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Diversity, Evenness, and Species Richness of Aerial Insects in Dry Land of Kefamenanu, North Central Timor, East Nusa Tenggara

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Abstract. This research was conducted to determine the diversity, richness, and evenness of aerial insects based on habitat characteristics in the dry land of Kefamenanu city, North Central Timor, East Nusa Tenggara. The research was conducted on three types of habitats, namely dry land, rivers, and lakes by purposive sampling method. Sampling was done by documenting specimens in each habitat, identifying, inventorying, and analyzing quantitatively to obtain data on species diversity, species richness, and species evenness. Results revealed that aerial insects in Kefamenanu City were found in 9 orders, 25 families, 44 genera, 54 species, and 1998 individuals in three habitat types with diversity index (H'=3,068), evenness index (E=0.774), richness index (R). = 6.974), and dominance index (0.074). Aerial insects in dryland habitats are found in 8 orders, 18 families, 32 genera, 32 species, 514 individuals with diversity index (H'=2.735), evenness index (E=0.789), richness index (R=4.966), and dominance index. (0.092). Aerial insects in river habitat found 7 orders, 20 families, 40 genera, 47 species, and 792 individuals with diversity index (H'=3.205), evenness index (E=0.833), richness index (R=6.892), and dominance index (0.075). Aerial insects in the lake habitat found 8 orders, 18 families, 35 genera, 39 species, 692 individuals with diversity index (H'=2,906), evenness index (E=0.793), richness index (R=5.811), and dominance index (0.083).

Keywords: aerial insect; dry land; diversity; evenness; richness

I. INTRODUCTION

Indonesia has a dry land area of 122.1 million ha, consisting of 108.8 million dry land with a wet climate, mostly located in western Indonesia, such as Sumatra and Kalimantan and 13.3 million ha of dry land with a dry climate mostly located in eastern Indonesia, such as the Nusa Tenggara region. Based on the 13.3 million ha of dry climates in Indonesia, 3 million ha are in East Nusa Tenggara, and 1.5 million ha in West Nusa Tenggara [1]. Dry land in the city of Kefamenanu forms several types of ecosystems, including dry land, rivers, lakes, and dry forests [2]. The soil structure of dry land with dry climates is mostly composed of coral rock and red soil [3], so that the use of dry land as agricultural land or fishery land has many problems and obstacles. The possible uses of this land are the construction of cisterns, dry fields, plantations, community forests, shrubs, and grasslands. The main problems in dry land are soil damage on dry land, lack of water in the dry season, lack of nutrients, and soil conditions that are sensitive to erosion. Other problems experienced by farmers in developing agriculture in dry land include the availability of water, nutrients, and insect pests [4].

Insects included to phylum Arthropoda that have an important role in the food web, namely as pest insects, predatory insects, detrivorous insects, pollinator insects, and bioindicator insects [5]. As an insect bioindicator, it shows that the more diversity of insects in an area, the better environmental quality in the area [6]. Insects are divided into aerial insects and soil insects. Aerial insects are insects that have wings to fly, but not all insects that have wings are aerial insects [7]. The existence of aerial insects in three types of ecosystems (dry land, rivers, and lakes) is interesting to study with the hope of finding some useful insects for agriculture, can determine the diversity, evenness, richness, dominance, and similarity index as well determine the quality of the environment in Kefamenanu city, North Central Timor, East Nusa Tenggara.

II. RESEARCH METHOD

The research was carried out in August-October 2022 in the dry land of the city of Kefamenanu, North Central Timor, East Nusa Tenggara. Kefamenanu dry land area consists of dry land habitat areas, rivers, and lakes. The tools used during the study included cameras, booknote research, insect nets, flakon bottles, insect envelopes, camphor, raffia string, locus, thermometer, hygrometer, altimeter, and anemometer. The research material consisted of 70% alcohol, and insects found in the field.

The method of species inventory and collection of aerial insect samples was carried out using the line transect method (8). The line transect method was carried out on insect habitat lines, namely in dry land lines, riverbank paths, and lakeside paths. The line transect method is carried out by making a 250 meter long transect line with 5 observation points with a distance of 100 meters between points. Observations were carried out for 3 times 8 hours (07.00 – 11.00 WITA & 13.00 – 17.00 WITA) in each habitat [9].

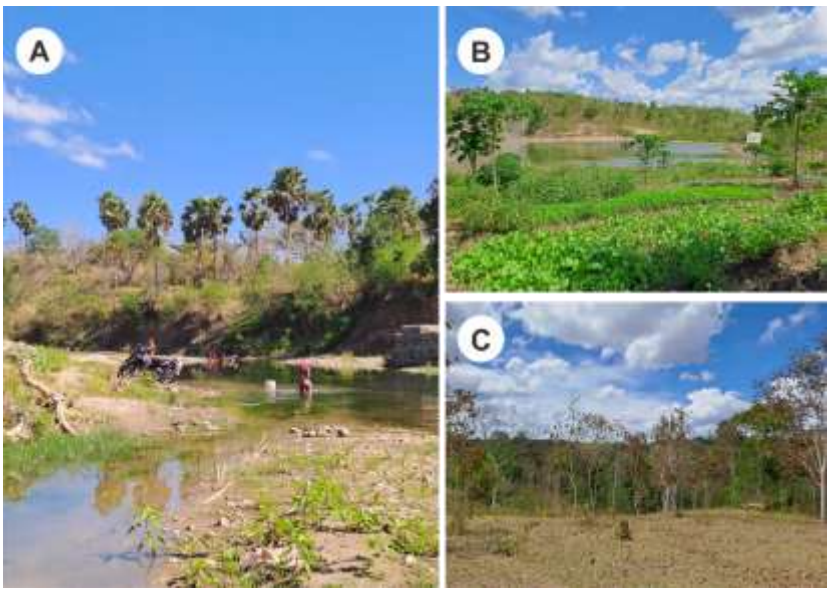

Figure 1. Types of habitat in the dry land of Kefamenanu City, TTU, NTT: A. Rivers; B. Lake; C. Dry land

The research was conducted on three types of habitats (Figure 1), namely dry land habitat, river habitat, and lake habitat using purposive sampling method. Sampling was done by taking pictures using a camera and taking aerial insect samples using a sweep net. Each individual aerial insect caught was put into an insect envelope and flakon bottle containing 70% alcohol, then labeled, and the date of the individual number, species name, fishing habitat was recorded, and for samples that were not caught and were still in the observation area only documentation was taken. to be identified immediately. The samples that have been taken are then documented for identification, inventory, classification, and quantitative data analysis. Identification was carried out using the guide book [10,11,12]. Measurement of environmental parameters was carried out on the three habitat types including air temperature (0C), light intensity (lux), humidity (%), wind speed (km/h), and altitude (mAMSL). The data analysis technique was carried out by calculating the diversity index (H'), evenness index (E), richness index (R), dominance index (C), and Similarity index (IS). Analysis of the data used above include [13]:

Diversity Index: The Species Diversity Index shows the diversity of species in the area. The species diversity index is calculated using the Shannon-Wienner (H') formula as follows:

$$H' = -\sum pi \ln pi$$
$$Pi = ni/N$$

Information:
H' = Shannon-Wiener diversity index
Pi = The ratio of the number of individuals of a species to the whole species
Ni' = Number of species caught
N = Total number of individuals of all species caught
The criteria for diversity index according to Michael (1995) are as follows:
If H'<1 means low insect diversity
If H'1-3 means moderate insect diversity
If H'>3 means high insect diversity

Evenness Index (E): Species abundance index is calculated using the Evenner Index formula (Odum, 1993), namely:

$$E=H'/LnS$$

Information:
E = Specific evenness index
H' = Index of species diversity
S = Number of insect species
The smaller the value of E, the narrower the distribution of species, and the greater the value of E, the wider the spread of species. The evenness index is:
If 0 < E 0.4, it means that the evenness of the species is low
If 0.4 < E 0.6, it means that the evenness of the species is moderate
If 0.6 < E 1.0, it means that the evenness of the species is classified as high

Richness Index (R): The insect species richness index in this study used the Margalef Index with the following equation:

$$R = S-1/Ln(N)$$

Information:
R = Specific Richness Index
S = Number of types
Ln = Natural logarithm
N = Total number of individuals
The criteria for the value of the similar wealth index are:
If R < 3.5, it means that the species richness is low
If R = 3.5 – 5.0, it means that the species richness is classified as moderate
If R > 5.0, it means that the species richness is high

Dominance Index (C): The dominance index is a parameter that expresses the level of dominance of a species in a community. The dominance of this species can occur centrally, several species, or many species which can be estimated from the high and low dominance index.

$$ID = \sum \left(\frac{ni}{N}\right)^2$$

Information:
C = dominance index (Simpson index)
ni = The i-th type of significant value index
N = Number of important value indexes of all types
The dominant index criteria are:
If 0 < C 0.5 means low insect dominance
If 0.5 < C 0.75 means moderate insect dominance
If 0.75 < C 1 means high insect dominance

Similarity Index: Species Similarity Index in the three research sites, the Sorensen similarity index formula was used (Odum, 1993):

$$IS = 2h/a+b$$

J = Number of the same type of insect found in both locations
a = number of insects found at location a
b = number of insects found at location b
The Sorensen similarity index is as follows:
If S > 50% then the area has the same
If S < 50% then the area has no similarities.

III. RESULT AND DICUSSION

Result

Aerial insects were found in three habitat types (dry land, rivers, and lakes) in the city of Kefamenanu, North Central Timor, East Nusa Tenggara as many as 1998 individuals belonging to 54 species, 44 genera, 25 families, and 9 orders. All the orders found were the orders Coleoptera, Diptera, Hemiptera, Hymenoptera, Isoptera, Lepidoptera, Neuroptera, Odonata, & Orthoptera (Table 1). Several aerial insect species from each order have been successfully documented as evidence of insect presence in the dry land of Kefamenanu city, North Central Timor, East Nusa Tenggara (Figure 2).

Documentation results of several aerial insect species found in dry land habitats, rivers, and lakes in the city of Kefamenanu, North Central Timor, East Nusa Tenggara, including those from the order Neuroptera; *Creoleon plumbens* (Fig. 2A), order Orthoptera; *Caelifera* sp (Figure 2B), order Hymenoptera; *Apis cerana* (Fig. 2C), order Odonata; *Pseudagrion pilidorsum* (Fig. 2D), order Lepidoptera; *Danaus chrysippus* (Fig. 2E), and the order Hemiptera; *Leptoglossus lonchoides* (Fig. 2F). The documentation process was carried out by euthanasia using 70% alcohol, and with direct documentation in the field.

TABLE I
AERIAL INSECTS WAS FOUND IN THE THREE HABITAT TYPES IN THE DRY LAND OF KEFAMENANU CITY, TTU, NTT

No.	Order dan Family	Genera atau Species	Number of Individuals			Total Number	Role
			Dryland	River	Lake		
	Coleoptera						
1	Carabidae	*Rhynchophorus* sp	4	0	2	6	Predator
2	Chrysomelidae	*Charidotella secpunctata*	0	11	0	11	Predator
3	Coccinelidae	*Coccinella septempunctata*	11	0	1	12	Predator
	Diptera						
4	Anthomyiidae	*Adia cinerella*	1	0	5	6	Pest

5	Culicidae	*Aedes* sp	23	28	23	74	Predator
6	Muscidae	*Musca domestica*	9	9	13	31	Pest
7	Muscidae	*Musca autumnalis*	0	1	1	2	Pest
	Hemiptera						
8	Alydidae	*Riptortus* sp	0	2	4	6	Pest
9	Coreidae	*Leptoglossus lonchoides*	0	38	0	38	Pest
10	Reduviidae	*Polytoxus fuscovittatus*	0	3	4	7	Pest
	Hymenoptera						
11	Apidae	*Apis cerana*	10	13	10	33	Pest
12	Apidae	*Xylocopa* sp	3	5	0	8	Pest
13	Vespidae	*Vespa affinis*	0	1	6	7	Pest
	Isoptera						
14	Rhinotermitidae	*Coptotermes curvignathus*	45	0	2	47	Predator
	Lepidoptera						
15	Hesperidae	*Taratrocera* sp	3	4	18	25	Pest
16	Lycanidae	*Zizina otis*	31	47	41	119	Pest
17	Nymphalidae	*Acraea violae*	26	35	24	85	Pest
18	Nymphalidae	*Danaus chrysippus*	13	36	31	80	Pest
19	Nymphalidae	*Elymnias hypermenestrata*	8	11	4	23	Pest
20	Nymphalidae	*Hypolimnas bolina*	2	3	1	6	Pest
21	Nymphalidae	*Ideopsis juventa*	1	1	1	3	Pest
22	Nymphalidae	*Junonia orithya*	1	2	1	4	Pest
23	Nymphalidae	*Junonia iphita*	0	10	0	10	Pest
24	Nymphalidae	*Junonia atlites*	0	1	0	1	Pest
25	Nymphalidae	*Neptis hylas*	6	11	12	29	Pest
26	Nymphalidae	*Phalanta phalanta*	2	0	1	3	Pest
27	Nymphalidae	*Ypthima baldus*	11	8	3	22	Pest
28	Papilionidae	*Graphium doson*	1	2	0	3	Pest
29	Pieridae	*Catopsilia pomona*	37	49	42	128	Pest
30	Pieridae	*Eurema blanda*	18	15	17	50	Pest
31	Pieridae	*Leptosia nina*	6	14	11	31	Pest
	Neuroptera						
32	Myrmeleontidae	*Creoleon plumbeus*	1	0	0	1	
	Odonata						
33	Chlorocyphidae	*Libellago lineata*	0	3	0	3	Predator
34	Coenagrionidae	*Agriocnemis pygmaea*	0	2	0	2	Predator
35	Coenagrionidae	*Ischnura senegalensis*	0	17	4	21	Predator
36	Coenagrionidae	*Pseudagrion microcephalum*	0	2	0	2	Predator
37	Coenagrionidae	*Pseudagrion pilidorsum*	0	2	0	2	Predator
38	Coenagrionidae	*Pseudagrion pruinosum*	0	4	0	4	Predator
39	Libelluidae	*Brachytemis contaminata*	0	27	28	55	Predator
40	Libelluidae	*Crocothemis servilia*	5	24	9	38	Predator
41	Libelluidae	*Diplacodes trivialis*	17	20	25	62	Predator
42	Libelluidae	*Neurothemis ramburii*	0	7	10	17	Predator
43	Libelluidae	*Neurothemis terminata*	0	6	4	10	Predator
44	Libelluidae	*Orthetrum pruinosum*	0	0	8	8	Predator
45	Libelluidae	*Orthetrum sabina*	60	59	78	197	Predator
46	Libelluidae	*Orthetrum testaceum*	0	12	15	27	Predator
47	Libelluidae	*Pantala flavenscens*	37	143	109	289	Predator

48	Libelluidae	*Potamarcha congener*	3	3	3	9	Predator
49	Libelluidae	*Tholymis tillarga*	0	1	1	2	Predator
50	Libelluidae	*Zyxoma obtusum*	0	1	1	2	Predator
51	Platycnemididae	*Copera marginipes*	0	2	0	2	Predator
	Orthoptera						
52	Acrididae	*Caelifera* sp	111	93	113	317	Pest
53	Gryllidae	*Acheta domesticus*	6	3	5	14	Pest
54	Mantidae	*Mantis* sp	2	1	1	4	Pest

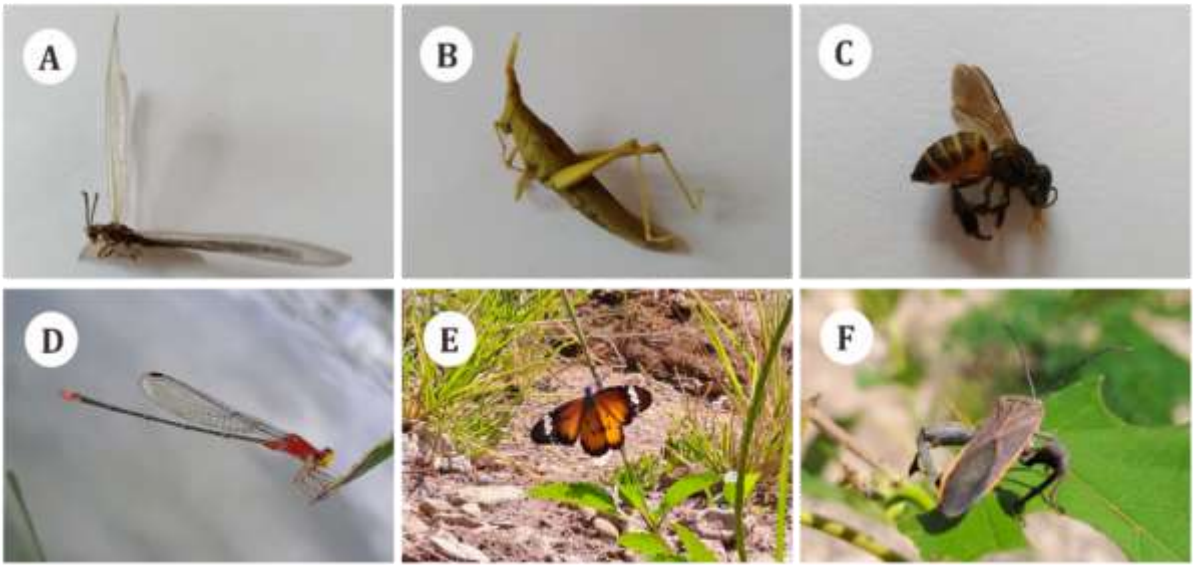

Figure 2. Aerial insects found on dry land in the city of Kefamenanu, TTU, NTT: A. *Creoleon plumbeus* (Neuroptera); B. *Caelifera* sp (Orthoptera); C. *Apis cerana* (Hymenoptera); D. *Pseudagrion pilidorsum* (Odonata); E. *Danaus chrysippus* (Lepidoptera); F. *Leptoglossus lonchoides* (Hemiptera).

The results showed the number of individuals and the number of species in each habitat type were 514 individuals, 32 species (dry land), 792 individuals, 47 species (rivers), and 692 individuals, 39 species (lakes). The results were analyzed quantitatively by calculating the diversity index (H'), evenness index (E), wealth index (R), dominance index (ID), and Similarity index (IS). The species diversity index (H') of aerial insects in three habitat types in the city of Kefamenanu, North Central Timor, East Nusa Tenggara is high (3,086>3). The distribution of species (E) of aerial insects in three habitat types in Kota Kefamenanu, North Central Timor, East Nusa Tenggara was high (0.6<0.774=<1.0). Species richness (R) of aerial insects in three habitat types in Kota Kefamenanu, North Central Timor, East Nusa Tenggara was high (6,974>5.0). The dominance (ID) of aerial insects in three habitat types in the city of Kefamenanu, North Central Timor, East Nusa Tenggara was low (0<0.074=<0.5).

TABLE II
AERIAL INSECT DIVERSITY INDEX ON DRY LAND IN KEFAMENANU CITY, TTU, NTT.

No.	Parameter	Habitat			Total Number
		Dry Land	River	Lake	
1	Number of Individuals	514	792	692	1998
2	Number of Species	32	47	39	54
3	Diversity Index (H')	2,735	3,205	2,906	3,086
4	Evenness Index (E)	0,789	0,833	0,793	0,774
5	Richness Index (R)	4,966	6,892	5,811	6,974
6	Dominance Index (ID)	0,092	0,075	0,083	0,074

Similarity index (IS) of aerial insects on dry land and rivers (73%>50%), which means aerial insects on dry land and rivers are relatively similar. Similarity index (IS) of aerial insects on dry land and lakes (86%>50%) which

means that aerial insects on dry land and lakes are relatively similar. Similarity index (IS) of aerial insects in rivers and lakes (81%>50%), which means that aerial insects in rivers and lakes are relatively similar. Similarity index (IS) of aerial insects on dry land, rivers and lakes (44%>50%), which means aerial insects on dry land, rivers, and lakes are classified as non-similar.

TABLE III
AERIAL INSECT SIMILARITY INDEX IN THE THREE HABITAT TYPES IN THE DRY LAND OF KEFAMENANU CITY, TTU, NTT.

No.	Parameter	Dry land - River	Dryland - Lake	River - Lake	Dry land – River - Lake
1	Number of species A + B	79	71	86	118
2	Number of same species	26	29	35	24
3	Similarity Index (IS)	0.658 (66%)	0.817 (81%)	0.814 (81%)	0.407(41%)

The results of the calculation of the diversity index, evenness index, richness index, and aerial insect dominance index are influenced by environmental parameters (air temperature, water temperature, light intensity, humidity, wind speed, and altitude). The measurement results of environmental parameters show the air temperature in dry land (260C - 340C), rivers (200C - 320C), and lakes (220C - 330C). Light intensity on dry land (702 lux), rivers (509 lux), and lakes (588 lux). Air humidity on dry land (47% - 20%), rivers (60% - 29%), and lakes (55% - 24%). Wind speed on dry land (10.5 km/h), rivers (8.2 km/h), and lakes (25.6 km/h). Altitude on dry land (482 mASML), rivers (345 mAMSL), and lakes (482 mAMSL).

TABLE IV
ENVIRONMENTAL PARAMETERS OF THE THREE HABITAT TYPES IN THE DRY LAND OF KEFAMENANU CITY, TTU, NTT.

No	Habitat	Parameter					Coordinate point
		Temperature (^{0}C)	Light Intensity (lux)	Humidity (%)	Wind Velocity (km/h)	Altitude (mAMSL)	
1	Dry land	26 – 34	702	47% - 20%	10,5	482	$9^0$29’23”S – $124^0$30’58”E
2	River	20 – 32	509	60% - 29%	8.2	345	$9^0$29’46”S – $124^0$30’38”E
3	Lake	22 – 33	588	55% - 24%	25.6	403	$9^0$27’22”S – $124^0$32’45”E

Discussion

Aerial insects found in the dry land of Kefamenanu City, North Central Timor, East Nusa Tenggara were as many as 1998 individuals, 54 species, 44 genera, 25 families, 9 orders spread over three types of habitats, including dryland habitat, river and lake habitat. (Table 1). The highest number of individual species found in the three habitat types was *Caelifera* sp (wood locust) with 317 individuals (Table 1). The family with the highest number of individuals found in the three habitat types was the libelluidae family, which was 725 individuals. The family with the highest number of species found in the three habitat types is the libelluidae family, which is 12 species. The number of families found in the dry land of Kefamenanu, North Central Timor Regency is greater than that found by Aveludoni (2021) in Maubeli Village, North Central Timor Regency, which reported 405 individuals, and 8 families of aerial insect [4].

Aerial insects found in dry land habitats were 514 individuals, 32 species, 32 genera, 18 families, and 8 orders. The 8 orders found in dry land habitats are the orders coleoptera, diptera, hymenoptera, isoptera, lepidoptera, neuroptera, odonata, and orthoptera. The species with the highest number of individuals found in dry land was *Caelifera* sp (wood locust) with 111 individuals. The family with the highest number of individuals found in dry land was the libelluidae family, which was 122 individuals. The family with the highest number of species found in dry land is the nymphalidae family, which is 9 species. Aerial insects found in river habitats were 792 individuals, 47 species, 40 genera, 20 families, and 7 orders. The 7 orders found in river habitats are the orders coleoptera, diptera, hemiptera, hymenoptera, lepidoptera, odonata, and orthoptera. The species with the highest number of individuals found in the river was Pantala flavescens (traveling dragonflies) with 143 individuals. The family with the highest number of individuals found in the river was the family libelluidae, which was 303 individuals. The family with the highest number of species found in rivers is the libelluidae family, which is 11

species. Aerial insects found in the lake habitat were 692 individuals, 39 species, 35 genera, 18 families, and 8 orders. The 8 orders found in the lake habitat are the orders coleoptera, diptera, hemiptera, hymenoptera, isoptera, lepidoptera, odonata, and orthoptera. The species with the highest number of individuals found in the lake was *Caelifera* sp (wood locust) with 113 individuals. The family with the highest number of individuals found in the lake is the libelluidae family, which is 300 individuals. The family with the most number of species found in the lake is the family libelluidae, which is 11 species. Acrididae and libelluidae are families of the insecta class that have a high tolerance for changes in environmental conditions, including polluted water conditions [15].

Based on the three habitat types, it was shown that the least number of insect species found was in dry land habitat (32 species), followed by lake habitat (39 species) and river habitat (49 species). The least number of insect individuals found was in dry land habitat (514 individuals), followed by lake habitat (692 individuals) and the highest number was found in river habitat (792 individuals). The most common species found in rivers are in the order Odonata suborder zygoptera (needle dragonflies). This dragonfly has a limited distribution in a habitat because of the nature of the needle dragonfly which has a high sensitivity to environmental changes. Needle dragonflies will not be found in forests that have been disturbed or have been converted [16]. The presence of dragonflies in a habitat can indicate the condition of a habitat is still classified as good or has been damaged, the presence of this abundant and diverse dragonfly can be used as one of the bioindicators of water quality [17].

The Shanno-Wiener (H') species diversity index of aerial insects in the dry land of Kefamenanu City is 3,068. These results indicate that the diversity of aerial insects in the dry land of Kefamenanu City is relatively high (3.68>3). The Shanno-Wiener (H') species diversity index of aerial insects in dry land habitats is 2,735. These results indicate that the diversity of aerial insects in dry land habitats is moderate (1<2,735<3). The Shanno-Wiener (H') species diversity index of aerial insects in river habitats is 3,205. These results indicate that the diversity of aerial insects in river habitats is high (3,205>3). The Shanno-Wiener (H') species diversity index of aerial insects in lake habitat is 2,906. These results indicate that the diversity of aerial insects in this lake habitat is moderate (1<2,906<3). The species evenness index (E) of aerial insects in the dry land of Kefamenanu City was 0.774. These results indicate that the distribution of aerial insects in the dry land of Kefamenanu City is relatively high (0.6<0.774≤1.0). The species evenness index (E) of aerial insects in dry land habitats was 0.789. These results indicate that the distribution of aerial insects in dry land habitats is high (0.6<0.789<1.0). The species evenness index (E) of aerial insects in river habitats was 0.833. These results indicate that the distribution of aerial insects in river habitats is high (0.6<0.833<1.0). The species evenness index (E) of aerial insects in the lake habitat was 0.793. These results indicate that the distribution of aerial insects in this lake habitat is high (0.6<0.793<1.0).

The species richness index (R) of aerial insects in the dry land of Kefamenanu City is 6.974. These results indicate that the abundance of aerial insects in the dry land of Kefamenanu City is relatively high (6,974>5.0). The species richness index (R) of aerial insects in dry land habitat was 4.966. These results indicate that the richness of aerial insects in dry land habitats is relatively high (3.5 < 4.966 < 5.0). The species richness index (R) of aerial insects in river habitat was 6.892. These results indicate that the richness of aerial insects in river habitats is high (6,892>5.0). The species richness index (R) of aerial insects in the lake habitat was 5.811. These results indicate that the richness of aerial insects in this lake habitat is relatively high (5,811>5.0). Species diversity (H'), species evenness (E), and species richness (R) of aerial insects were highest in river habitats followed by species diversity (H'), species evenness (E), and species richness (R) of aerial insects in lake habitat and dry land habitat. This is related to the number of individuals and the number of species most commonly found are aerial insects in river habitats. Most of the species found in river habitats are the order Odonata and the order Lepidoptera. This is probably due to the availability of good enough food, the carrying capacity of the environment to meet the needs of aerial insects is still quite good, productivity is quite good, ecological pressure is low, and ecosystem conditions are quite balanced [18].

The species dominance index (ID) of aerial insects in the dry land of Kefamenanu City is 0.074. These results indicate that the dominance of aerial insects in the dry land of Kefamenanu City is low (0<0.074≤0.5). The species dominance index (ID) of aerial insects in dry land habitats was 0.092. These results indicate that the dominance of aerial insects in dry land habitats is low (0<0.092≤0.5). The species dominance index (ID) of aerial insects in river habitat is 0.075. These results indicate that the dominance of aerial insects in river habitats is low (0<0.075≤0.5). The species dominance index (ID) of aerial insects in lake habitat is 0.083. These results indicate that the dominance of aerial insects in this lake habitat is low (0<0.083≤0.5). Species dominance (ID) of aerial insects in river habitat was low, followed by dominance of species (ID) of aerial insects in lake and dry land habitats. The dominant insects in the three habitat types were Caelifera sp (wood grasshopper) 317 individuals, *Pantala flavescens* (travel dragonfly) 289 individuals, and *Orthetrum sabina* (green

sambar dragonfly) 197 individuals. Species that dominate the three habitat types are species that have a solitary character with a wide distribution and have a fairly high tolerance for changes in environmental conditions [19].

The value of the dominance index (ID) is inversely proportional to the value of the diversity index (H'), the species evenness index (E), and the species richness index (R). The higher the dominance of a species, the lower the diversity, evenness, and richness of a species and the lower the dominance of the species, the higher the diversity, evenness, and richness of a species in a habitat. The greater the number of individuals in one species found in a habitat, the greater the dominance index that will be obtained in that habitat. The greater the number of species found in a habitat, the greater the value of the diversity index (H'), the species evenness index (E), and the species richness index (R) in that habitat. This is influenced by several internal factors such as ecosystem balance, food availability, and stable environmental conditions. In addition, the diversity index (H'), species evenness index (E), and species richness index (R) are influenced by external factors such as humidity, air temperature, light intensity, wind speed, and altitude [20].

Similarity index (IS) of aerial insects on dry land and rivers (66%>50%), which means aerial insects on dry land and rivers are relatively similar. Similarity index (IS) of aerial insects on dry land and lakes (81%>50%) means that aerial insects on dry land and lakes are relatively similar. Similarity index (IS) of aerial insects in rivers and lakes (81%>50%), which means that aerial insects in rivers and lakes are relatively similar. Similarity index (IS) of aerial insects on dry land, rivers and lakes (41% <50%), which means that aerial insects on dry land, rivers, and lakes are classified as non-similar. The species found similarity on dry land and rivers were 26 species, consisting of the order diptera (2 species), hymenoptera (2 species), lepidoptera (14 species), odonata (5 species), and orthoptera (3 species). Species found similarity in dry land and lakes were 29 species, consisting of the order Coleoptera (2 species), Diptera (3 species), Hymenoptera (2 species), Isoptera (1 species), Lepidoptera (14 species), Odonata (12 species). species), and orthoptera (3 species). The species found similarity in rivers and lakes were 35 species, consisting of the order diptera (3 species), hemiptera (2 species), hymenoptera (2 species), lepidoptera (14 species), odonata (5 species), and orthoptera (3 species). species). The species found similarity in dry land, rivers, and lakes were 24 species, consisting of the order Diptera (2 species), Hymenoptera (1 species), Lepidoptera (13 species), Odonata (5 species), and orthoptera (3 species). The species similarity index in dry land habitats, rivers and lakes is dominated by the orders Lepidoptera and Orthoptera, this is due to the role of these two orders in the food chain as producers, in addition to the high tolerance level of the orders Orthoptera and Lepidoptera in dry land ecosystems [21].

The results of the calculation of the diversity index, evenness index, richness index, and high aerial insect dominance index in three types of habitats in Kefamenanu City are influenced by environmental parameters. The environmental conditions of dry land habitats have dense weed vegetation, sparse tree plants, the air temperature is quite hot, the humidity is quite low, the forest floor is covered with dry grass and dry leaf litter, minimal water sources, temperature 280-320C, alkaline pH, calcareous rocky substrate, and red soil structure. The environmental conditions of the river habitat have dense weed vegetation, rare tree plants, the air temperature is cooler than dry land habitats, moderate humidity, the forest floor is covered with dry grass, wet grass, and dry leaf litter, near water sources, temperature 260-290C, alkaline pH, calcareous rocky substrate, red soil structure, and muddy riverbanks. The environmental conditions of the lake habitat have sandalwood tree vegetation, agricultural land, the air temperature is cooler than dry land habitats, moderate humidity, the lakeside floor is covered with wet grass, near water sources, temperature 260-290C, alkaline pH, and wet soil structure is given additional soil humus (2,22,23).

IV. CONCLUSION

Aerial insects found on dry land in Kefamenanu City contained 9 orders, 25 families, 44 genera, 54 species, 1998 individuals in three habitat types with diversity index (H'=3,068), evenness index (E=0.774), richness index (R = 6.974), and the dominance index (0.074). Aerial insects in dry land habitat were found in 8 orders, 18 families, 32 genera, 32 species, 514 individuals with diversity index (H'=2.735), evenness index (E=0.789), richness index (R=4.966), and dominance index. (0.092). Aerial insects in river habitats were found in 7 orders, 20 families, 40 genera, 47 species, 792 individuals with diversity index (H'=3.205), evenness index (E=0.833), richness index (R=6.892), and dominance index (0.075). Aerial insects in lake habitat found 8 orders, 18 families, 35 genera, 39 species, 692 individuals with diversity index (H'=2,906), evenness index (E=0.793), richness index (R=5.811), and dominance index (0.083).

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