ENHANCED KNOWLEDGE IN SCIENCES AND TECHNOLOGY
e-ISSN: 2773-6385

EKST

Vol. 4 No. 2 (2024) 662-672
https://publisher.uthm.edu.my/periodicals/index.php/ekst

Public Perception Toward Oil Palm-Based Entomotourism Development in Carey Island Sime Darby EcoGardens

Ain Nazhirah Abdullah[1], Aqilah Awg Abdul Rahman[2]*

[1] *Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia (UTHM), Muar, 84600, MALAYSIA*
[2] *Centre of Research for Sustainable Uses of Natural Resources (COR-SUNR), Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia (UTHM), Muar, 84600, MALAYSIA*

*Corresponding Author: aqilah@uthm.edu.my
DOI: https://doi.org/10.30880/ekst.2024. 04.02.071

Article Info

Received: 27 December 2023
Accepted: 12 January 2024
Available online: 12 December 2024

Keywords

Oil palm, Entomotourism, Insects, Sime Darby, Tourism

Abstract

Oil palm-based entomotourism is a fusion of agriculture and ecotourism. This sector offers a unique experience by showcasing biodiversity within and around oil palm plantations. However, many people have a negative perception toward the oil palm industry due to its impacts on the environment. This results in the effort of developing sustainable oil palm plantation. This study aimed to determine insect diversity in Carey Island Sime Darby EcoGardens and develop a new entomotourism product there. We also investigated public perception on the development of oil palm-based entomotourism to understand how individuals perceive the integration of oil palm plantations and entomotourism initiatives. This study employed field sampling of insects, a questionnaire survey, and the creation of a new entomotourism product. Our results show that the mangrove area in Carey Island Sime Darby EcoGardens have the highest insect diversity with H' = 2.43. The questionnaire revealed a preference for Lepidoptera as the main taxon for entomotourism. We also suggested a new entomotourism package detailing activities related to Lepidoptera for a comprehensive visitor experience. Activities in the entomotourism package include oil palm plantation guided tour, catch-and-release activity as well as insect photography workshop. Hopefully, this entomotourism package can unveil the sustainable aspect of oil palm plantation in Malaysia.

1. Introduction

Insects are directly and indirectly related to our lives and affect human well-being in many ways. Insect tourism or entomotourism is a bridge between humans and insects. It helps combat the negativity and contempt associated with insects, turning disgust into attraction [1]. There is a need to develop conservation strategies and policies aimed at preserving insects and promoting insect tourism [2]. Recently, entomotourism has garnered attention, with these small, six-legged creatures carving out a distinct space in the tourism sector. After being overlooked for decades, entomotourism has gained traction among both insect enthusiasts and tourists [3].

The intersection of agriculture and tourism has witnessed a compelling paradigm shift in recent years, with a growing emphasis on sustainable and educational experiences. One intriguing facet of this evolving landscape

is the emergence of oil palm-based entomotourism, a niche where the dynamic interplay between agriculture and the insect world takes center stage. Oil palm plantations may exhibit reduced biodiversity in comparison to logged-over forests. However, it cannot be solely held responsible for deforestation in Malaysia, especially before 1985 when logging was prevalent [4].

The European Union (EU) has formally prohibited the use of palm oil products as biofuel material among its member states, implementing a phased approach due to concerns about environmental damage [5]. Exporters of crude coconut oil have a promising opportunity in the European cosmetics market as a substitute for palm oil. Increasing consumer awareness of the adverse environmental effects associated with palm oil is driving the demand for alternatives like coconut oil [6]. However, palm oil stands out as a highly productive crop, providing significantly higher yields at a lower production cost compared to other vegetable oils [7]. Also, limited-scale implementation of mixed cropping involving oil palm alongside other crops or livestock has been observed. Experiments have suggested that incorporating multi-purpose tree species (MPTS) for biodiversity enrichment in oil palm plantations could enhance the ecological and social functions of the landscapes [8].

However, according to a comprehensive consumer poll conducted in the UK, palm oil is the least environmentally friendly type of vegetable oil, where 41% of respondents deemed palm oil as "environmentally unfriendly" [9]. Thus, our study focused on public opinion toward oil palm plantation.

This study can be vital to the oil palm sustainability and the successfulness of oil palm-based entomotourism by determining the diversity of insect species in Carey Island Sime Darby EcoGarden, which will allow us to develop new entomotourism product there. The study also investigated public perception on the development of oil palm-based entomotourism to understand how individuals perceive the integration of oil palm plantations and entomotourism initiatives.

The study site was Sime Darby Plantation EcoGardens, an eco-friendly retreat based at Sime Darby Plantation Academy in Carey Island, Selangor. This place was created as a haven from the busy city life as well as to share Sime Darby Plantation's sustainability efforts and the benefits of the oil palm industry. Sime Darby Plantation EcoGardens Sdn Bhd was incorporated on 23 November 1974, and it is fully operational on 1 January 2020 [10].

2. Materials and method

2.1 Study site

This research was carried out at Sime Darby EcoGardens in Carey Island Selangor, Malaysia. (2.983°, 101.373°). Study areas were within the whole area of Sime Darby EcoGardens. Insects were sampled at three different areas: the mangrove area (2.9113°, 101.356°), the Biodiversity Centre (2.888°, 101.364°), and outdoor camp (2.912°, 101.350°).

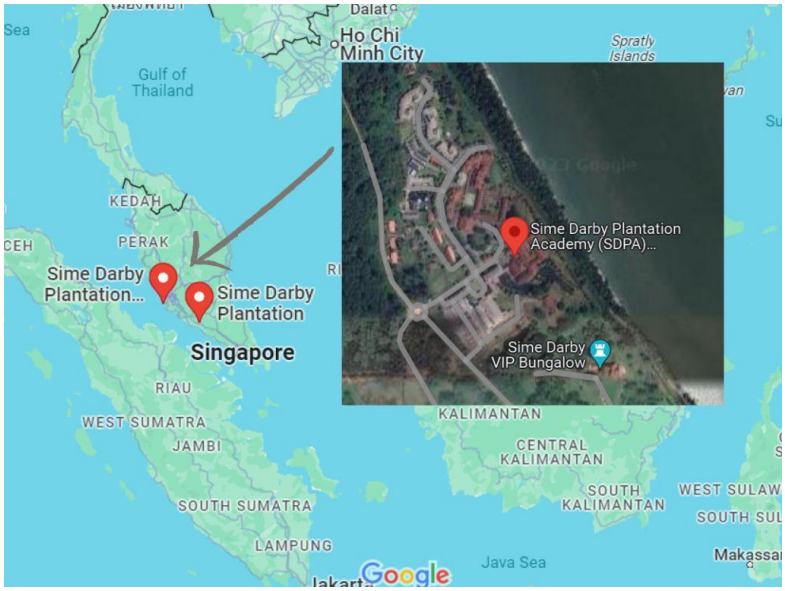

Fig. 1 *Map of Sime Darby EcoGardens*

Enhanced Knowledge in Sciences and Technology Vol. 4 No. 2 (2024) p. 662-672

(a) (b) (c)

Fig. 2 *(a) Mangrove area, (b) Biodiversity Centre, (c) outdoor camp*

2.2 Insect Sampling

An opportunistic sampling design was used in this research. This method is used in field studies where specimen availability is uncertain and researchers will take advantage of opportunities to collect data whenever they arose [11]. Samples were collected in 3 days where sampling for Day 1 was at the mangrove area, for Day 2 was at the Biodiversity Centre, and for Day 3 was at the outdoor camp. The insects were captured using an aerial net and euthanized by gently pinching the thorax part using thumb and forefinger. The specimens were temporarily kept in envelopes. Important notes such as date, location, and collector's name were written down for subsequent identification and labeling [12]. Fig. 3 summarizes the steps in insects sampling.

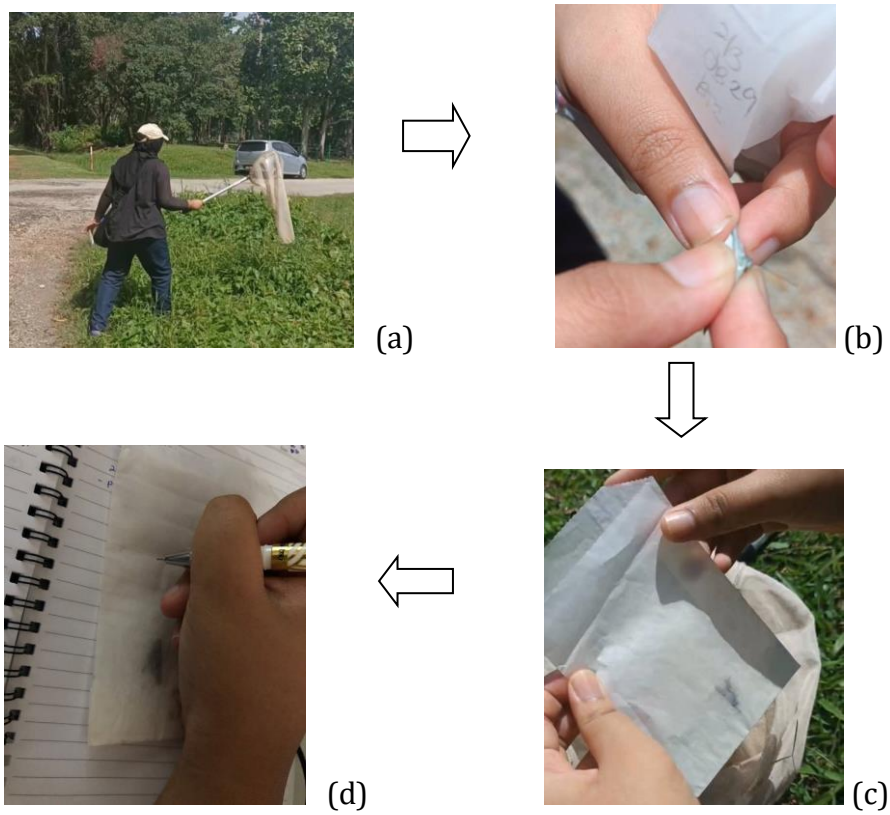

Fig. 3 *Steps in insect sampling: (a) collect samples manually, (b) pinch the thorax gently, (c) store specimen temporarily in envelope, and (d) write important information on the envelope*

2.3 Insect Curation and Identification

The specimens were brought to the Centre of Research for Sustainable Uses of Natural Resources (COR-SUNR) laboratory in Universiti Tun Hussein Onn Malaysia for further curation and identification. The specimens were kept in a freezer to avoid them from drying out. The specimens were then curated using pins on a mounting board. Insects with wings were spread to make sure the details of their features can be seen properly for taxonomic identification [13].

Fig. 4 *Example of insect curation*

The specimens were labelled with the following information: locality (location, date of capture, and collector's name), taxonomic information (order, family, genus, species), collection technique, and habitat data were [14]. The specimens were identified using keys and illustrations following Corbet and Pendlebury [15], Hill and Fatimah [16], Orr [17], and Choong, Arifin, and Hijas [18].

2.4 Data Analysis

Insect diversity was calculated using the Shannon diversity index and Simpson diversity index using Paleontological Statistics software (PAST) [19]. A questionnaire survey will be given out to the public or potential visitors of Sime Darby EcoGardens. Data of the questionnaire survey to know the potential taxa of the entomotourism were analyzed using Microsoft Excel 2019.

2.4.1 Simpson Diversity Index (D') and Shannon Diversity Index (H')

Simpson diversity index (D') was calculated to measure the diversity at the sampling area. Simpson diversity index is a dominance index because it gives more weight to common or dominant species. The value ranges from 0 to 1, with 1 indicating infinite diversity [20].
The formula is as follows in (1).

$$D = \Sigma n_i(n_i-1) / N(N-1) \quad (1)$$

where
n_i: the number of organisms that belong to species *i*
N: the total number of organisms

Meanwhile, Shannon diversity index (H') was calculated to determine insect diversity at the three different sampling sites. Shannon diversity index is computed by considering the count of each species, determining its proportion relative to the total number of individuals, and summing the product of this proportion and the natural logarithm of the proportion for each species. As this yields a negative value, the sum is negated to obtain a positive result. A higher index value indicates greater species diversity. Ideally, comparisons should be made between populations of equal size in terms of individual numbers [21].
The formula is as in (2).

$$H = \Sigma[(p_i)\times\ln(p_i)] \quad (2)$$

where
p_i: the proportion of the entire community made up of species *i*

2.4.2 Questionnaire Survey and Analysis

A questionnaire survey was given out to potential tourists of the entomotourism in Sime Darby EcoGardens, Carey Island. The survey aimed to find out the most preferred taxa to be developed into an entomotourism product. The most preferred taxa will be chosen as the main taxa for our entomotourism products or packages. The questionnaire was developed based on the eight criteria of good nature tourism product [22]. Shapiro–Wilk test was used to first determine whether the data is normally distributed. On a normally distributed data, *t* test is employed to test for its significance. A *t* test is a statistical method employed to compare the means of two groups, and it is one of the most commonly utilized hypothesis tests in statistical studies. [23]. A result is considered statistically significant if the *p* value from a *t* test is less than 0.05. The result is not significant if the *p* value is higher than 0.05 [24].

Enhanced Knowledge in Sciences and Technology Vol. 4 No. 2 (2024) p. 662-672

The *t* test formula is as follows:

$$t = \frac{m - \mu}{s/\sqrt{n}} \quad (3)$$

where
m: mean
μ: theoretical value
s: standard deviation
n: variable set size

If the data is not normally distributed, the Kruskal–Wallis test would be conducted [25]. The Kruskal–Wallis test is a technique used to compare the medians of more than two groups to determine whether the samples share a common origin. [26]. The null hypothesis that no difference exists is rejected if the adjusted *p* value in a pairwise comparison is less than the significance level, which is typically 0.05. The two groups are therefore thought to differ if the adjusted *p* value is less than 0.05 [27].

$$H = \left(\frac{12}{N(N+1)} \sum_{j=1}^{k} \frac{R_j^2}{n_j} \right) - 3(N+1) \quad (4)$$

where
k: the number of comparison groups
N: the total sample size
N_j: the sample size in the *j*th group
R_j: the sum of the ranks in the *j*th group

2.5 New Entomotourism Products

Based on the questionnaire results, a new entomotourism package was developed. This package was developed following the eight criteria of a good nature tourism product and tailored for Sime Darby EcoGardens [22]. Entomotourism-based souvenirs were also designed based on the need of potential tourists from the questionnaire.

3. Results and Discussions

3.1 Insect Diversity

A total of 37 individuals from 17 species and 4 orders of insects were collected. The highest insect diversity was found in the mangrove area with a total of 14 individuals from 11 species, while the outdoor camp had the highest number of individuals at 17 consisting of only 7 species. The Biodiversity Centre had the lowest diversity with only 4 individuals from 3 species. In terms of insect order, Odonata (dragonflies and damselflies) recorded the highest number of species and individuals sampled followed by Lepidoptera (butterflies and moth), Orthoptera (grasshoppers and crickets), and Diptera (flies and mosquitos).

Table 1 *Number of insects sampled in Sime Darby EcoGardens according to species and order*

Order	Species	Mangrove Area	Biodiversity Centre	Outdoor Camp
Odonata	*Neurothemis fluctuans/terminata*	1	2	2
	Pachydiplax longipennis	0	1	1
	Rhyothemis phyllis	2	0	7
	Acisoma panorpoides	1	0	0
	Tholymis tillarga	1	0	0
	Orthetrum sabina	0	1	0

	Neurothemis ramburii	2	0	2
Lepidoptera	*Appias olferna*	0	0	3
	Appias sp.	1	0	0
	Appias libythea	1	0	0
	Potanthus omaha	1	0	0
Orthoptera	*Arcyptera fusca*	0	0	1
	Atractomorpha lata	1	0	0
	Acrida cinerea	2	0	0
Diptera	Asilidae (robber flies)	1	0	0
	Hermetia illucens	0	0	1

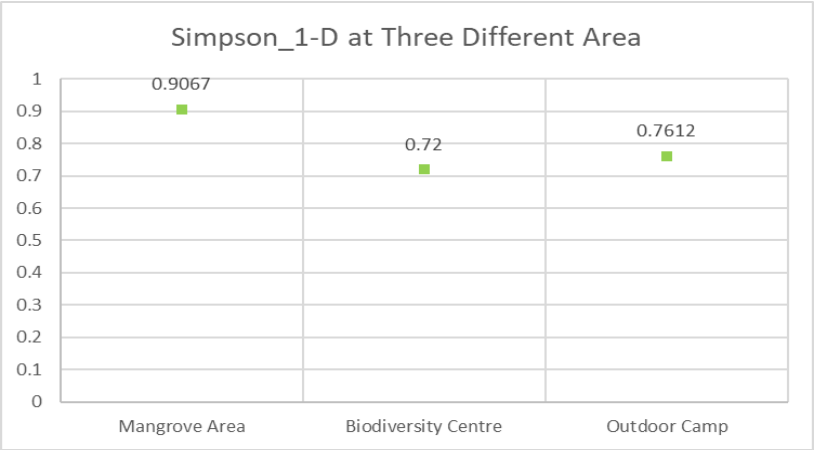

Fig. 5 *Simpson diversity index (D') in three different areas: mangrove area, Biodiversity Centre, and outdoor camp*

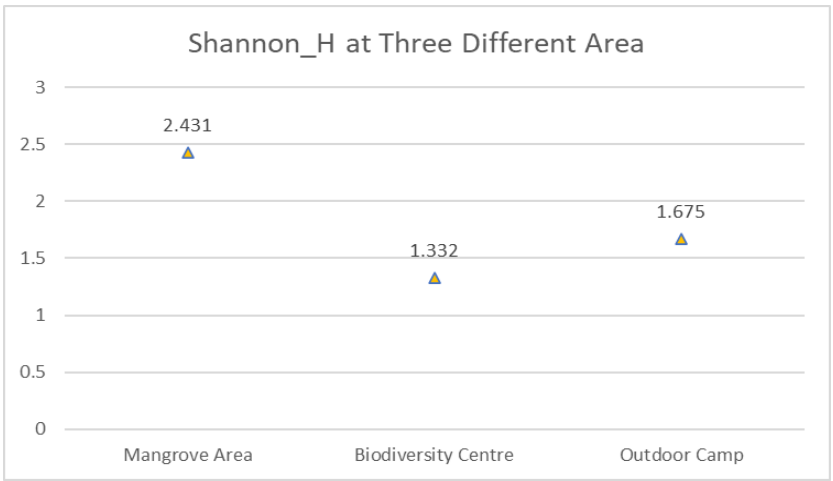

Fig. 6 *Shannon diversity index (H') in three different areas: mangrove area, Biodiversity Centre, and outdoor camp*

The Simpson diversity index (D') for the mangrove area was 0.9067, for the Biodiversity Centre was 0.72, and for the outdoor camp was 0.7612 (Fig. 4). A value closer to 1 indicates higher diversity. Among the three sites, the mangrove area has the highest diversity with a D' value of 0.9067. Meanwhile, the Shannon diversity index (H') for the mangrove area was 2.431, for the Biodiversity Centre was 1.332, and for the outdoor camp was 1.675 (Fig. 5). A higher H' value indicates higher diversity. Therefore, it can be concluded that the mangrove area has the highest diversity.

In most environments, plant diversity may be used to predict insect diversity. However, mangrove areas are an exception to this rule, as they host an exceptionally rich population of predators, the larvae of which feed on the prolific mudflats, making up for the relatively low number of phytophagous and frugivorous insect species found there [28]. In the future, these insect varieties may be used as bio-indicators for assessing the state of a mangrove ecosystem. Insect diversity offers a distinct response to the extent of environmental harm, making it a potential indicator species capable of detecting changes and gauging environmental health [29]. Mangrove

ecosystems are often characterized by nutrient-rich soils. The decomposition of organic matter, including fallen leaves and detritus, creates a fertile environment that supports microorganism growth. These microorganisms, in turn, serve as a food source for many insects [30].

The outdoor camp has the second highest diversity according to both Simpson and Shannon diversity indices. This may be due to the high volume of human activity in the area, since it is a camp site. This results in a lower number of insects found. Habitat changes and disturbance due to human activities affect not only insect diversity but also the structure of the insect communities [31]. Illegal logging, land clearing, and changes in land use result in a fall in sizes from 10% to 20% and in species numbers from 20% to 50%. It has also been established that human activity has a considerable effect on insect diversity [31].

The Biodiversity Centre recorded the lowest diversity among the three places. This may be attributed to undersampling since access to this area was limited by the authority of Sime Darby EcoGardens. The smaller area sampled may have led to the lower number of insects sampled there. Small sampling area reduces the calculated species diversity and raises the disparities in composition within limited areas [32].

3.2 Questionnaire Survey

A total 205 respondents answered the questionnaire survey. In terms of demographics, more female respondents answered the questionnaire than male respondents. The age group of 20–30 years old had the highest number of respondents, and the respondents' highest educational level was bachelor's degree.

Fig. 6 and Table 3 summarize the respondent's feedback on insect tourism knowledge and experience in Sime Darby EcoGardens Carey Island, Selangor.

Table 2 *Questions on insect tourism knowledge and experience in Sime Darby EcoGardens*

No	Questions	Percentage of respondents' agreement with the questions (%)
1.	Insects are suitable to be used as a tourism product.	75.1
2.	I know about insect tourism or also known as entomotourism	64.9
3.	I have been to an observation area for insects or insect park (e.g. Butterfly Park, Entopia).	70.7
4.	I have been involved in insect-based tourism activities before (e.g. Catch and Release, Firefly Watching).	63.0
5.	I know how to observe as well as identify the type of insects.	52.2

A total of 75.1% of respondents agreed that insects are suitable to be used as a tourism product, indicating their interest in entomotourism. Beautiful insects will attract people's attention, leading tourists toward insect watching activities [33]. However, less than 52.2% of the respondents did not know how to observe as well as identify insect types. This is not a surprise since identifying the insects may require proper knowledge and guidance [34].

(a) (b)

Fig. 6 *Graph of the number of respodents who are interested in insect tourism being carried out in Sime Darby EcoGardens; (a) English version and (b) Malay version*

Sime Darby EcoGardens attracted most respondents where 94.1% of them showed interest in insect tourism at that location due to the activities and facilities provided there. EcoGardens provides many comfortable accommodations for the visitors and also enhances tourist experience with its Plantation Museum, Golf Course and Club, and the Wildlife Sanctuary. These activities were meant as a respite for tourists from their busy lives and for them to enjoy their stay in sustainable oil palm plantation area [10].

For the section on the order Odonata, 79.5% respondents agreed with the statement that dragonflies have an attractive shape and color. Indeed, dragonflies are known for their bright and vibrant color that can attract people to them [35]. Also, 34.2% of the respondents did not know that adult dragonflies contribute to the natural control of mosquito populations. The lack of knowledge about the biology and behavior of dragonflies could lead to skepticism or disagreement. Table 4 shows a summary of the respondent's perception and knowledge of the order Odonata.

Table 3 *Questions on respondents' perception and knowledge of the order Odonata*

No	Questions	Percentage of respondents' agreement with the questions (%)
1.	From the picture shown, the color and shape of this insect are attractive.	79.5
2.	Dragonflies are harmless to humans and do not pose any safety risks.	75.1
3.	In their natural surroundings, dragonflies are easy to notice.	72.7
4.	Some dragonflies are rare and can be hard to find in other regions.	71.2
5.	Dragonflies have interesting mating rituals.	66.8
6.	Dragonflies are often associated with bodies of water, as their nymphs live in aquatic environments. In cultures where water is sacred or holds spiritual significance, dragonflies may be regarded as symbols of purity and renewal.	67.8
7.	Adult dragonflies contribute to the natural control of mosquito populations.	65.8

On the section on Lepidoptera, 81.5% respondents agreed with the statement that butterflies have an attractive shape and color. As with dragonflies, butterflies are also known for their bright and vibrant wing colors. Also, 40.5% of the respondents did not know that male butterflies often engage in puddling behavior, in which they gather on damp soil or sand to extract essential minerals. This is because not all species of butterflies exhibit this behavior, making it quite unknown to people [36]. Table 5 shows a summary of the respondent's perception and knowledge of the order Lepidoptera.

Table 4 *Questions on respondents' perception and knowledge of the order Lepidoptera*

No	Questions	Percentage of respondents' agreement with the questions (%)
1.	From the picture shown, the color and shape of this insect are attractive.	81.5
2.	Butterflies are harmless to humans and do not pose any safety risks.	77.6
3.	In their natural surroundings, butterflies are easy to notice.	79.0

4.	Some butterflies are rare and can be hard to find in other regions.	70.2
5.	Male butterflies often engage in puddling behavior, gathering on damp soil or sand to extract essential minerals.	59.5
6.	Butterflies symbolize transformation and rebirth in certain cultures.	61.5
7.	Butterflies play a crucial role in pollination.	71.2

An entomotourism package was developed based on the respondents' answers from the last section of the questionnaire. A total of 75.6% of respondents preferred two-day package instead of a single day. A starting price of RM35 was calculated for the entomotourism package.

The result of the normality test is considered normal if the value is greater than 0.05. From our result, the values are not normal because they are smaller than 0.05. So, a Kruskal–Wallis test was done to determine if there is any significant difference between the two taxa. Our statistical test revealed no significant difference between the Lepidoptera and Odonata taxa ($p < 0.05$). However, the order Lepidoptera was chosen as a tourism product since more than 81.5% of the respondents think that butterflies are attractive compared to the dragonflies.

3.3 New Entomotourism Product

A new entomotourism product was developed following the eight characteristics of quality tourism product [20]. This development utilized the data obtained from the biodiversity study results and questionnaire answers. The resulting entomotourism package is tailored for Sime Darby EcoGardens.

A tour package is a tour that includes goods and services like lodging, food, entertainment, and transportation for one price [37]. A tourism destination's ability to grow and survive is typically influenced by the five A's of tourism: accessibility, accommodation, amenities, attractions, and activities [37]. The brochure for the entomotourism package in Sime Darby EcoGardens. Two packages are introduced: Escape 1 and Escape 2. The package starts with tourist arrival at Sime Darby EcoGardens. Then, a guided insect tour starts in the morning where tourists can discover diverse species, learn about their behaviors, and observe the beauty of butterflies in their natural habitat. Then the package continues with a hands-on insect activity where the tourists are able to catch and release butterflies found in the area. Proper catch-and-release techniques would be used to lower damage, death, and sublethal changes in butterfly physiology and behavior [38]. After lunch, the tour continues with oil palm insight tour. Here, tourists can gain insights into the agricultural processes, environmental considerations, and importance of responsible plantation.

After that, the package continues with butterfly conservation programs where the tourists will support or engage in butterfly conservation programs that aim to protect butterfly habitats, address environmental threats, and promote sustainable practices. Moths and butterflies are signs of healthy habitat and surroundings. They show that there are many kinds of invertebrates, which make up more than two-thirds of all species. Other invertebrates are abundant in areas with a high butterfly and moth population. When taken as a whole, these offer numerous environmental advantages, such as pollination and organic pest management [39]. For Escape 1, the package ends in the afternoon but for Escape 2, the package will continue with dinner and a night walk. The tourists will embark on a guided night insect safari, exploring the fascinating world of nocturnal insects. The package continues on Day 2 for insect photography, where the tourists can capture the intricate details of butterflies and other insects in their natural environment. The Day 2 of Escape 2 package ends at noon. Every purchase of the package includes a souvenir, which is a butterfly keychain made from resin.

4. Conclusion

In conclusion, the public are perceptive to the potential of entomotourism in Sime Darby EcoGardens. From this study, the mangrove area has the highest insect diversity. From the questionnaire, most respondents chose Lepidoptera as the main taxa for the entomotourism package. Although there was no significant difference between the two taxa, Lepidoptera was chosen because the percentage of respondents choosing Lepidoptera was higher. A complete entomotourism brochure was also designed, which is filled with fun activities related to Lepidoptera. The mangrove area is recommended as the main focus of this entomotourism package, and the oil palm plantation can be focused on as one of the sampling sites to accurately evaluate insect diversity for this oil palm-based entomotourism. Hopefully this study will help to improve public perception toward oil palm and its sustainability.

Acknowledgement

The authors would like to thank the Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia, for its support in completing this project.

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design, data collection, methodology, analysis and interpretation of results:*** *Ain Nazhirah Abdullah and Aqilah Awg Abdul Rahman. All authors reviewed the results and approved the final version of the manuscript.*

References

[1] Lockwood, J., & Lemelin, R. H. (2013) "The Philosophical and Psychological Dimensions of Insects." The Management of Insects in Recreation and Tourism, pp. 37–55, https://doi.org/10.1017/cbo9781139003339.004.

[2] Amita Kanaujia, et al. (2022) "Insect Tourism." Insect as Service Providers, pp. 283–305, https://doi.org/10.1007/978-981-19-3406-3_10.

[3] Lemelin, R. H. (2015). 14. From the Recreational Fringe to Mainstream Leisure: The Evolution and Diversification of Entomotourism. Animals and Tourism, 229–239. https://doi.org/10.21832/9781845415051-018

[4] Tang, Kuok Ho Daniel, and Hamad M. S. Al Qahtani. (2019) "Sustainability of Oil Palm Plantations in Malaysia." Environment, Development and Sustainability, vol. 22, no. 6, link.springer.com/article/10.1007/s10668-019-00458-6, https://doi.org/10.1007/s10668-019-00458-6.

[5] Salam, S., & Juned, M. (2022). Ban of Indonesia's Palm Oil Products to the European Union and Indonesia's Diplomacy Efforts. European Modern Studies Journal. https://www.researchgate.net/publication/363651846_Ban_of_Indonesia's_Palm_Oil_Products_to_the_European_Union_and_Indonesia's_Diplomacy_Efforts

[6] Duijvenbode, A. van . (2021). West Africa Competitiveness Programme (WACOMP) Cosmetics Sector Export Marketing Plan. https://wacompghana.org/wp-content/uploads/Cosmetics-SEMP-2021-Report.pdf

[7] Mazidi Abd Ghani. (2019). Palm Oil | Industries | WWF. Retrieved from World Wildlife Fund website: https://www.worldwildlife.org/industries/palm-oil

[8] Budiadi, Susanti, A., Marhaento, H., Ali Imron, M., Permadi, D. B., & Hermudananto. (2019). Oil palm agroforestry: an alternative to enhance farmers' livelihood resilience. IOP Conference Series: Earth and Environmental Science, 336, 012001. https://doi.org/10.1088/1755-1315/336/1/012001

[9] Hannah Ritchie (2021) - "Palm Oil" Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/palm-oil'

[10] Ecotourism Destination | SDP EcoGardens | Malaysia. (n.d.). Retrieved from EcoGardens website: https://www.palmecogardens.com/

[11] Stratton, S. J. (2021). Population research: Convenience Sampling Strategies. Prehospital and Disaster Medicine, 36(4), 373–374. Cambridge. https://doi.org/10.1017/S1049023X21000649

[12] Balogun, I., & Kehinde, T. (2021). Habitat type influences the choice of sampling method in a butterfly survey. ~ 12 ~ Journal of Entomology and Zoology Studies, 9(1), 12–18. https://www.entomoljournal.com/archives/2021/vol9issue1/PartA/8-6-166-143.pdf

[13] Hunter, G. (2006). Con serve O Gram Curation Of Insect Specimens Storage of Insect Specimens. https://www.nps.gov/museum/publications/conserveogram/11-08.pdf

[14] Gullan, P., & Cranston, P. (2010). The Insects: An Outline of Entomology (4th Edition ed.). UK: Wiley-Blackwell Publishing.

[15] Corbet, A., & Pendlebury, H. (1992). The Butterflies of Malay Peninsula (4th edition ed.). Kuala Lumpur: Malayan Nature Society.

[16] Hill, D. S., & Abang, F. (2005). The Insects of Borneo. Universiti Malaysia Sarawak.

[17] Orr, A. (2005). Dragonflies of Peninsular Malaysia and Singapore.

[18] Choong, C. Y., Arifin, Y. M., & Hijas, N. H. (2017). Ancient Creatures: Dragonflies and Damselflies of Malaysia: Malaysia Biodiversity Information System (MyBIS). Malaysia Biodiversity Information System (MyBIS).

[19] Hammer, D., Ryan, P., Hammer, Ø., Harper, D., Museum, Ø., & Voldgade. (2001). Past: Paleontological Statistics Software Package for Education and Data Analysis. Palaeontologia Electronica, 4(1), 178.

[20] Sharashy, O. (2022). Application of Shannon and Simpson Diversity Index to Study Plant biodiversity on Coastal Rocky Ridges Habitats with Reference to Census Data in the Ras El-Hekma and Omayed Area on the Western Coastal Region of Egypt. Journal of Pure & Applied Sciences, 21(1), 41–45. https://doi.org/10.51984/jopas.v21i1.1578

[21] Nolan, K.A. and J.E. Callahan. 2006. Beachcomber biology: The Shannon-Weiner Species Diversity Index. Pages 334-338, in Tested Studies for Laboratory Teaching, Volume 27 (M.A. O'Donnell, Editor). Proceedings of the 27th Workshop/Conference of the Association for Biology Laboratory Education (ABLE), 383 pages.
[22] Hamdi, A. E., Maryati, M., & Shafiq Hamdin, M. (2019). The Potential of Nature Tourism at Muar and Tangkak Districts, Johor, Malaysia. IOP Conference Series: Earth and Environmental Science, 269(1), 012008. https://doi.org/10.1088/1755-1315/269/1/012008
[23] Taylor, G. J., Paulk, A. C., Pearson, T. W. J., Moore, R. J. D., Stacey, J. A., Ball, D., … Srinivasan, M. V. (2015). Insects modify their behaviour depending on the feedback sensor used when walking on a trackball in virtual-reality. Journal of Experimental Biology, (218), 3118–3127. https://doi.org/10.1242/jeb.125617
[24] Kim, T. K. (2015). T Test as a Parametric Statistic. Korean Journal of Anesthesiology, 68(6), 540–546. https://doi.org/10.4097/kjae.2015.68.6.540
[25] Grabowski, B. (2016). "P< 0.05" Might Not Mean What You Think: American Statistical Association ClarifiesPValues. Journal of the National Cancer Institute, 108(8). https://doi.org/10.1093/jnci/djw194
[26] Ahmed, K. (2023, January 11). Kruskal Wallis Test (A. K. Srivastav, Ed.). Retrieved from WallStreetMojo website: https://www.wallstreetmojo.com/kruskal-wallis-test/
[27] Greenland, S., Senn, S. J., Rothman, K. J., Carlin, J. B., Poole, C., Goodman, S. N., & Altman, D. G. (2016). Statistical tests, P values, Confidence intervals, and power: a Guide to Misinterpretations. European Journal of Epidemiology, 31(4), 337–350. https://doi.org/10.1007/s10654-016-0149-3
[28] Yeo, D., Srivathsan, A., Puniamoorthy, J., Maosheng, F., Grootaert, P., Chan, L., … Meier, R. (2021). Mangroves are an overlooked hotspot of insect diversity despite low plant diversity. BMC Biology, 19(1). https://doi.org/10.1186/s12915-021-01088-z
[29] Chatarina Gradict Semiun, Eufrasia R. A. Lengur, & Duhan, B. (2020). Insect diversity profile of mangrove ecosystem in Menipo Nature Tourism Park, East Amarasi, East Nusa Tenggara. IOP Conference Series, 823(1), 012050–012050. https://doi.org/10.1088/1757-899x/823/1/012050
[30] Thatoi, H., Behera, B. C., Mishra, R. R., & Dutta, S. K. (2012). Biodiversity and biotechnological potential of microorganisms from mangrove ecosystems: a review. Annals of Microbiology, 63(1), 1–19. https://doi.org/10.1007/s13213-012-0442-7
[31] Sutrisno, H. (2010). The Impact of Human Activities to Dynamic of Insect Communities: a Case Study in Gunung Salak, West Java. HAYATI Journal of Biosciences, 17(4), 161–166. https://doi.org/10.4308/hjb.17.4.161
[32] Forsyth, L. Z., & Gilbert, B. (2020). Parallel responses of species diversity and functional diversity to changes in patch size are driven by distinct processes. Journal of Ecology, 109(2), 793–805. https://doi.org/10.1111/1365-2745.13506
[33] Le, G., Ak Matusin, A. M. R., Yusah, K. M., Aziz, N. A. A., Pengiran Bagul, A. H. B., Nordin, N. Mohd., … Saikim, F. H. (2021). Entotourism potential in Sabah, Malaysia: A Tourists' perspective. Cogent Social Sciences, 7(1), 1914950. https://doi.org/10.1080/23311886.2021.1914950
[34] Golick, D. A., Heng-Moss, T. M., Steckelberg, A. L., Brooks, David. W., Higley, L. G., & Fowler, D. (2012). Using Web-Based Key Character and Classification Instruction for Teaching Undergraduate Students Insect Identification. Journal of Science Education and Technology, 22(4), 509–521. https://doi.org/10.1007/s10956-012-9410-z
[35] Suárez‐Tovar, C. M., Guillermo‐Ferreira, R., Cooper, I. A., Cezário, R. R., & Córdoba‐Aguilar, A. (2022b). Dragon colors: the nature and function of Odonata (dragonfly and damselfly) coloration. Journal of Zoology, 317(1), 1–9. https://doi.org/10.1111/jzo.12963
[36] Beck, J., Eva Mühlenberg, & Fiedler, K. (1999). Mud-Puddling Behavior in Tropical Butterflies: In Search of Proteins or Minerals? Oecologia, 119(1), 140–148. http://www.jstor.org/stable/4222287
[37] Abdul Rahman, Syariza & Benjamin, Aida & Bakar, Engku. (2013). Economic Tour Package Model Using Heuristic. AIP Conference Proceedings. 1605. 10.1063/1.4887754.
[38] COOKE, S. J., & SCHRAMM, H. L. (2007). Catch-and-release science and its application to conservation and management of recreational fisheries. Fisheries Management and Ecology, 14(2), 73–79. https://doi.org/10.1111/j.1365-2400.2007.00527.x
[39] Wankhede, C. (2019). Issue 3 www.jetir.org (ISSN-2349-5162). JETIRAO06039 Journal of Emerging Technologies and Innovative Research, 6(3).