*Coelophorainaequalis*	Coleoptera	Coccinellidae	*Coelophora*	*inaequalis*
13	Mottled Tortoise Beetle	*Deloyalaguttata*	Coleoptera	Chrysomelidae	*Deloyala*	*guttata*
14	Mimusop Stem Borer	*Pachyteriadimidiata*	Coleoptera	Cerambycidae	*Pachyteria*	*dimidiata*
No.	Common name	Scitenfic Name	Order	Family	Genus	Species
Flies						
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8	Oriental Latrine Fly	*Chrysomya meqacephala*	Diptera	Calliphoridae	*Chrysomya*	*meqacephal*
9	Red-Legged Robberfly	*Dioctria rufipes*	Diptera	Asilidae	*Dioctria*	*rufipes*
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12	Picture wing Fly	*Delphinia picta*	Diptera	Ulidiidae	*Delphinia*	*picta*
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Beetles						
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2	-	*Sagrafemorata*	Coleoptera	Chrysomelidae	*Sagra*	*femorata*
3	Wood Boring Jewel Bettle	*Belionotaaenea*	Coleoptera	Buprestidae	*Belionota*	*aenea*
4	Jewel Beetle	*Agrilusplanipennis*	Coleoptera	Buprestidae	*Agrilus*	*planipennis*
5	Jewel Beetle	*Sternoceraaequisignata*	Coleoptera	Buprestidae	*Sternocera*	*aequisignata*
6	Jewel Beetle	*Sternocerasp*	Coleoptera	Buprestidae	*Sternocera*	-
7	Round-necked Longhorn Beetle	*Pachyterialambii*	Coleoptera	Cerambycidae	*Pachyteria*	*lambii*
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9	Longhorn Beetle	*Aristobiaapproximator*	Coleoptera	Cerambycidae	*Aristobia*	*approximator*
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12	Ladybird Beetle	*Coelophorainaequalis*	Coleoptera	Coccinellidae	*Coelophora*	*inaequalis*
13	Mottled Tortoise Beetle	*Deloyalaguttata*	Coleoptera	Chrysomelidae	*Deloyala*	*guttata*
14	Mimusop Stem Borer	*Pachyteriadimidiata*	Coleoptera	Cerambycidae	*Pachyteria*	*dimidiata*

The diversity of beetles

The totals of 14 species were observed as high diversity with family Buprestidae at la yaung taw, Naypyidaw union territory. Among them, the representative 6 species in 3 families were shown in Figure 6.

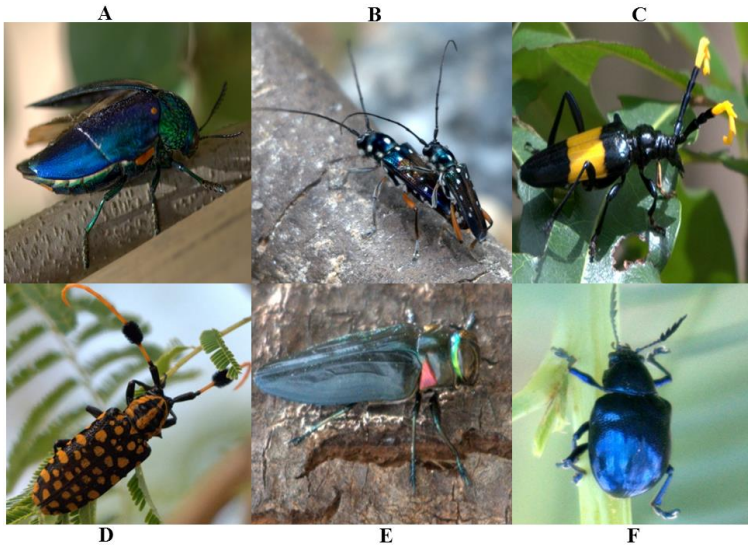

Fig 6: The original six pictures of representative Beetles species (family Buprestidae, Cerambycidae, Passalidae) A. *Sternocera aequisignata*, B. *Anoplophora chinensis*, C. *Pachyteria lambii*, D. *Aristobia approximator*, E. *Belionota aenea and* F. *Odontotaenius disjunctus* at la yaung taw, Naypyidaw union territory.

Table 4: The diversity of grasshoppers, wasps, bugs, moths, centipede and millipede (common name, scientific name, order, family, genus, and species) at la yaung taw, Naypyidaw union territory.

No.	Common name	Scitenfic Name	Order	Family	Genus	Species
Grasshopper						
1	Short-horned Grasshopper	*Oxyahyla intricate*	Orthoptera	Acrididae	Oxya	hyla
2	Meadow Grasshopper	*chorthippusparallelus*	Orthoptera	Acrididae	chorthippus	parallelus
3	Carolina Grasshopper	*Dissosteiracarolina*	Orthoptera	Acrididae	Dissosteira	carolina
4	-	*Chorthippusbrunneus*	Orthoptera	Acrididae	Chorthippus	brunneus
5	-	*Romaleamicroptera*	Orthoptera	Acrididae	Romaleinae	Romalea
6	Common Green Grass Hopper	*Omocestusviridulus*	Orthoptera	Acrididae	*Omocestus*	*viridulus*
7	Eastern Lubber Grasshopper	*Romaleamicropter*	Orthoptera	Acrididae	Romalea	microptera
8	Small Rice Grasshopper	*Oxya Japonica*	Orthoptera	Acrididae	*Oxya*	*Japonica*
9	Grasshoppers	*Erianthussp*	Orthoptera	Chorotypidae	*Erianthus*	-
10	-	*Atractomorphcrenulata*	Orthoptera	Pyrgomorphidae	*Atractomorph*	*Acrenulata*
Wasps						
1	-	*Sceliphronlaetum*	Hymenoptera	Sphecidae	*Sceliphron*	*laetum*
2	-	*Polistescarnifex*	Hymenoptera	Vespidae	*Polistes*	*carnifex*
3	-	*Ropalidiamarginata*	Hymenoptera	Vespidae	*Ropalidia*	*marginata*
4	Yellowjacket	*Vespula*	Hymenoptera	Vespidae	*Vespula*	-
5	Blue Banded Bee	*Amegillacingulata*	Hymenoptera	Apidae	*Amegilla*	*cingulata*
6	Honey Bees	*Apis*	Hymenoptera	Apidae	*Apis*	-
7	Stem borer	*Trichogramma japonica*	Hymenoptera	Trichogrammatidae	*Trichogramma*	*japonica*
Bugs						
1	Leaf-footed Bug	*Leptoglossusoppositus*	Hemiptera	Coreidae	Leptoglossus	opposítus
2	True bug	*Antilochuscoquebertii*	Hemiptera	Pyrrhocoridae	Antilochus	coquebertii
3	Broad-headed Bug	*Megalotomusquinquespinosus*	Hemiptera	Alydidae	Megalotomus	quinquespinosus
4	Plant bug	*Trigonotylusspp*	Hemiptera	Miridae	*Trigonotylus*	-
5	Sugarcane Spittle Bug	*Callitettixversicolor*	Hemiptera	Cercopidae	*Callitettix*	*versicolor*
6	Water Striker	*Gerridae*	Hemiptera	*Gerridae*	-	-
Moths						
1	Hooded Owl Moth	*Cucullia asteroides*	Lepidoptera	Noctuidae	*Cucullia*	*asteroides*
2	-	*Zygaenaephialtes*	Lepidoptera	Zygaenidae	*Zygaena*	*ephialtes*

3	Owl moth	*Brahmaea wallichii*	Lepidoptera	Brahmaeidae	*Brahmaea*	*wallichii*
Centipede						
1	Centipede	*Scolopendragigantea*	Scolopendromorpha	Scolopendridae	*Scolopendra*	*gigantea*
Millipede						
1	Millipede	*Archispirostreptusgigas*	Spirostreptida	Spirostreptidae	*Archispirostreptus*	*gigas*

The diversity of grasshopper

The totals of 10 species grasshopper, 7 species wasps, 6 species bugs, 3 species moths, 1 species centipede and 1 species millipede were discovered as high diversity with family Acrididae, Vespidae, in grasshopper and wasps respectively at la yaung taw, Naypyidaw union territory (Table 4). The representative 6 species in 1 family grasshopper were shown in Figure 7.

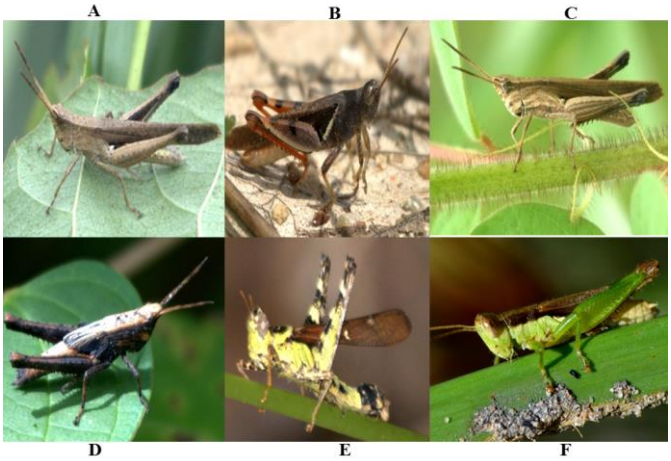

Fig 7: The original six pictures of representative grasshopper species (family Acrididae) A. *Dissosteira Carolina,* B. *Chorthippus brunneus,* C. *chorthippus parallelus,* D. *Romalea microptera,* E. *Romalea micropter* and F. *Oxya hyla intricates* at la yaung taw, Naypyidaw union territory.

The diversity of wasps, bugs, moths, centipede and millipede

The totals of 7 species (wasps), 6 species (bugs), 3 species (moth), 1 species (centipede) and 1 species (millipede) were observed at la yaung taw, Naypyidaw union territory (Table 5). Among them, the representative 6 species were shown in Figure 8.

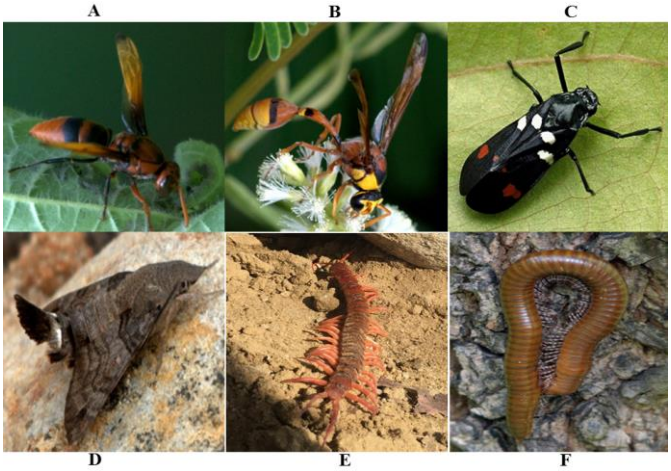

Fig 8: The original picture of representative wasps, bugs, moth, centipede and millipede species A. *Polistes carnifex,* B. *Sceliphron laetum,* C. *Callitettix versicolor,* D. *Cucullia asteroids,* E. *Scolopendra gigantea* and F. *Archispirostreptus gigas* at la yaung taw, Naypyidaw union territory.

Relative abundance of Arthropods

The relative abundance (RA) were observed as 39.6% with the highest butterflies species while the centipede and millipede 0.9% as the lowest species at la yaung taw, Naypyidaw union territory (Figure 9).

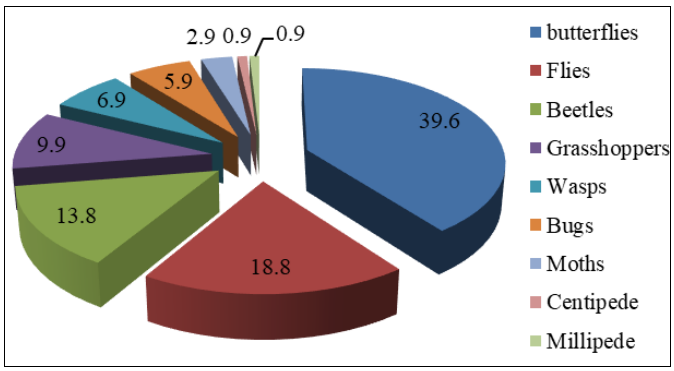

Fig 9: Relative abundance of arthropods (butterflies, flies, beetles, grasshoppers, wasps, bugs, moths, centipede and millipede) at la yaung taw, Naypyidaw union territory.

Discussion

In China, 114 species of arthropods (58 species of spiders, 16 species of predatory insects, 25 species of phytophagous insects, 15 species of other insects), and 109 species of arthropods (50 species of spiders, 19 species of predatory insects, 24 species of phytophagous insects, and 16 species of other insects) were observed in the early and late season crop respectively [22]. Here, we discovered the total of the 101 species of arthropods which consists of 40 species of butterflies, 19 species of flies, 14 species of beetles, 10 species of grasshoppers, 7 species of wasps, 6 species of bugs, 3 species moth, 1 species of millipede and 1 species of centipede at la yaung taw agricultural landscaping site, Naypyidaw union territory. Twenty species of harmful arthropods with the 17 families 6 orders were found in Brinjal Field, Gazipur, Bingaladish [23]. The family of Diptera (Some flies), Scolopendridae (Centipede) and Spirostreptidae (Millipede) were indicated as the harmful arthropods in Naypyidaw union territory. The abundance of butterflies is the highest and it indicates the healthy above-ground ecosystem at Naypyidaw union territory.

Although the distribution of parasitoids were higher in integrated pest management paddy fields than in non-integrated pest management paddy fields, it is the same distribution in others arthropods [24]. In non-integrated pest management at Naypyidaw union territory, the distribution of wasps such as parasitoids, bees is not higher than butterflies. In biodiversity-agro ecosystem functioning relationships, plant diversity effects on arthropods and arthropod-dependent ecosystem [25]. Arthropods diversity index is more than 1 in Naypyidaw union territory with the relationships of host plant diversity vice visa. Different spatial distribution patterns in the landscape show the high diversity index of butterfly mean that ecosystem functioning [26]. We observed the same as butterflies assembling with the highest relative abundance. The ecological suitability of forest management treatments responds to beetles and spiders with the habitats interaction

[27]. The arthropods diversity including beetles species was shown the ecological suitability in Naypyidaw unionterritory. Arthropods abundance in tropical, subtropical and also cool temperate sites shows the healthy ecosystem in Austrilia [28]. Naypyidaw union territory which is situated in the tropical region of Myanmar show the spatial arthropods abundance with butterfly assembling.

Arthropod community structure and local impact factors such as habitat and management and surrounding landscape structure affected on the arthropods diversity [29]. Naypyidaw union territory was indicated that it belong to the high-quality habitats by the evidence of arthropods abundance. Agro-environmental indicators assessment needed for data recoding as well as suggestions for a implication of indicator systems [30]. Comparing location area, the diversity of arthropods as ecological indicator of sustainable agriculture is recorded as spatial distribution. Managing insects and ecosystems, and their interactions, in ways that ensure sustainability of ecosystem services and that minimize induction of disservices [31]. Arthropods abundance with the butterflies assembling show the interaction between arthropods and host plants in sustainable agriculture.

The spatial distribution patterns of butterflies' conservation with species richness have the effective interaction on the high habitats of agro-ecosystem [32]. Because of butterflies, flies, beetles, grasshoppers, wasps, bugs, moths, centipede and millipede distribution on the Naypyidaw union territory, it possess the high habitats of agro-ecosystem. The land-use effect on the impact of diversity and functioning of arthropods community associated ecosystem [33]. La yaung taw agricultural landscaping site exhibit the high diversity index even they may affect of land-use. Above-ground and below-ground arthropods communities' exhibit different community structure patterns controlled different spatial processes [34]. Here, even only above-ground arthropods communities, Naypyidaw union territory poses community structure patterns with high diversity index.

Conclusion

Although the la yaung taw, Naypyidaw union territory is not large area, 101 species of arthropods were occurred and the diversity index is more than 1. Even Naypyidaw union territory is situated at tropical dry zone of Myanmar, arthropods abundance which is related to the high-quality habitats is high. The highest relative abundance of butterflies refers to the healthy ecosystem. Arthropods assembling indicated to lack of constant usage pesticides. Thus, our results reveal that Naypyidaw union territory possesses the sustainable agriculture of healthy ecosystem.

Conflict of interest

All the authors declare no conflict of interest.

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