Monitoring of Butterfly Abundance in the Urban Forests of Cibubur Arboretum and University of Indonesia

Pemantauan Kelimpahan Kupu-kupu di Hutan Kota Arboretum Cibubur dan Universitas Indonesia

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ABSTRAK

Penelitian berkaitan dengan biodiversitas yang dilakukan secara berkala, dapat menjadi bagian dari aktifitas pemantauan untuk melihat perubahan populasi kupu-kupu di suatu wilayah. Kupu-kupu memiliki peran sebagai bioindikator lingkungan yang umum ditemukan di berbagai tempat. Hutan kota seperti Arboretum Cibubur, dan Universitas Indonesia adalah lokasi konservasi mini yang menjadi habitat bagi kupu-kupu. Tujuan dari Penelitian ini untuk memantau perubahan kelimpahan kupu-kupu di hutan kota Arboretum Cibubur dan UI. Penelitian ini dilakukan pada tahun 2014 dan tahun 2021. Pengamatan ini dilakukan dengan metode purposive sampling. Masing-masing hutan kota dibagi menjadi 3 stasiun yang berbeda terdiri dari 2 plot (20 x 20 m), dan dilakukan pengulangan sebanyak 3 kali pada masing-masing plot dengan interval 1 minggu dengan menggunakan sweeping net dan kamera. Pengamatan dilakukan selama 1 jam pada tiap plot. Total pengamatan kupu-kupu di kedua hutan kota sebanyak 18 kali. Individu kupu-kupu yang ditemukan pada tahun 2014 di Hutan Kota Arboretum Cibubur (339) individu, dan tahun pada tahun 2021 (232) individu. di Hutan Kota UI pada tahun 2014 ditemukan 898 individu dan 269 individu pada tahun 2021. Famili Nymphalidae merupakan famili dengan jumlah individu tertinggi yang ditemukan di tahun 2014 dan 2021. Spesies individu yang ditemukan pada tahun 2014, termasuk dalam kategori sporadis, subreceden, receden, subdominan dan dominan. Sedangkan, spesies kupu-kupu yang ditemukan di lokasi penelitian terkategori dalam kelompok Subreceden, Receden, dan Subdominan pada tahun 2021. Perbedaan vegetasi, perubahan tata guna, gangguan antropogenik dapat mempengaruhi perubahan hasil pengamatan kupu-kupu.

Kata kunci: arboretum, kelimpahan, kupu-kupu, hutan kota, UI

ABSTRACT

Research related to biodiversity that was carried out regularly could be part of monitoring activities to see changes in butterfly populations in an area. Butterflies have a role as environmental bioindicators that were commonly found in various places. Urban forests such as the Cibubur Arboretum and the University of Indonesia were mini

conservation sites that were habitats for butterflies. The purpose of this study was to monitor changes in butterfly abundance in the urban forest of Cibubur Arboretum and UI. This research was conducted in 2014 and 2021. This observation was carried out by purposive sampling method. Each urban forest was divided into 3 different stations consisting of 2 plots (20 x 20 m), and repeated 3 times on each plot with an interval of 1 week using a sweeping net and camera. Observations were carried out for 1 hour on each plots. The total observations of butterflies in both urban forests were 18 times. Individual butterflies found in 2014 in the Urban Forest Arboretum Cibubur (339) individuals, and the year 2021 (232) individuals. in the UI City Forest in 2014 898 individuals were found and 269 individuals in 2021. Nymphalidae family was the family with the highest number of individuals found in 2014 and 2021. The individual species found in 2014, included in the category of sporadic, subrecedent, recedent, subdominant and dominant. Meanwhile, the butterfly species found at the study site were categorized into Sub-recedent, Recedent, and Sub-dominant groups in 2021. Differences in vegetation, changes in use, and anthropogenic disturbances could affect changes in butterfly observations.

Keywords: arboretum, abundance, butterflies, urban forest, UI

INTRODUCTION

Research related to biodiversity that was carried out regularly could be part of monitoring activities to see changes in butterfly populations in an area (Wang et al., 2018). Monitoring was generally carried out to obtain information as an effort to support butterfly conservation efforts in nature (Wang et al., 2020). Urban forest was a green area that could be managed well, to maximize its role not only as a tourist spot and the lungs of the city, but also as a small-scale conservation location for many insects, including butterflies. Butterflies help in the process of pollinating various kinds of plants (Sharma et al., 2020). In addition, butterflies were also used as bioindicators that function to see changes in habitat, namely in the form of use and microclimate (Ismail et al., 2020). In some areas, butterflies were used as part of tourism that has educational value because they have an interesting morphology as known in Bantimurung (Mustari et al., 2013).

Butterflies belong to the Order Lepidoptera which was a large order with diverse members. Based on previous publications, it was known that there were 200,000 Lepidoptera species that have been identified (Abdullahi et al., 2019). The special character of this order was the presence of scales on the wings with attractive colors. The scales on the wings were also used in identification activities carried out to determine the grouping of butterflies to recognize the name of the species (Pacific Science Center, 2010).

Urban forest was one of the patches that could act as a source of oxygen and absorb harmful gases that could be produced by factories and vehicles (Kusyanto, 2012). In addition, urban forests were also used as city air conditioners, tourist sites (Musawantoro et al., 2020) and habitats for several organisms including butterflies. Some of the urban forests in the Jakarta city area were the Cibubur Arboretum City Forest, and the University of Indonesia Urban Forest which was also a habitat for butterflies. In this research, no new species were found buth this research could be a source of Information that supports the finding of a decline in butterfly populations.

The purpose of this study was to monitor butterflies in the urban forest of Arboretum Cibubur and UI in 2014 and 2021, as well as factors affecting abundance in the two research locations. Information related to the abundance and diversity of butterflies in the urban forest was expected to become basic information in supporting butterfly conservation efforts, one of which was to

provide certain habitats that were conducive to the life and breeding of butterflies.

MATERIALS AND METHODS

This research was conducted in 2014, and 2021 in two urban forests of DKI Jakarta, namely; the city forest of the Cibubur Arboretum, and the urban forest of the University of Indonesia and (Figure 1). The equipment used in this study included a butterfly identification book, a butterfly net (sweeping net), GPS (Global positioning system), a compass, and a camera as well as a plant identification application to identify the types of forage plants that were recorded. Equipment used to measure abiotic factors such as humidity, light intensity, wind speed and temperature include: Anemometer, Hygrometer, and Lux meter.

The observation method used in this research was scan sampling (Koneri et al., 2020a) and the technique of determining the plot was purposive sampling. Observation of butterflies using a net (sweeping net), and a camera. The captured butterflies were identified, photographed, the number of individuals and species recorded, and then released again. In each - each urban forest was divided into 3 different stations based on the coordinates in which it consists of 2 plots based on vegetation density, namely; open vegetation and closed vegetation with an area of 20 x 20 m each and repeated 3 times in each plot with an interval of 1 week. Observations were made for 1 hour on each plot with the aimed of avoiding the repetition of certain types of observations.

The total observations of butterflies in both urban forests were 18 times. After obtaining the type of butterfly identified based on the pattern and color on the wings and body size, the butterflies that have been identified were recorded based on the species name and the number of individuals found. Plant identification was carried out on each plot by recording and observing certain plant species and by using an application in plant identification which was then adjusted by the plant identification book (Chen et al., 2015). Butterflies found in the plot were then photographed and identified through photographs using the identification book by Koneri et al. (2020b) and Kirton (2014).

The abundance of a butterfly species used to assess the population abundance of a species in an area. Another parameter observed was the relative abundance category of each species (Hadi & Naim, 2018). By comparing the relative abundance value ($Di = ni/N \times 100\%$) with the range of the category scale as followed:
1. Dominan, relative abundance > 10 %
2. Subdominan, relative abundance 3.2 -9.9 %
3. Receden, relative abundance 1.0-3.1 %
4. Subreceden, relative abundance 0.32-0.99 %
5. Sporadis, relative abundance < 0.32 %

In addition to looking at the abundance and species of butterflies, observations were also made on the vegetation found in the two urban forests. Identification of plants was done by recording and observing the number of plant types based on their families.
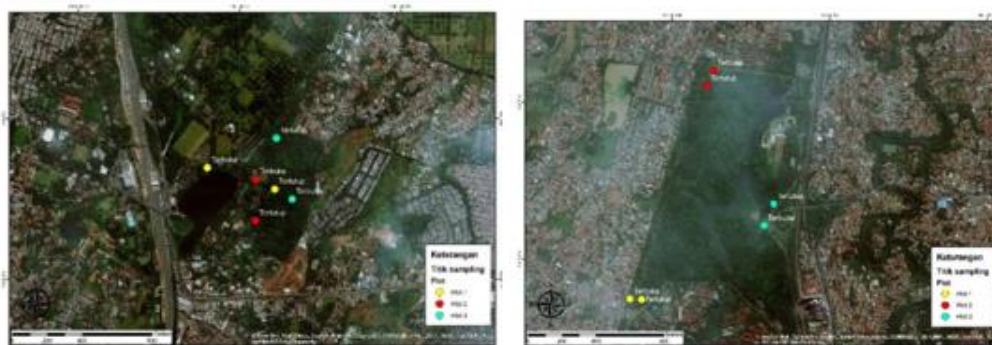

Figure 1. (a) Cibubur arboretum urban forest and (b) urban forest of the University of Indonesia

RESULTS

Based on the observations and identifications made, the following were the butterfly species found in the Arboretum Urban Forest and UI Urban Forest which were presented in 2014 and 2021 (Table 1).

Table 1. Family, species and individu abundance of Butterflies found in Cibubur Arboretum Urban Forest and University of Indonesia Urban Forest at 2014 & 2021

Famili	Spesies	2014	2021
Papilionidae	*Papilio memnon*	25	12
	Papilio demoleus	1	2
	Papilio demolion	1	10
	Papilio polytes	4	0
	Graphium agamemnon	6	14
	Graphium doson	2	0
	Graphium sarpedon	6	5
Pieridae	*Appias olferna*	19	7
	Appias lyncida	0	3
	Catopsilia scylla	0	2
	Catopsilia pomona	3	2
	Delias hyparete	1	12
	Eurema hecabe	**35**	17
	Eurema sari	6	6
	Leptosia nina	26	**22**
	Catopsila pyranthe	1	0
	Eurema alitha	2	0
	Eurema blanda	9	0
Nymphalidae	*Bassarona dunya*	0	1
	Cupha erymantis	17	6
	Danaus genutia	0	1
	Doleschallia bisaltidae	20	1
	Elymnias hypermnestra	0	9
	Elymnias nesaea	0	1
	Euthalia aconthea	0	3
	Euthalia monina	0	3
	Euploea mulciber	20	9
	Euploea eunice	2	2
	Euploea phaenareta	5	5
	Hypolimnas bolina	9	5
	Ideopsis juventa	6	0
	Ideopsis vulgaris	0	1
	Junonia almana	3	0
	Junonia atlites	3	0
	Junonia erigone	10	1
	Junonia orithya	2	2
	Junonia hedonia	17	15
	Junonia iphita	15	10
	Melanititis leda	0	1
	Moduza procris	2	3
	Mycalesis janardana	11	3
	mycalesis mineus	4	9
	Neptis hylas	2	4
	Phaedyma columella	6	7
	Polyura hebe	9	1
	Tanaecia iapis	0	1
	Yptima baldus	2	6
	Ypthima horsfieldii	3	1
	Yptima philomela	7	2
	Amathusia phidipus	1	0
	Cirrochroa tyche	1	0
	Euploea climena	1	0
	Elymnias nesae	1	0
	Melanithis leda	1	0
	Mycalesis horsfeldi	9	0
	Phalanta phalanta	1	0
Lycaenidae	*Arhopala centaurus*	0	1
	Jamides pura	0	2
	Tajuria cippus	0	1
	Zizina otis	0	1
	Euchrysops cnejus	2	0
	Total	**339**	**232**

Table 2. Family, species and individu abundance of Butterflies found in University of Indonesia at 2014 & 2021

Famili	Spesies	2014	2021
Papilionidae	*Papilio memnon*	33	16
	Papilio demoleus	21	2
	Papilio demolion	5	4
	Papilio polytes	2	2
	Graphium agamemnon	30	20
	Graphium doson	24	1
	Graphium sarpedon	10	3
	Pachliopta aristolochiae	1	0
Pieridae	*Appias olferna*	31	7
	Appias lyncida	0	3
	Catopsilia pomona	65	16
	Delias hyparete	13	11
	Eurema hecabe	44	16
	Eurema sari	14	8
	Leptosia nina	60	25
	Catopsila pyranthe	7	0
	Catopsila scylla	22	0
	Delias periboea	1	0
	Eurema alitha	4	0
	Eurema blanda	9	0
Nymphalidae	*Ariadne ariadne*	6	1
	Cupha erymantis	6	3
	Danaus chrysippus	5	1
	Doleschallia bisaltidae	22	5
	Elymnias hypermnestra	0	7
	Euthalia monina	0	3
	Euploea crameri	0	1
	Euploea mulciber	19	11
	Euploea eunice	13	3
	Euploea phaenareta	9	5
	Hypolimnas bolina	32	6
	Ideopsis juventa	2	1
	Ideopsis vulgaris	0	2
	Junonia almana	0	1
	Junonia atlites	4	7
	Junonia erigone	0	3
	Junonia orithya	22	1
	Junonia hedonia	27	11
	Junonia iphita	22	3
	Lethe europa	1	1
	Melanititis leda	0	2
	Moduza procris	0	3
	Mycalesis janardana	19	8
	mycalesis mineus	2	1
	Neptis hylas	5	11
	Phaedyma columella	4	0
	Polyura hebe	0	4
	Spesies 1	0	1
	Tanaecia iapis	0	2
	Ypthima horsfieldii	7	3
	Yptima philomela	102	14
	Acraea issoria	2	0
	Cethosia hypsea	1	0
	Elymnias casiphone	2	0
	Elymnias nesae	5	0
	Elymnias hypernmestra	6	0
	Euthalia Aconthea	1	0
	Euthalia adonia	1	0
	Melanithis leda	1	0
	Mycalesis horsfeldi	11	0
	Mycalesis perseus	3	0
	Polyura athamas	2	0
	Tanaicia palguna	1	0
	Terinos terpander	1	0
	Yptima arba	4	0
Lycaenidae	*Arhopala centaurus*	1	0
	Castalius rosimon	4	2
	Catochrysops strabo	2	1
	Jamides alecto	0	3
	Jamides pura	1	0
	jamides sp	0	2
	Zizina otis	87	2
	Athene lycaenina	4	0
	Everest lacturnus	2	0
	Jamides celeno	7	0
	Leptotes plinius	4	0
	Rapala suffusa	1	0
	Zizulu hylax	19	0
	Total	**898**	**269**

The following was a table containing families, species and the number of individuals found in the urban forests of the Cibubur and UI Arboretum in 2014 which were presented in the Table 2. The following was a comparison of the number of individual butterflies based on family grouping in the 2014 & 2021 Cibubur Arboretum City Forest showed that the most family group found in 2014 and 2021 was Pieridaewhich was presented in Figure 2. Meanwhile, a comparison of the number of individual butterflies based on family grouping in the UI City Forest in 2014 & 2021 showed that the most family group found in 2014 and 2021 was Nymphalidaeas showed in Figure 3. The butterfly species found with the highest number of individuals in the urban forest of Cibubur Arboretum and UI City Forest in 2021 is*Leptosia nina* species and in 2014 the highest number of individual species was found in Cibubur Arboretumis*Yptima philomela and Eurema hecabe* species in UI City Forest (Figure 4).

Based on the category of species abundance, most butterfly species in both locations (2021) fall into the subrecedent, recedent and subdominant categories as showed in Figure 5. Based on the category of species abundance, the butterfly species in the two 2014 locations (Ruslan et al., 2020), mostly belonged to the dominant, subdominant, subrecedent, recedent and sporadic categories as attached in Figure 6.
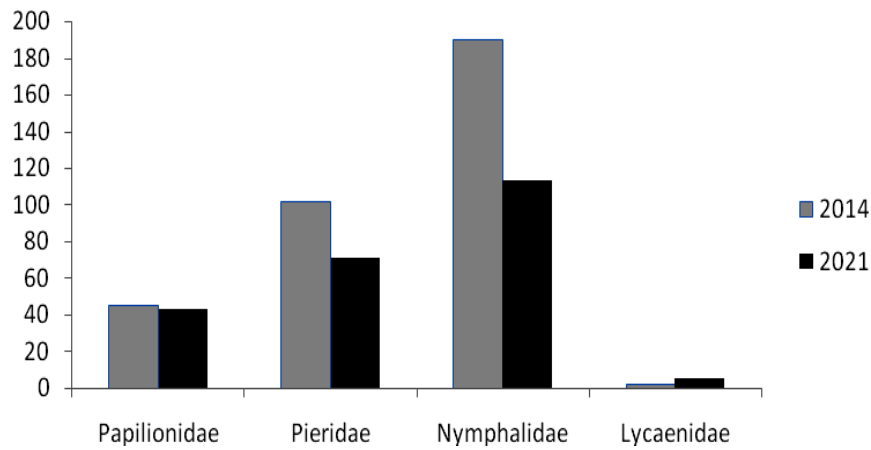

Figure 2. Comparison between abundane of individu in Cibubur Arboretum Urban forest at 2014 & 2021
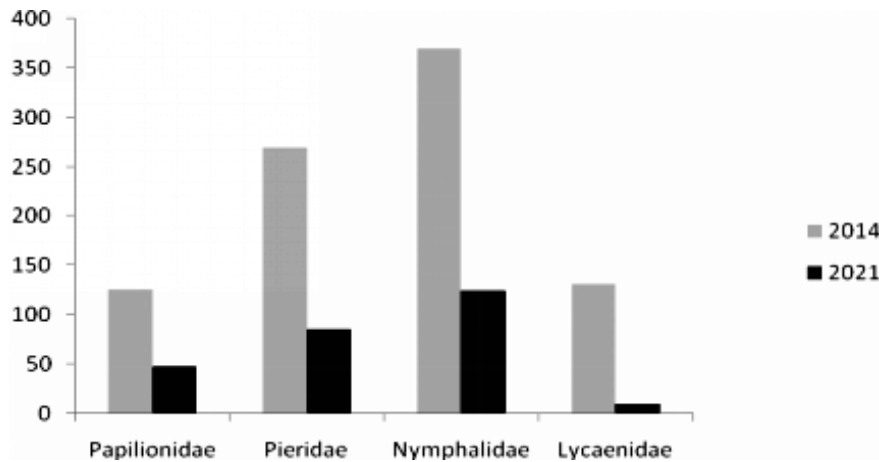

Figure 3. Comparison of individu abundance (in family level) in University of Indonesia at 2014 & 2021

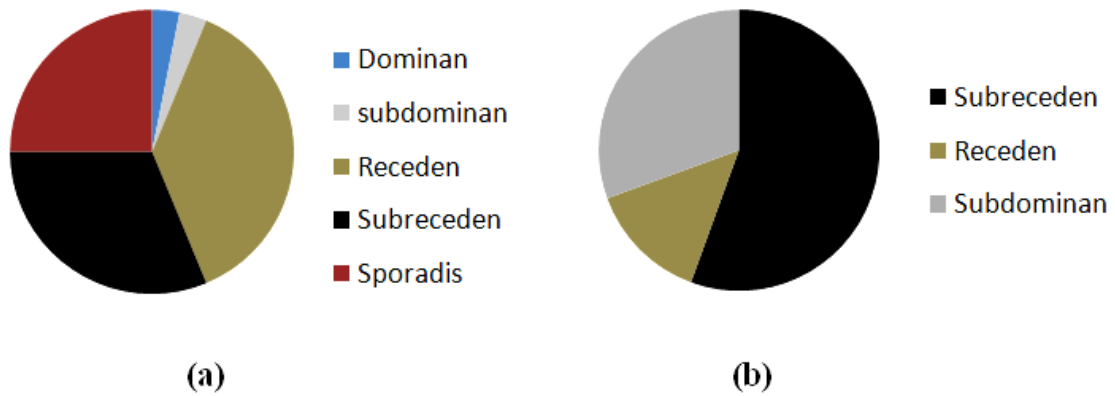Figure 4. Species *Leptosia nina, Yptima philomela* and *Eurema hecabe*

Figure 5. Comparison abundance of butterflies individu based of relative abundance in Cibubur Arboretum Urban Forest at 2014 (a) and 2021 (b)
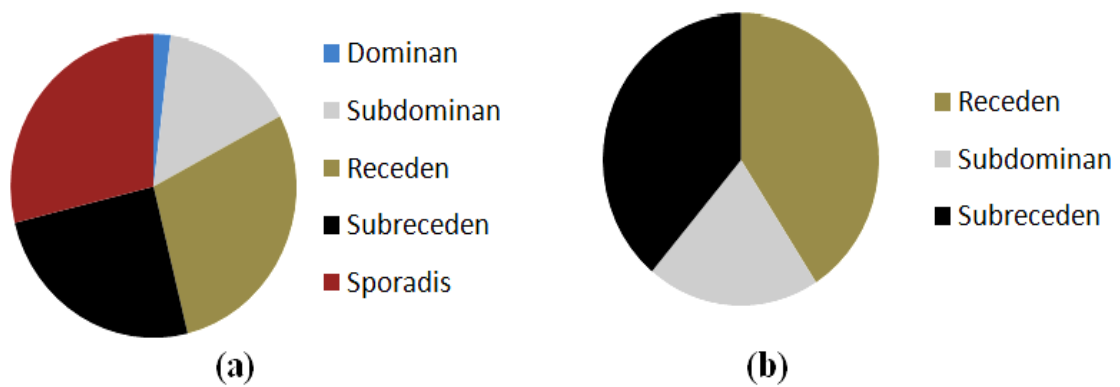

Figure 6. Comparison of butterflies individu abundance based of relative abundance in University of Indonesia Urban Forest at 2014 (a) and 2021 (b)

DISCUSSION

Based on observations made in 2014, it was found that there were 339 individual butterflies found in the urban forest of the Cibubur Arboretum and 232 individuals in 2021 (Table 1). The results of observations in 2014 in the UI urban forest found 898 individuals, and in 2021 found 269 individuals. The results obtained showed a decrease in individual butterflies found in both observation locations. In contrast to individuals, the comparison of the number of families in 2014 and 2021, shows the same pattern (Figure 2 & 3). Lycaenidae is the family with the lowest number and Nymphalidae is the family with the highest number of individuals.

The difference in the number of individuals found at the two observation

sites and in two different years could be caused by differences and changes in the composition of the vegetation found at the two observation sites. Vegetation composition is related to food resources for both adult and imago butterflies (Pires et al., 2020). Habitat changes can also affect differences in the number of individual butterflies found at the two observation sites. Kwon et al. (2021), stated that changes in habitat in which grass and flower plants are getting lesser, affect the butterfly populations. Some examples of changing vegetation include: Tridax procumben, Ruellia tuberosa, Biden philosa, Mimosa pudica, Ageratum cunysoides, Mikania micrata, Synedrella nodiflorae

Butterfly species from the Nymphalidae family had the highest number found in both years of observation compared to other families (Figure 2 & 3). Nymphalidae is known as a family with polyphagous members (Arya et al., 2020). Because it has a wide host range, many species of Nymphalidae can survive in habitats that have a variety of vegetation (Khyade et al., 2018a). While the family that has the lowest number of individuals is Lycaenidae. Based on its morphology, butterflies belonging to the Lycaenidae family have a small size with a fairly high flight speed (Khyade et al., 2018b). This may be due to the low value of individual Lycaenidae found during observations at both research sites and at 2 years of observation.

There are butterfly species found with the highest number of individuals in the urban forest of the Cibubur Arboretum (2014) in the *Eurema hecabe* species and the urban forest of the Cibubur Arboretum (2021) in the *Leptosia nina* species. In 2014 the highest number of individual species in the UI urban forest was found in the *Yptima philomela* species, and in the UI urban forest (2021), in the *Leptosia nina* species. *Leptosia nina*, is a butterfly species that is cosmopolitan and includes a generalist species (Setiawan et al., 2019). *Yptima*

philomela is a species that has a large number of individuals, and flies relatively low, making it easy to catch. *Yptima philomela* belongs to the Nymphalidae family. Most species of Nymphalidae are polyphagous which have a wide host range, so they can be found in high numbers (Sabran et al., 2021). *Eurema hecabe* has the highest abundance because this species has a wide distribution and is polyphagous and can adapt to various environmental conditions (Setiawan et al., 2019).

Based on the category of species abundance (Figure 5 & 6), it is known that the species abundance of butterfly species in the two observation locations at 2 different years was categorized as, sporadic, subrecedent, recedent, subdominant and dominant (Hadi & Naim, 2018).In observations in 2014, several butterfly species were categorized as sporadic and dominant. Meanwhile, according to observations in 2021, it is known that there are no butterflies that fall into the dominant and sporadic categories. Changes in the category and number of individual butterflies found during observations in 2021 can be caused by various factors including changes in vegetation, climate change, use of pesticides, anthropogenic disturbances, to changes in land use (Warren et al., 2021).

CONCLUSSION

Butterfly individuals found in 2014 in the Cibubur Arboretum City Forest (339) individuals, and in 2021 (232) individuals. in UI City Forest in 2014 found 898 individuals and 269 individuals in 2021. The Nymphalidae family is the family with the highest number of individuals found in 2014 and 2021. Individual species found in 2014, are included in the category of sporadic, subrecedent, receden, subdominant and dominant. Meanwhile, the butterfly species found at the study site are categorized in the Subrecedent, Recedent, and Subdominant groups in 2021. Differences in vegetation, land use changes,

anthropogenic disturbances can affect changes in butterfly observations.

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