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Recorded and predicted butterflies in the Padang Bindu Karst, South Sumatra, Indonesia

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Abstract. *Qodri A, Encilia, Yulizah, Girmansyah D, Sunardi, Santoso W, Megawati, Rachmatiyah R, Fatimah, Darmawan, Sarino, Peggie D. 2023. Recorded and predicted butterflies in the Padang Bindu Karst, South Sumatra, Indonesia. Biodiversitas 24: 1057-1082.* Padang Bindu Karst is one of the national cultural heritages in South Sumatra that has not been explored further for its faunal diversity, including the butterflies. Therefore, a preliminary survey of butterfly diversity of karst fauna outside the cave was carried out in the area for eight days. The aim was to analyze the butterfly diversity at an initial step, especially in the four main cave areas in the area, namely Harimau Cave, Silabe Cave, Putri Cave, and Candi Cave. Vegetation data based on their utility as host plants and/or nectar plants were also recorded to predict the number of butterfly species available in the area. There were 59 species of 157 individuals recorded, *Eurema alitha* being the most abundant and followed by *Junonia hedonia*. From this preliminary survey, butterflies in the Padang Bindu Karst accounted for 35.75% of the total butterflies predicted to be there and 20.2% of the total butterflies recorded in South Sumatra. At least 12 species have not been recorded in South Sumatra, one of which is a rare species, namely *Mahathala ariadeva*, found in the secondary forest. Predicting the occurrence of butterflies based on the approach of host plants and nectar plants, as well as abiotic factors, is a butterfly conservation strategy that needs to be supported by long-term observations.

Keywords: Butterfly conservation, diversity, host plant, *Mahathala arideva*, nectar plant

INTRODUCTION

Karst is a specific area that has surface relief and underground water storage, which is characterized by the dissolution of rocks, such as limestone, limestone and dolomite, as well as gypsum and salt (Bonacci 1987). The formation of karst is a karstification process resulting from a combination of circulating water and dissolved rock. The thick humus layer above the carbonate rocks makes the karstification process more intensive because it affects the production and accumulation of CO_2. Temperature and rainfall are important factors in the formation of karst forms (Bonacci 1987). The karst area can simply be divided into two levels, namely the surface and the cave (Clements et al. 2006). In karst areas such as caves, there are groups of fauna, i.e., troglophile, troglobite, and trogloxene. The fauna is categorized as troglophile if the life cycles are spent in the cave, but they are still able to survive outside the cave. Troglobite is a group of fauna which very dependent on life in the cave. While trogloxene is a group of fauna that live in caves, but their source of life mostly comes from outside the cave (Chapman 1982). Meanwhile, on the karst surface, the fauna is supported by unique plants that are able to adapt to limestone soils, resulting in a unique fauna that must adapt to the thin soil layer and very alkaline pH (Clements et al. 2006).

Karst also has a high potential for species endemicity both of ecosystems on the surface and in the cave. Multitude ecology, variable climate conditions, different tectonics, and degrees of isolation can be some factors to species diversity and endemicity in karst (Clement et al. 2006). The unfriendly ecosystem in karst makes some specific species adapt and survive and become locally or regionally endemic (Culver et al. 2003; Salas et al. 2005).

Padang Bindu is a hilly karst area in Padang Bindu Village, Semidang Aji District, Ogan Komering Ulu Regency, South Sumatra Province, with an altitude of ±164 m asl and is located at coordinates 4°02'49.7"-4°09'47.6" S and 103°55'26.4"-104°01'23.6" E where the biodiversity in the area is still not much explored. Studies on fauna in the Padang Bindu Karst have only been carried out inside the cave (Atmawijaya 2010; Kamal et al. 2011), not outside the cave yet. Some parts of the Padang Bindu Karst areas are used for ecotourism and plantation, and some other parts are still natural ecosystems without mining activities. In the area around the cave in Padang Bindu, changes in the landscape from primary forest to plantation were found, such as coffee, maize, and teak. These changes would have

an impact on the diversity, especially invertebrates such as insects which are relatively not well represented around karst.

The butterfly is one of insect groups that exhibits endemism on karst, possibly due to its association with certain host plants (Holloway 1986). Based on data from the Global Biodiversity Information Facility (GBIF) (National Museum of Nature and Science, Japan 2020; Gall 2021; Hinton and Ranatunga 2021; Pauwels et al. 2021; de Vos and Creuwels 2022; Harvard University and Morris 2022; Peggie 2022a, b, c, d, e, f, g, h, i, j; Slieker et al. 2022; Wild 2022), iNaturalist (2021, 2022), and some reports (Lamin et al. 2016; Aprillia et al. 2018; Sugiarto 2018; Sari et al. 2019; Septiana et al. 2019; Sugiarto 2019; Aprillia et al. 2020; Iqbal et al. 2020a, b, c; Lestari et al. 2020; Setiawan et al. 2020a, b; Triyanti and Arisandy 2020; Iqbal et al. 2021a, b; Nikmah et al. 2021; Setiawan et al. 2021), there were 292 species from six butterfly families in South Sumatra Province. We conducted this research to provide a record of butterfly diversity in Padang Bindu and to predict the possibility of butterfly occurrence based on the existence of the plants associated with the butterflies. This research is expected to provide benefits for policymakers to assess the potential of the Padang Bindu Karst area in relation to the initial representation of the butterfly diversity found.

MATERIALS AND METHODS

Study area and sampling procedure

Specimen collections were carried out for eight days from 28 May to 4 June 2021 (from 9 AM to 11.30 AM and 12.30 PM to 3 PM) at the Padang Bindu Karst area, Semidang Aji District, Ogan Komering Ulu Regency using BioQuip insect net in four main areas around the caves (Harimau Cave, Silabe Cave, Putri Cave, and Candi Cave), two additional areas around the caves (Yemaye Cave and Pandan Cave), and outside the cave area but still within the Ogan Komering Ulu Regency, namely Meraksa Hill and Kambas Waterfall (Table 1). However, in this preliminary survey, we put more effort on the four main cave areas (Figure 1) with two people conducting observation assisted by two field assistants. Sampling was carried out three times in the Harimau Cave and Candi Cave areas, twice in the Silabe Cave area, and seven times in the Putri Cave area. Meanwhile, in the Yemaye Cave and Kambas Waterfall areas, we conducted one sampling, only brief observations were performed at Pandan Cave, and one Idea stolli specimen of Meraksa Hill was obtained from another exploration team. Maps of butterfly observation locations were created using ArcGIS online. Few species were accidentally caught in the malaise trap. For butterfly sampling, we did not use the malaise trap, yet some butterflies were captured in the malaise trap and not collected with an insect net, so we called them by accident. We included them due to our focus on butterfly species records in the Padang Bindu Karst area. In addition, we conducted an inventory of flora using the taxonomic data collection method (exploration method), namely by exploring every corner of the research location and collecting flowering and/or fruiting plant material. The flora inventory was carried out to predict the suitability of host plants and nectar plants with butterflies that might be present, yet also confirmed for topographical reasons and butterfly records in South Sumatra.

The habitat in the Padang Bindu Karst is divided into five types, i.e., (1) near the river (we do not call it "riparian" but instead "near the river" because there is a river area that is bordered by retaining walls); (2) the cave mouth zone; (3) open forest; (4) plantation forest; and (5) secondary forest. The first and second habitat types are also part of open forests, plantation forests, or secondary forests. All forests in the Padang Bindu Karst are generally secondary forests because they have been degraded. However, we divided the forest into three forest types because when we sampled, apart from finding open and near-open forest areas, we also found quite dense forest areas. The Harimau Cave and Putri Cave areas represented open forest during sampling, yet at the top of the Putri Cave area is a secondary forest with limestone forest floors, while on the slopes, plantation forests such as teak and coffee are found. We also collected specimens in the coffee plantation of the Harimau Cave area. The Silabe Cave and Candi Cave areas mostly represented secondary forests, although some parts were still included in the open forest and plantation forest. However, three cave areas have become the main tourist destinations, namely Harimau Cave, Putri Cave, and Silabe Cave.

Table 1. Collection sites in Padang Bindu Karst area and surrounding, South Sumatra, Indonesia

Collection site	Coordinate	Altitude (m asl.)	Humidity (%)	Temperature (°C)
Harimau Cave area (HC)	S 04°04'01.11" - 04°04'29.76" E 103°55'52.90" - 103°56'07.90"	103-429	79-82	29-31
Silabe Cave area (SC)	S 04°03'56.90" - 04°04'00.42" E 103°55'45.40" - 103°55'47.55"	127-145	83-87	29-30
Putri Cave area (PuC)	S 04°04'03.16" - 04°04'14.18" E 103°55'23.69" - 103°55'38.73"	112-306	87-90	28-29
Candi Cave area (CC)	S 04°04'02.91" - 04°04'05.71" E 103°55'21.97" - 103°55'24.10"	111-152	89-90	29-30
Yemaye Cave area (YC)	S 04°04'14.47" E 103°55'42.29"	190	NA	NA
Kambas Waterfall (KW)	S 04°06'32.93" E 103°45'24.51"	294	NA	NA
Meraksa Hill (MH)	S 04°05'12.5" E 103°49'45.6"	230	84-89	28-29

Note: Coordinate data for the Pandan Cave area (PaC); humidity and temperature for PaC; YC, and KW are not available (NA)

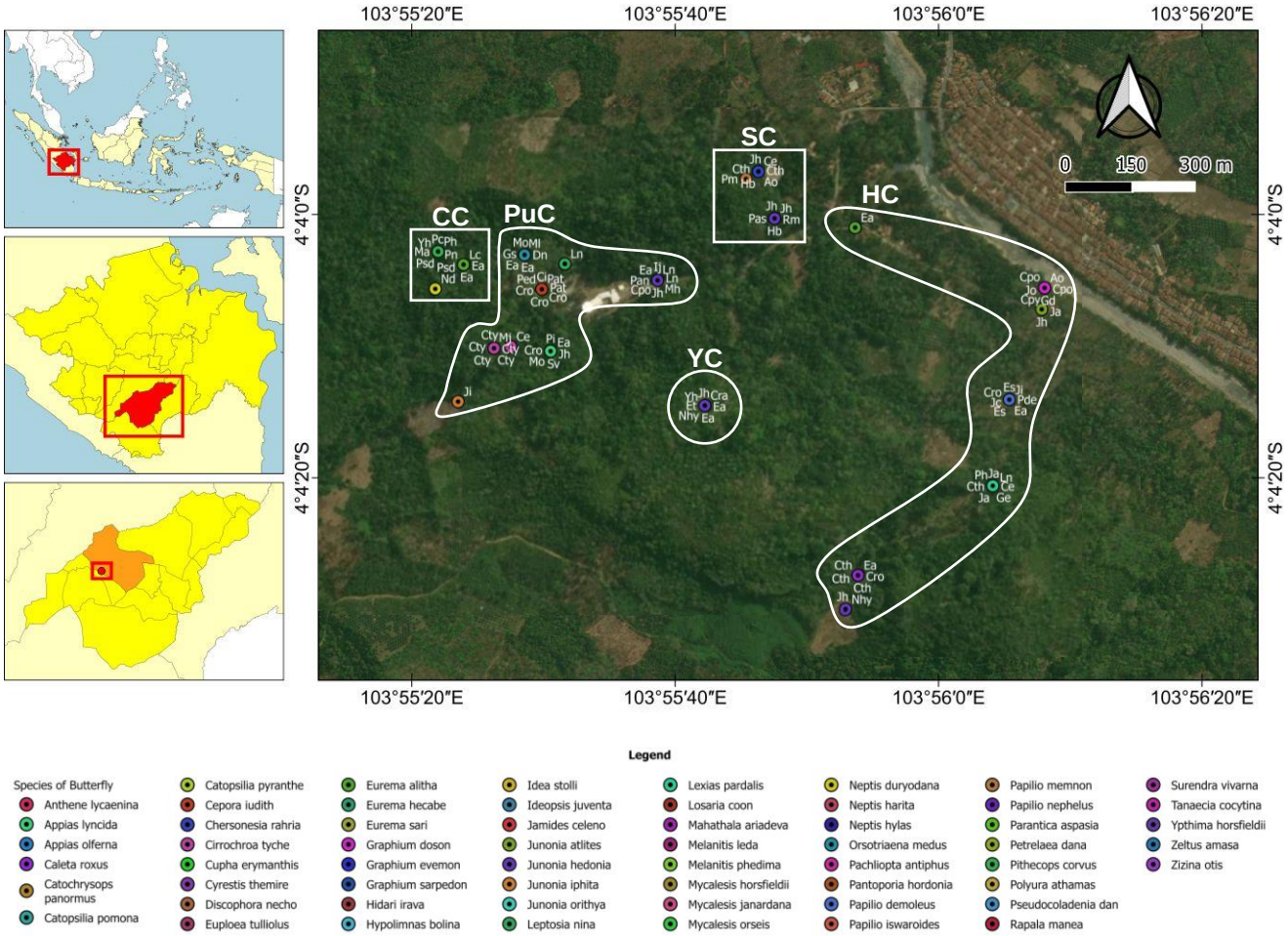

Figure 1. Location map of butterflies observing in Padang Bindu Karst, South Sumatra. Description of collection sites (HC, SC, PuC, CC, YC) refers to Table 1. Abbreviation descriptions of the butterfly representatives at each location: Ao, *Appias olferna*; Ce, *Cupha erymanthis*; Ci, *Cepora iudith*; Cpo, *Catopsilia pomona*; Cpy, *Catopsilia pyranthe*; Cra, *Chersonesia rahria*; Cro, *Caleta roxus*; Cth, *Cyrestis themire*; Cty, *Cirrochroa tyche*; Dn, *Discophora necho*; Ea, *Eurema alitha*; Es, *Eurema sari*; Et, *Euploea tulliolus*; Gd, *Graphium doson*; Ge, *Graphium evemon*; Gs, *Graphium sarpedon*; Hb, *Hypolimnas bolina*; Ij, *Ideopsis juventa*, Ja, *Junonia atlites*; Jc, *Jamides celeno*; Jh, *Junonia hedonia*; Ji, *Junonia iphita*; Jo, *Junonia orithya*, Lc, *Losaria coon*; Ln, *Leptosia nina*; Ma, *Mahathala ariadeva*; Mh, *Mycalesis horsfieldi*; Mj, *Mycalesis janardana*; Ml, *Melanitis leda*; Mo, *Mycalesis orseis*, Nd, *Neptis duryodana*; Nhy, *Neptis hylas*; Pan, *Pachliopta antiphus*; Pas, *Parantica aspasia*; Pat, *Polyura athamas*; Pc, *Pithecops corvus*; Pde, *Papilio demoleus*; Ped, *Petrelaea dana*; Ph, *Pantoporia hordonia*; Pi, *Papilio iswaroides*; Pm, *Papilio memnon*; Pn, *Papilio nephelus*; Psd, *Pseudocoladenia dan*; Rm, *Rapala manea*; Sv, *Surendra vivarna*; Yh, *Ypthima horsfieldii*.

Specimen processing and identification

Collected butterfly specimens were processed at the Entomology Laboratory, Museum Zoologicum Bogoriense (MZB), BRIN - Cibinong. Specimens in good condition are photographed and presented on the results. However, specimens in poor condition (e.g., wings detached from the body or quite damaged) are not photographed unless they are rarely obtained. Specimens were identified based on Pinratana (1977, 1979), Yata and Morishita (1981), Aoki et al. (1982), Tsukada and Nishiyama (1982), Tsukada (1985, 1991), Maruyama (1991), Seki et al. (1991), Peggie and Amir (2006), Jeratthitikul et al. (2009), Peggie and Noerdjito (2011), and Moonen (2016).

Data analysis and compilation

The number of butterfly species in South Sumatra was estimated through various scientific literature and biodiversity data platforms such as GBIF and iNaturalist. The criteria of how to justify a species being the most common in South Sumatra based on the number of occurrences. Vegetation data includes seed plant species recorded around the four main cave areas (Table 2), and the vegetation data from additional areas (Yemaye Cave) in Padang Bindu Karst are available only to complement the host plant and nectar plant data that will be presented in Table 5. The criteria of vegetation data as host plants and/or nectar plants are determined based on various references also listed in Table 5. The predicted butterflies to occur in the Padang Bindu Karst were calculated using PivotTable. We also analyzed species diversity data using the species accumulation curve via Anne Chao-shinyapps.io (iNEXT Online 2022) to find out whether this result has been maximized or still allows other species that have not been caught with added days.

Table 2. Vegetation data in Padang Bindu Karst, South Sumatra, Indonesia

Site	Plant Species
HC	*Sambucus* sp. (Adoxaceae); *Spondias* sp. (Anacardiaceae); *Annona reticulata, Uvaria rufa* (Annonaceae); *Anadendrum microstachyum* (Araceae); *Agathis dammara* (Araucariaceae); *Calamus sabut, Caryota mitis, Cocos nucifera* (Arecaceae); *Chromolaena odorata* (Asteraceae); *Garcinia* sp. (Clusiaceae); *Erycibe tomentosa* (Convolvulaceae); *Alangium uniloculare* (Cornaceae); *Scleria purpurascens* (Cyperaceae); *Tetracera indica, Tetracera scandens* (Dilleniaceae); *Tacca palmata* (Dioscoreaceae); *Hopea dryobalanoides* (Dipterocarpaceae); *Elaeocarpus longifolius* (Elaeocarpaceae); *Alchornea rugosa, Aleurites moluccanus, Claoxylon indicum, Hevea brasiliensis, Macaranga triloba, Mallotus philippensis* (Euphorbiaceae); *Abrus* sp., *Archidendron jiringa, Caesalpinia sepiaria, Cassia* sp., *Dalbergia rostrata, Dialium platysepalum, Millettia sericea, Saraca declinata, Senna siamea* (Fabaceae); *Epithema sarawakense, Monophyllaea horsfieldii* (Gesneriaceae); *Clerodendrum disparifolium, Vitex pinnata* (Lamiaceae); *Litsea* sp. (Lauraceae); *Barringtonia racemosa* (Lecythidaceae); *Scurrula fusca* (Loranthaceae); *Hibiscus macrophyllus, Microcos tomentosa, Pterospermum* sp. (Malvaceae); *Aglaia argentea, Aglaia silvestris, Lansium domesticum* (Meliaceae); *Artocarpus dadah, Artocarpus elasticus, Artocarpus integer, Ficus fistulosa, Ficus hispida, Ficus* sp., *Streblus asper* (Moraceae); *Musa* spp. (Musaceae); *Syzygium acuminatissimum, Syzygium polyanthum, Syzygium* spp. (Myrtaceae); *Lepionurus sylvestris* (Opiliaceae); *Averrhoa carambola* (Oxalidaceae); *Eurya nitida* (Pentaphylacaceae); *Antidesma montanum, Antidesma* sp., Aporosa sp., *Aporosa whitmorei, Baccaurea macrophylla, Baccaurea racemosa, Breynia cernua, Bridelia* sp. (Phyllanthaceae); *Gigantochloa atter, Gigantochloa nigrociliata, Gigantochloa scortechinii, Schizostachyum* sp. (Poaceae); *Helicia robusta* (Proteaceae); *Coffea canephora, Coffea robusta, Ixora* sp., *Nauclea* sp., *Pavetta montana, Psychotria* sp., *Psychotria viridiflora, Timonius* sp., *Urophyllum* sp. (Rubiaceae); *Clausena excavata, Micromelum minutum* (Rutaceae); *Meliosma* sp. (Sabiaceae); *Flacourtia* sp. (Salicaceae); *Lepisanthes amoena, Nephelium lappaceum, Pometia pinnata* (Sapindaceae); *Elatostema latifolium* (Urticaceae); *Leea aequata, Leea indica* (Vitaceae); *Amomum compactum, Zingiber neglectum, Zingiber* sp. (Zingiberaceae)
SC	*Hemigraphis sumatrensis* (Acanthaceae); *Bouea oppositifolia* (Anacardiaceae); *Polyalthia* sp. (Annonaceae); *Ichnocarpus frutescens, Toxocarpus* cf. *lineatus* (Apocynaceaae); *Aglaonema vittatum, Pothos junghuhnii, Pothos rumphii* (Araceae); *Arenga* sp., *Cocos nucifera, Licuala* sp. (Arecaceae); *Chromolaena odorata* (Asteraceae); *Begonia trichopoda* (Begoniaceae); *Lonicera* sp. (Caprifoliaceae); *Quisqualis indica* (Combretaceae); *Commelina benghalensis* (Commelinaceae); *Erycibe tomentosa* (Convolvulaceae); *Trichosanthes montana* (Cucurbitaceae); *Scleria purpurascens* (Cyperaceae); *Dillenia excelsa, Tetracera indica, Tetracera scandens* (Dilleniaceae); *Elaeocarpus longifolius* (Elaeocarpaceae); *Acalypha wilkesiana, Alchornea rugosa, Alchornea* sp., *Aleurites moluccanus, Croton* cf. *caudatus, Hevea brasiliensis, Homalanthus populneus, Macaranga triloba, Neoscortechinia* sp. (Euphorbiaceae); *Caesalpinia sepiaria, Derris trifoliata, Pongamia* sp. (Fabaceae); *Lithocarpus* sp. (Fagaceae); *Epithema sarawakense* (Gesneriaceae); *Curculigo* sp. (Hypoxidaceae); *Hyptis capitata, Vitex pinnata* (Lamiaceae); *Litsea* sp. (Lauraceae); *Grewia* sp., *Pterospermum* sp. (Malvaceae); *Aglaia odoratissima* (Meliaceae); *Anamirta cocculus* (Menispermaceae); *Sloetia elongata* (Moraceae); *Musa* spp. (Musaceae); *Knema* sp. (Myristicaceae); *Syzygium* sp. (Myrtaceae); *Eurya acuminata* (Pentaphylacaceae); *Antidesma montanum, Antidesma* sp., *Baccaurea macrophylla, Breynia cernua, Bridelia* sp., *Sauropus androgynus* (Phyllanthaceae); *Piper* sp. (Piperaceae); *Dendrocalamus asper, Gigantochloa* sp., *Zea mays* (Poaceae); *Helicia excelsa* (Proteaceae); *Tarenna dasyphylla* (Rubiaceae); *Nephelium lappaceum, Xerospermum noronhianum* (Sapindaceae); *Schima wallichii* (Theaceae); *Stachytarpheta jamaicensis* (Verbenaceae); *Cayratia lanceolata, Cissus repens, Leea aequata, Leea indica* (Vitaceae); *Curcuma longa, Zingiber neglectum* (Zingiberaceae)
PuC	*Hemigraphis sumatrensis, Justicia ptychostoma, Ruellia prostrata* (Acanthaceae); *Hydnocarpus* sp. (Achariaceae); *Cyathula prostrata* (Amaranthaceae); *Mangifera longipetiolata* (Anacardiaceae); *Artabotrys suaveolens, Monoon* sp. (Annonaceae); *Schefflera elliptica* (Araliaceae); *Agathis dammara* (Araucariaceae); *Calamus sabut, Calamus* sp. (Arecaceae); *Bidens* sp., *Chromolaena odorata, Clibadium surinamense* (Asteraceae); *Capparis micracantha* (Capparaceae); *Garcinia dioica* (Clusiaceae); *Commelina benghalensis, Forrestia mollissima* (Commelinaceae); *Erycibe tomentosa* (Convolvulaceae); *Trichosanthes montana* (Cucurbitaceae); *Scleria purpurascens* (Cyperaceae); *Dillenia excelsa, Dillenia obovata, Tetracera indica, Tetracera scandens* (Dilleniaceae); *Diospyros cauliflora* (Ebenaceae); *Acalypha wilkesiana, Alchornea* sp., *Hevea brasiliensis, Macaranga tanarius, Macaranga triloba, Mallotus mollissimus, Mallotus philippensis* (Euphorbiaceae); *Cassia fistula, Derris trifoliata, Desmodium gangeticum, Mimosa* sp., *Senna alata* (Fabaceae); *Epithema sarawakense* (Gesneriaceae); *Cratoxylum formosum* (Hypericaceae); *Callicarpa pentandra, Hyptis capitata, Tectona grandis, Vitex pinnata* (Lamiaceae); *Litsea* sp. (Lauraceae); *Barringtonia racemosa* (Lecythidaceae); *Hibiscus macrophyllus, Kleinhovia hospita, Urena lobata* (Malvaceae); *Clidemia hirta* (Melastomataceae); *Aglaia argentea, Aglaia odorata* (Meliaceae); *Anamirta cocculus* (Menispermaceae); *Ficus benjamina, Ficus* spp., *Artocarpus* sp., *Parartocarpus* sp., *Sloetia elongata* (Moraceae); *Musa* spp. (Musaceae); *Syzygium acuminatissimum* (Myrtaceae); *Eurya acuminata* (Pentaphylacaceae); *Antidesma montanum, Aporosa octandra* var. *malesiana, Aporosa* sp., *Bridelia* sp. (Phyllanthaceae); *Piper* sp. (Piperaceae); *Gigantochloa atter, Isachne albens, Oplismenus compositus, Panicum sarmentosum* (Poaceae); *Helicia excelsa* (Proteaceae); *Drypetes* sp. (Putranjivaceae); *Carallia brachiata* (Rhizophoraceae); *Ixora* sp., *Mycetia* sp., *Nauclea* sp., *Tarenna dasyphylla* (Rubiaceae); *Nephelium lappaceum* (Sapindaceae); *Pipturus hubertii, Pouzolzia zeylanica* (Urticaceae); *Stachytarpheta jamaicensis* (Verbenaceae); *Cayratia lanceolata, Cissus* sp., *Leea aequata, Leea indica, Leea* sp., *Tetrastigma* sp. (Vitaceae); *Curcuma longa, Etlingera* sp. (Zingiberaceae)

CC	*Bouea oppositifolia* (Anacardiaceae); *Orophea enneandra, Uvaria rufa, Uvaria* sp. (Annonaceae); *Hoya* sp., *Ichnocarpus frutescens* (Apocynaceaae); *Aglaonema pictum, Aglaonema simplex, Amorphophallus* sp., *Anadendrum microstachyum, Pothos hosei, Scindapsus splendidus* (Araceae); *Trevesia sundaica* (Araliaceae); *Calamus sabut, Caryota mitis* (Arecaceae); *Aristolochia acuminata* (Aristolochiaceae); *Chromolaena odorata* (Asteraceae); *Begonia trichopoda* (Begoniaceae); *Garcinia* sp. (Clusiaceae); *Commelina benghalensis* (Commelinaceae); *Erycibe tomentosa* (Convolvulaceae); *Scleria purpurascens* (Cyperaceae); *Dillenia excelsa, Dillenia obovata, Tetracera indica, Tetracera scandens* (Dilleniaceae); *Hopea dryobalanoides* (Dipterocarpaceae); *Acalypha hispida, Acalypha wilkesiana, Alchornea* sp., *Aleurites moluccanus, Hevea brasiliensis, Homalanthus populneus, Macaranga triloba, Mallotus mollissimus, Neoscortechinia* sp. (Euphorbiaceae); *Abrus* sp., *Cassia fistula, Dalbergia rostrata, Desmodium* sp., *Mucuna macrophylla, Senna alata* (Fabaceae); *Cyrtandra oblongifolia, Cyrtandra* sp., *Epithema sarawakense* (Gesneriaceae); *Cratoxylum formosum* (Hypericaceae); *Curculigo* sp. (Hypoxidaceae); *Peronema canescens, Rotheca serrata, Vitex pinnata* (Lamiaceae); *Litsea* sp. (Lauraceae); *Grewia laevigata, Microcos tomentosa* (Malvaceae); *Clidemia hirta* (Melastomataceae); *Aglaia silvestris, Chisocheton ceramicus* (Meliaceae); *Anamirta cocculus, Stephania corymbosa* (Menispermaceae); *Ficus benjamina, Ficus fistulosa, Ficus hispida, Ficus* sp., *Sloetia elongata* (Moraceae); *Syzygium polyanthum, Syzygium* sp. (Myrtaceae); *Corymborkis* sp., *Malaxis* sp., *Nervilia concolor, Phaius* sp. (Orchidaceae); *Pandanus* sp. (Pandanaceae); *Antidesma montanum, Aporosa whitmorei, Baccaurea macrophylla, Bridelia* sp., *Sauropus androgynus* (Phyllanthaceae); *Piper aduncum* (Piperaceae); *Ardisia* sp. (Primulaceae); *Ziziphus horsfieldii, Ziziphus javanensis, Ziziphus* sp. (Rhamnaceae); *Carallia brachiata* (Rhizophoraceae); *Ixora* sp., *Neonauclea calycina, Pavetta montana, Tarenna* sp. (Rubiaceae); *Luvunga* sp., *Micromelum minutum* (Rutaceae); *Flacourtia* sp. (Salicaceae); *Harpullia arborea, Lepisanthes tetraphylla, Xerospermum noronhianum* (Sapindaceae); *Schima wallichii* (Theaceae); *Elatostema latifolium, Pipturus* sp., *Poikilospermum suaveolens, Villebrunea* sp. (Urticaceae); *Stachytarpheta jamaicensis* (Verbenaceae); *Cissus repens, Leea aequata, Leea indica, Leea* sp. (Vitaceae); *Zingiber neglectum* (Zingiberaceae)

Note: Site descriptions refer to Table 1

RESULTS AND DISCUSSION

As many as 157 individual butterflies of five families and 59 species (*Idea stolli* excluded) were observed in the Padang Bindu Karst (Table 3). The species number can still increase if the number of sampling days is added based on the species accumulation curve (Figure 2). In the Candi Cave area, four species were accidentally caught in the malaise trap, namely *Mahathala ariadeva* (Figure 3A), *Pantoporia hordonia, Pithecops corvus* (Figure 4M-N), and *Ypthima horsfieldii*. *Mycalesis janardana* (Figure 5E-F) in the Putri Cave area was also caught in the malaise trap. The preliminary butterfly survey data in Padang Bindu represented 20.2% of the total butterflies in South Sumatra (292 species). However, 12 species have never been scientifically published or recorded in iNaturalist and GBIF in the South Sumatra region, namely *Anthene lycaenina* (Figure 4K-L), *Cyrestis themire* (Figure 6C), *Catochrysops panormus* (Figure 4I-J), *Euploea tulliolus* (Figure 7A-B), *Mahathala ariadeva*, *Melanitis phedima* (Figure 5C-D), *Neptis duryodana* (Figure 8A-B), *Neptis harita* (Figure 8C-D), *Pithecops corvus*, *Pseudocoladenia dan* (Figure 9B), *Petrelaea dana* (Figure 4A-B), and *Rapala manea* (Figure 3B-C). The occurrence of *Papilio memnon* was the most common in South Sumatra Province. Specifically, *P. memnon* (Figure 10E) from Padang Bindu was collected in secondary forest areas (Table 3), although this butterfly also frequently presents in residential areas (Peggie and Amir 2006).

The Nymphalidae ranked at the top in terms of total individuals and the number of species, with the most individuals belonging to *Junonia hedonia* (Figure 11C) and *Cyrestis themire* (Figure 6C). The two species were found in three main karst areas, namely in the Harimau Cave, Silabe Cave, and Putri Cave. Several studies have reported *J. hedonia* as the most abundant nymphalid butterfly species or at least included in the top three most butterflies (Koneri and Maabuat 2016; Koneri and Nangoy 2019; Gracia et al. 2021). Their distribution in Indonesia is very wide, they can be found from Sumatra to Papua (Vane-Wright and de Jong 2003; Gotts and Pangemanan 2010). The high number of *J. hedonia* individuals was supported by the presence of the host plant, i.e., Acanthaceae and Malvaceae (Vane-Wright and de Jong 2003), which were found in the Padang Bindu area (Table 2). Moreover, Indonesia is one of the main locations for the distribution of Acanthaceae besides Malaysia, Africa, Brazil, and Central America (Khan et al. 2017), thus contributing to the distribution of *J. hedonia*. Meanwhile, the distribution of *C. themire* is known to cover Sumatra, Enggano, Java, Kangean, Bali, and Nusa Tenggara (Tsukada 1985; Müller and Tennent 2011). The life cycle of *C. themire* was first reported from the Kondang Merak forest, Malang, and it was found that *Streblus ilicifolius* (Moraceae) are food plants for *C. themire* in the area (Wafa and Sari 2017). Like *Junonia hedonia*, the presence of *C. themire* in the Padang Bindu Karst was also supported by the availability of host plants. Dilleniaceae and Moraceae are food plants for butterflies of the genus *Cyrestis* (Vane-Wright and de Jong 2003), and they were found in the Padang Bindu (Table 2). In addition, Corbet and Pendlebury (1956) previously reported the host plants for the *Cyrestis* butterfly are *Tetracera sarmentosa* (Dilleniaceae) and *Fi*cus (Moraceae).

Table 3. Diversity of butterflies in Padang Bindu Karst area, South Sumatra, Indonesia

Species	Elevation (m asl)	Habitat	Main Areas			Additional Areas			Outside Padang Bindu		Total
			HC	SC	PuC	CC	YC	PaC	KW	MH	
Hesperiidae											**3**
Hidari irava	136	NR, SF		1							1
Pseudocoladenia dan	111-152	NR, SF				2					2
Papilionidae											**14**
Graphium doson	103	NR, OF	1								1
Graphium evemon	133	OF	1								1
Graphium sarpedon LC	112	OF			1						1
Losaria coon LC	111	SF				1					1
Pachliopta antiphus LC	306	OF			1						1
Papilio demoleus	429	OF	1								1
Papilio iswaroides	142	PF			1						1
Papilio memnon	145	SF		1							1
Papilio nephelus	111	SF				1					1
Troides spp. *	111-230	SF	1	1	1	1		1			5
Pieridae											**46**
Appias lyncida	142	PF			1						1
Appias olferna	103-136	NR, OF	1	1	1						3
Catopsilia pomona	103-306	NR, OF	2		1				1		4
Catopsilia pyranthe	103-142	NR, OF, PF	2		1						3
Cepora iudith	119	NR, OF			1						1
Eurema alitha LC	111-429	NR, OF, PF, SF	5	1	8	2	2		1		19
Eurema hecabe	119	NR, OF			1						1
Eurema sari	429	OF	2								2
Leptosia nina	112-306	NR, OF	2		10						12
Nymphalidae											**77**
Chersonesia rahria	136-190	NR, OF, SF		1			1				2
Cirrochroa tyche	119-230	NR, CM, OF			7						7
Cupha erymanthis	133-153	NR, CM, OF, SF	1	1	1				1		4
Cyrestis themire LC	130-306	NR, OF, SF	6	3	1						10
Discophora necho	112	OF			1						1
Euploea tulliolus	190	OF					1				1
Hypolimnas bolina	127-306	NR, OF, SF		2	1						3
Idea stolli	-	PF								1	1
Ideopsis juventa	306	OF			1						1
Junonia atlites	133-143	OF	3						1		4
Junonia hedonia	127-306	NR, OF, PF	3	3	6		1				13
Junonia iphita	135-306	NR, OF, PF	1		3						4
Junonia orithya LC	103	NR, OF	1								1
Lexias pardalis	133	OF	1								1
Melanitis leda LC	112	OF			1						1
Melanitis phedima	112	OF			1						1
Mycalesis horsfieldii	142-306	OF, PF			2						2
Mycalesis janardana LC	230	SF			1						1
Mycalesis orseis	112-142	OF, PF			2						2
Neptis duryodana	134	CM, SF				1					1
Neptis harita	142	PF			1						1
Neptis hylas	129-190	OF, PF	1				1				2
Orsotriaena medus	112	OF			1						1
Pantoporia hordonia	133-152	OF, SF	1			1					2
Parantica aspasia	127-142	PF, SF		1	1						2
Polyura athamas	119-142	NR, OF, PF			5						5
Tanaecia cocytina	112	OF			1						1
Ypthima horsfieldii	152-190	OF, SF				1	1				2
Lycaenidae											**22**
Anthene lycaenina	119	NR, OF			1						1
Caleta roxus	112-429	NR, OF, PF	2		7						9
Catochrysops panormus	119	NR, OF			1						1
Jamides celeno	429	OF	1								1
Mahathala ariadeva	152	SF				1					1
Petrelaea dana	119	NR, OF			2						2
Pithecops corvus	152	SF				1					1
Rapala manea	127	SF		1							1
Surendra vivarna	142	PF			1						1
Zeltus amasa	136-142	NR, PF, SF		1	2						3
Zizina otis LC	136	NR, OF		1							1
Total			39	19	79	12	7	1	4	1	**162**
Number of species			21	14	35	10	6	1	4	1	

Note: Description of location abbreviations refer to Table 1. *only recorded their presence; LC is Least Concern category in the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species; NR: Near the River; CM: Cave Mouth Zone; OF: Open Forest; PF: Plantation Forest; SF: Secondary Forest

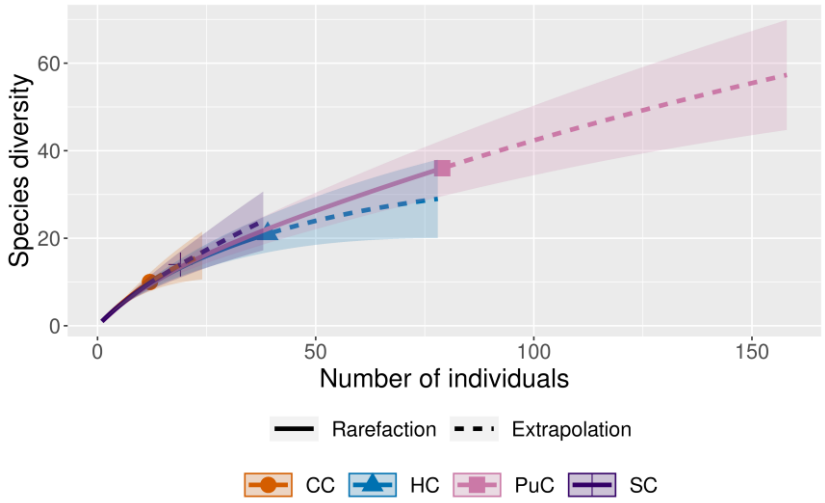

Figure 2. Species accumulation curve in the main areas of Padang Bindu Karst. Site abbreviations refer to Table 1

A **B** **C**

Figure 3. Recto-verso of Theclinae (Lycaenidae) from Padang Bindu Karst: A. *Mahathala ariadeva* ♀; B-C. *Rapala manea*. Scale bar: 1 cm

Other highlighted species from the Nymphalidae are *Cirrochroa tyche* (Figure 12A), *Polyura athamas* (Figure 13), and *Cupha erymanthis* (Figure 12B). *Cirrochroa tyche* and *P. athamas* were only found in the Putri Cave area at the time of the survey, while *C. erymanthis* was found in the three main areas of the Padang Bindu Karst, as were *J. hedonia* and *C. themire* (Table 3). The genus *Cirrochroa* is known to use *Flacourtia* and *Hydnocarpus* as larval food plants (Vane-Wright and de Jong 2003). Based on vegetation data, both host plants were recorded in the Padang Bindu Karst (Table 2). However, some literature reported that *Hydnocarpus* is the host plant for *C. tyche* (Peggie and Amir 2006; Tan et al. 2015; Hardy and Lawrence 2017; Day 2022), so this may explain this species was only found in the Putri Cave area where *Hydnocarpus* was located. Fabaceae is the most widely used food plant by the genus *Polyura* (Vane-Wright and de Jong 2003). From the 22 genera of food plants for *Polyura*, five of them were recorded in the Padang Bindu, namely *Albizia*, *Archidendron*, *Caesalpinia*, *Cassia*, and *Senna* (Table 2). In addition to the genera of Fabaceae, four genera from 23 genera of other plant families, which are food plants for *Polyura* (Vane-Wright and de Jong 2003), were also recorded in the Padang Bindu, i.e., *Annona* (Annonaceae), *Bridelia* (Euphorbiaceae), *Grewia* (Tiliaceae), and *Nephelium* (Sapindaceae). During the preliminary survey, we only encountered *Polyura athamas* in the Putri Cave area. Although previously mentioned that at least nine plant genera were host plants for *P. athamas*, if we look at the species level based on references (Smiles 1982; Gupta and Majumdar 2012; Hardy and Lawrence 2017; Iqbal et al. 2021b), only two plants are the host plants, namely *Albizia* sp. (found in Putri Cave) and *Grewia* sp. (found in Silabe Cave). In addition, due to our base camp was in the Putri Cave area, we often observed these butterflies doing mud-puddling activities. Food plants for the genus *Cupha* were mostly recorded from the Flacourtiaceae, the rest from the Euphorbiaceae, Rosaceae, Salicaceae, and Sapindaceae (Vane-Wright and de Jong 2003). From the 10 genera of food plants mentioned for *Cupha*, three of them were recorded in Padang Bindu, i.e., *Breynia* (Euphorbiaceae), *Flacourtia* (Flacourtiaceae), and *Lepisanthes* (Sapindaceae) (Table 2).

The second rank of butterflies with the most individuals observed was Pieridae. Of the nine species obtained, *Eurema alitha* (Figure 14A-B) and *Leptosia nina* had the highest number of individuals (Table 3). Like *P. athamas*, the food plants chosen by *E. alitha* are mostly from the Fabaceae (Vane-Wright and de Jong 2003). From the 10 genera of food plants for *E. alitha*, three of them were

found in the Padang Bindu Karst, namely *Albizia*, *Cassia*, and *Senna* (Fabaceae) (Table 2). *Commelina benghalensis* is a nectar plant for *Eurema* spp. (Rusman et al. 2016) and recorded in three cave areas (Silabe Cave, Putri Cave, and Candi Cave) where *E. alitha* was also found there. Meanwhile, *L. nina* mostly uses food plants from the Capparaceae (Vane-Wright and de Jong 2003). During a brief survey in Padang Bindu, only *Capparis micracantha* was recorded (Table 2). Several studies reported the abundance of *L. nina* consistently dominates in every butterfly observation (Tati-Subahar et al. 2007; Nisa' et al. 2013; Sukma et al. 2021).

Apart from *E. alitha*, other *Eurema* species found in the Padang Bindu are *E. hecabe* and *E. sari* (Table 3). There are 51 genera of larval food plants for *E. hecabe* (Figure 14E) according to Vane-Wright and de Jong (2003), and as many as 12 genera recorded in the Padang Bindu Karst, i.e., *Cocos* (Arecaceae), *Abrus, Albizia, Cassia, Mimosa*, *Senna* (Fabaceae), *Cratoxylum* (Hypericaceae), *Tectona* (Lamiaceae), *Breynia, Bridelia* (Phyllanthaceae), and *Coffea* (Rubiaceae). From the vegetation data, the host plant records for *E. hecabe* were more than *E. alitha*, but the abundances of the two species indicated otherwise. Nielsen (2015) revealed the ability of *E. alitha* to exploit host plants outside their normal distribution, which is thought to cause their presence to be more abundant. Seasonality was also expected to influence the temporal distribution of *Eurema alitha*. This *Eurema* species probably preferred the karst habitat compared to the *Eurema hecabe* and *Eurema sari*. This requires a lot of observations, so the conclusion cannot be ascertained only with this preliminary survey. Furthermore, *E. sari* (Figure 14F-G) was reported to use *A. jiringa*, *Pithecellobium dulce*, and *S. siamea* (Fabaceae) as its host plants (Ng et al. 2020; Iqbal et al. 2021b). From the three food plants, only *P. dulce* was not recorded in the Padang Bindu Karst. Meanwhile, the presence of *C. benghalensis* has not been recorded in the Harimau Cave area where *E. sari* is collected, but *Averrhoa carambola* is also reported to be a source of nectar for *Eurema* spp. (Kunte et al. 2022), and the nectar plant was only recorded in the Harimau Cave area (Table 2).

Lycaenidae was ranked third in terms of the number of individuals collected but had more species (11 species) than Pieridae (Table 3). *Caleta roxus* (Figure 4C-D) was the most abundant lycaenid collected, and the species was often observed puddling on wet ground in groups not far from rivers. This is in accordance with the observations made by Fiedler (1994) and added by him that *C. roxus* was puddling in bird droppings. Larvae of *C. roxus* use *Ziziphus* (Rhamnaceae) as food plants and *Stachytarpheta jamaicensis* (Verbenaceae) and *Hyptis brevipes* (Lamiaceae) as sources of nectar (Fiedler 1994). The first two plants were found in Padang Bindu, while the third was replaced by *H. capitata* (Table 2). The two nectar plants were in the same location as *C. roxus*, but only in the Putri Cave area, not recorded in the Harimau Cave area. Meanwhile, the host plant was recorded in a different location, namely the Candi Cave area. Another lycaenid highlighted was *Zizina otis* (Figure 4E-F). The species is included in the LC category on the IUCN Red List. Larval food plants for *Z. otis* are Fabaceae (Vane-Wright and de Jong 2003). From the 16 genera of host plants mentioned, only *Desmodium* (in the Candi Cave area) and *Mimosa* (in the Putri Cave area) were recorded in the Padang Bindu Karst, but their location was different from the place of *Z. otis* was found (Silabe Cave area).

The fourth rank was Papilionidae. Only one individual was collected for each species, and no individuals of *Troides* spp. were obtained (Table 3). Three species are listed on the IUCN Red List with LC status, namely *Graphium sarpedon* (Figure 10A), *Losaria coon* (Figure 10C), and *Pachliopta antiphus* (Figure 10D). The host plants for *G. sarpedon* vary (D'Abrera 1977; Dunn and Dunn 1991; Chou 1994; Iqbal et al. 2021b), at least 54 known species and two of them were recorded in the Padang Bindu Karst, namely *Annona reticulata* and *Macaranga tanarius* (Table 2). *Thottea tomentosa* is a host plant for *L. coon* (Corbet and Pendlebury 1992) and *Aristolochia* sp. is a food plant for *P. antiphus* (Page and Treadaway 2003). Only *Aristolochia* was recorded in the Padang Bindu Karst (Candi Cave area), yet the location was different from the finding of *P. antiphus* (Putri Cave area). Two other *Graphium* species obtained were *G. doson* and *G. evemon* (Figure 10B). There are 10 known host plant genera for *G. doson* (Page and Treadaway 2003), and three of them were recorded in the Padang Bindu Karst, namely *Annona, Polyalthia*, and *Uvaria* (Table 2). *Artabotrys wrayi* and *Polyalthia longifolia* (Annonaceae) were reported as host plants for *G. evemon* (Sanjaya et al. 2017; Ng et al. 2020), yet *Artabotrys* (in Putri Cave area) and *Polyalthia* (in Silabe Cave area) species recorded in the Padang Bindu Karst were found in different locations with the finding of *G. evemon* (Harimau Cave area). For *Artabotrys* species, it is also different from the species that have been reported, namely *Artabotrys suaveolens*.

Hesperiidae was obtained in the least number in Padang Bindu (Table 3). Some members of this family are crepuscular (Peggie and Amir 2006), which is active in dim lightings such as dawn and dusk. Although Hesperiidae was lowest in this preliminary survey, two long-term studies in karst areas did not place the Hesperiidae at the lowest abundance (Lien 2014; McGrath 2015). Two species collected were *Hidari irava* (a crepuscular species according to Khew et al. (2019)) and *Pseudocoladenia dan*. One of the host plants of *H. irava* (Figure 9A), *Cocos nucifera* (Iqbal et al. 2021b), was recorded in the Padang Bindu Karst. The food plants of *P. dan* (Figure 9B) are *Achyranthes, Cyathula prostrata*, and *Mimosa* (Corbet and Pendlebury 1992; Igarashi and Fukuda 2000; Vane-Wright and de Jong 2003), although the latter is doubtful. *Cyathula prostrata* and *Mimosa* sp. were recorded in the Padang Bindu Karst (Putri Cave area), yet at different locations from where *P. dan* was found (Candi Cave area).

During the survey, butterflies in Padang Bindu were observed more often in open forests (Table 3). Ohwaki et al. (2017) showed the importance of sunlight in the presence of butterflies. The part of the forest area that is illuminated by the sun or the canopy is more open will be more visited by butterflies (Hamer et al. 2003). The

number of butterfly species in Baturaden Forest, Mount Slamet was found to be the most in plantation forests, but rare species were more often found in secondary forests (Widhiono 2015). From our collection, the species that have not been recorded in South Sumatra were slightly more found in open forests, yet the expected rarest species were found in secondary forest (Candi Cave area), namely *Mahathala ariadeva* (Figure 3A). Since the description of *M. ariadeva* by Fruhstorfer (1908), its occurrence has not been scientifically re-recorded in one of its distribution areas (Sumatra).

In addition, Widhiono (2015) revealed open habitats in tourist areas had more diverse butterfly species than secondary forests, but the lowest number of butterfly species was found in open habitats in agroforest areas. Reflecting on this, the Harimau Cave and Putri Cave areas are the main ecotourism sites and the representatives of open habitat which, when viewed in the preliminary survey of this study, the number of butterfly species in these two areas was higher (Table 3), although especially in the Putri Cave area there is an influence of more sampling duration due to the location of our basecamp in that area (Table 4). However, although the Silabe Cave area included a secondary forest, the area was also a major tourist destination. Judging from the number of butterflies finds per day, the total species collected were slightly higher than in the Putri Cave area (Table 4).

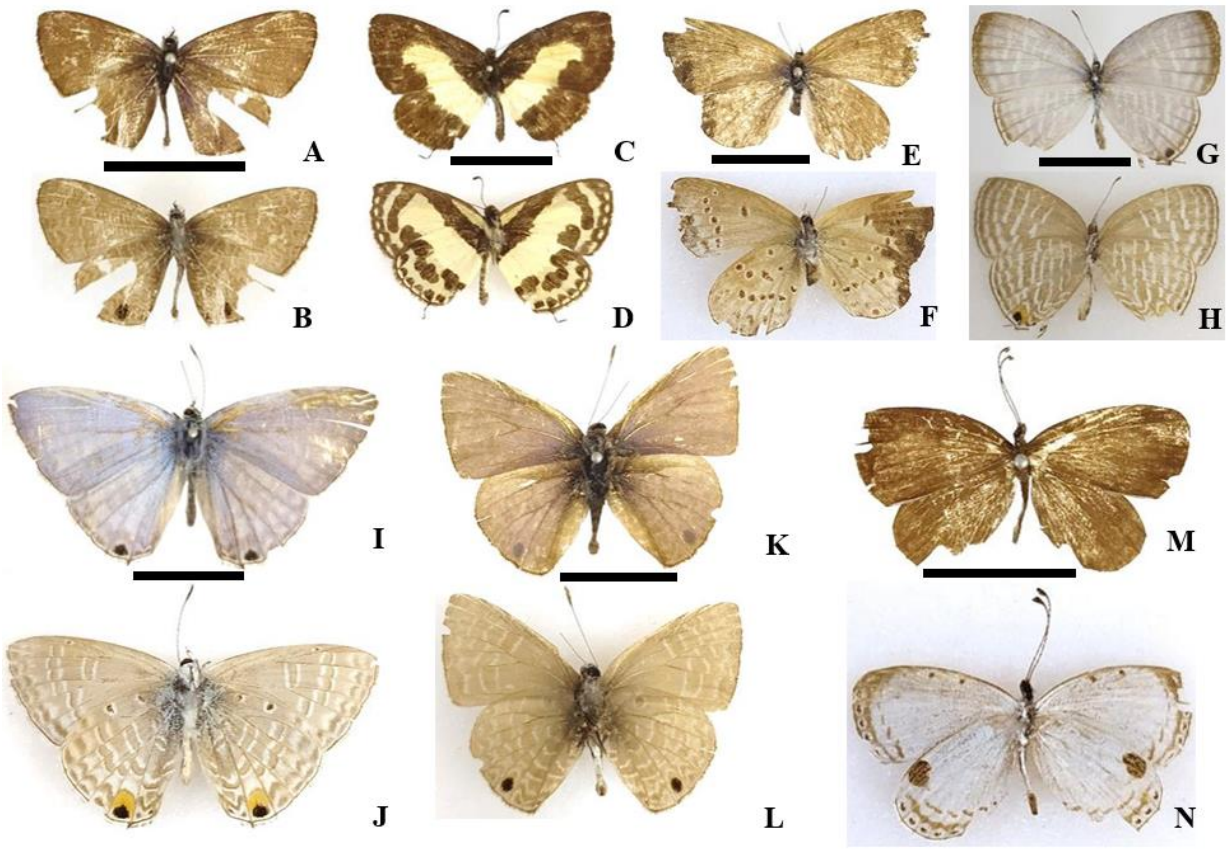

Figure 4. Recto-verso of Polyommatinae (Lycaenidae) from Padang Bindu Karst: A-B, *Petrelaea dana*; C-D, *Caleta roxus*; E-F, *Zizina otis*; G-H, *Jamides celeno*; I-J, *Catochrysops panormus*; K-L, *Anthene lycaenina*; M-N, *Pithecops corvus*. Scale bar: 1 cm

Table 4. Number of butterfly species per day collected in the areas of Padang Bindu Karst

Date	Number of species per day in the area of						
	HC	SC	PuC	CC	YC	KW	MH
28 May 2021	8	4	4	NS	NS	NS	NS
29 May 2021	NS	NS	3	7	NS	NS	NS
30 May 2021	NS	11	5	1	NS	NS	NS
31 May 2021	12	NS	5	NS	NS	NS	NS
1 June 2021	NS	NS	8	3	6	NS	NS
2 June 2021	NS	NS	15	NS	NS	NS	NS
3 June 2021	5	NS	8	NS	NS	NS	1[Is]
4 June 2021	NS	NS	1[Mp]	NS	NS	4	NS

Note: Description of site abbreviations refer to Table 1. NS: no sampling; [Mp]sampling was carried out in KW, yet a *Melanitis phedima* visited our basecamp. [Is]no sampling, yet the botanical team captured an *Idea stolli* from MH

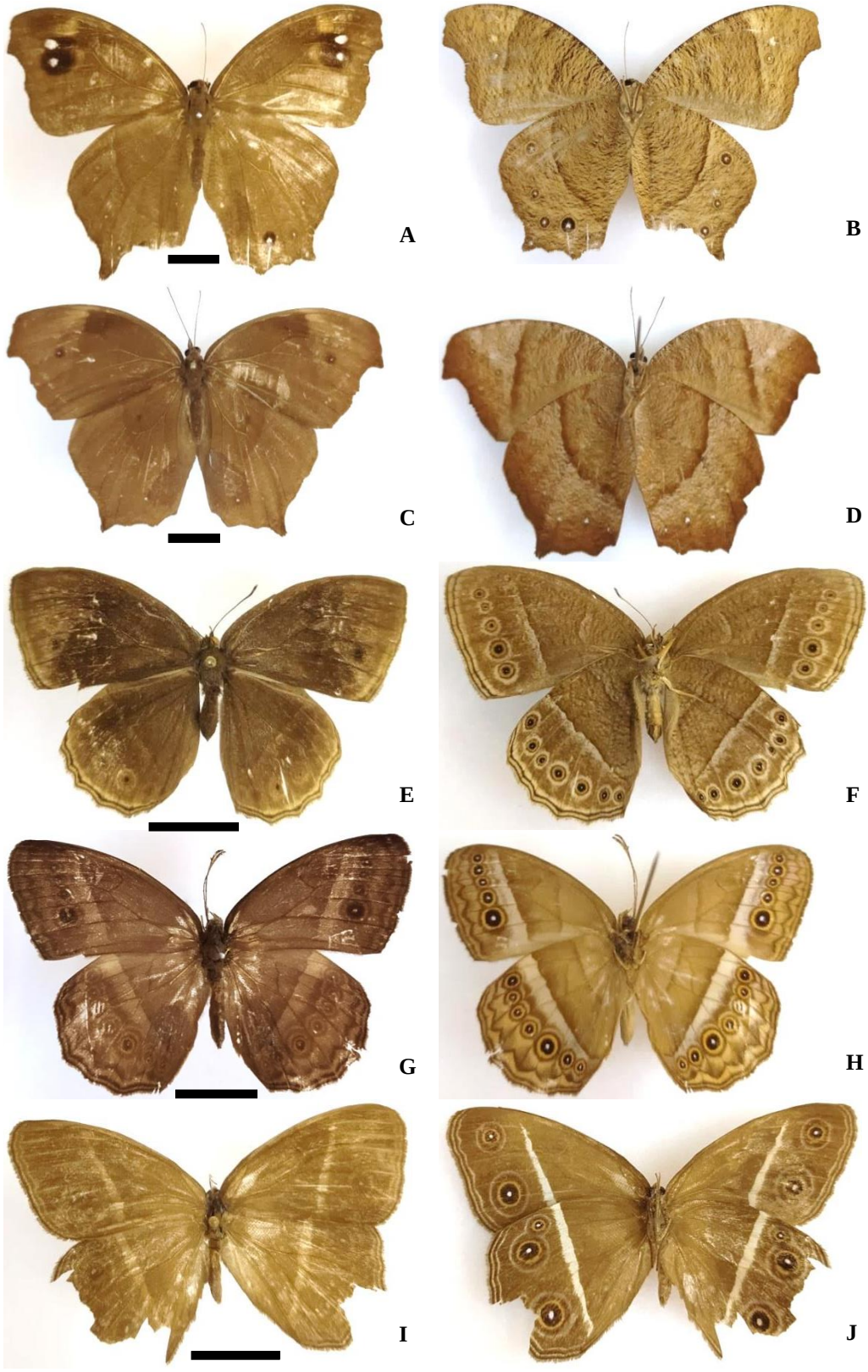

Figure 5. Recto-verso of Satyrinae (Nymphalidae) from Padang Bindu Karst: A-B, *Melanitis leda*; C-D, *Melanitis phedima*; E-F, *Mycalesis janardana*; G-H, *Mycalesis orseis*; I-J, *Orsotriaena medus*. Scale bar: 1 cm

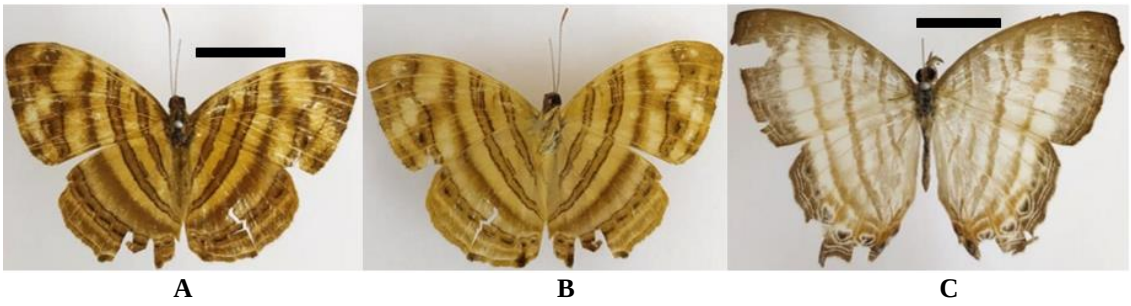

Figure 6. Cyrestinae (Nymphalidae) from Padang Bindu Karst: A-B, *Chersonesia rahria* (recto-verso); C, *Cyrestis themire*. Scale bar: 1 cm

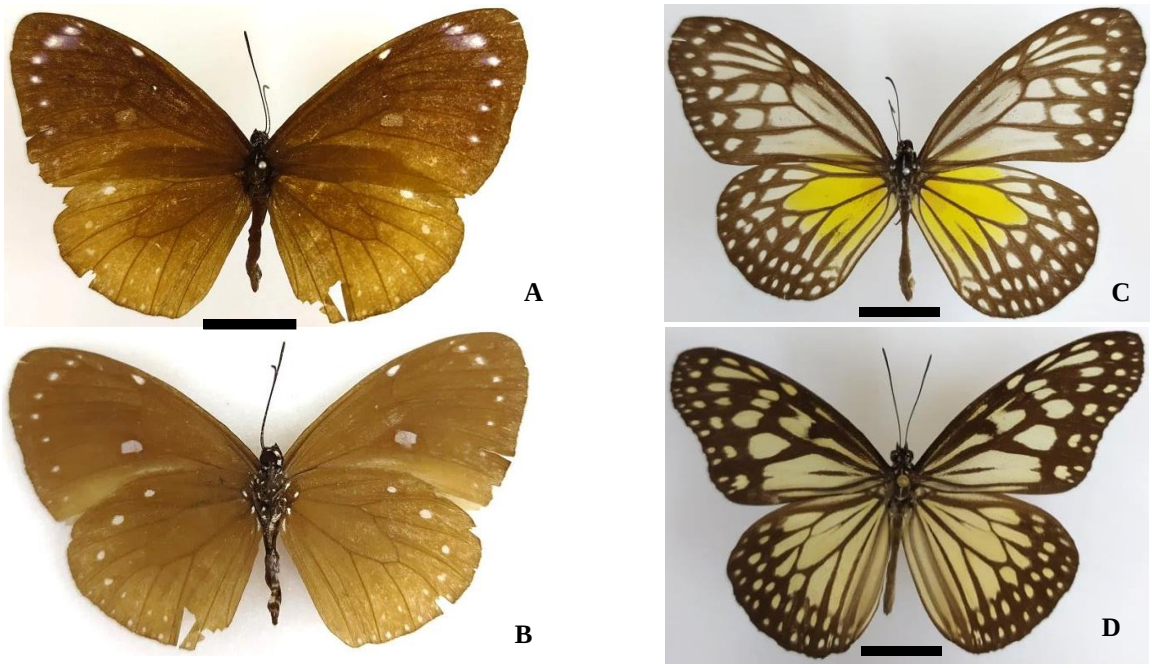

Figure 7. Danainae (Nymphalidae) from Padang Bindu Karst: A-B, *Euploea tulliolus* (recto-verso); C, *Parantica aspasia*; D, *Ideopsis juventa*. Scale bar: 1 cm

Unfortunately, observations in the Silabe Cave area are not every day like in the Putri Cave area. The open habitats provide sunlight or many flowering plants, which butterflies love to visit, yet it does not mean that they support the high diversity. If the open habitats do not have food resources, the butterflies are just visiting the area and not breeding. It is the open habitat that attracts butterflies to come, not because the area is a tourism site.

A total of 24 butterfly species in the Padang Bindu Karst were collected near the river (Table 3) and at least 14 species were also found in riverlet and forest stream areas near the Sankosh River, Bhutan (Singh 2012), i.e., *Anthene lycaenina*, *Catochrysops panormus* (Lycaenidae), *Cirrochroa tyche*, *Hypolimnas bolina*, *Junonia iphita*, *Junonia orithya*, *Polyura athamas* (Nymphalidae), *Catopsilia pomona*, *Catopsilia pyranthe*, *Eurema hecabe*, *Leptosia nina* (Pieridae), *Pseudocoladenia dan* (Hesperiidae), and *Graphium doson* (Papilionidae). For additional information, nine species were found in the riparian habitat of IPB University, West Java (Mustari and Gunadharma 2016), i.e., *Appias olferna*, *Catopsilia pyranthe*, *Leptosia nina* (Pieridae), *Hypolimnas bolina*, *Junonia hedonia*, *Junonia iphita*, *Junonia orithya* (Nymphalidae), and *Zizina otis* (Lycaenidae); then six species were also found in the riparian habitat of Gunung Ciremai National Park, West Java (Sari 2013), namely *H. bolina*, *J. iphita*, *Polyura athamas* (Nymphalidae), *Caleta roxus* (Lycaenidae), *Pseudocoladenia dan* (Hesperiidae), and *L. nina* (Pieridae).

Figure 8. Limetidinae (Nymphalidae) from Padang Bindu Karst: A-B, *Neptis duryodana* (recto-verso); C-D, *Neptis harita* (recto-verso); E-F, *Neptis hylas* (recto-verso); G, *Lexias pardalis* ♀; H, *Tanaecia cocytina* ♀. Scale bar: 1 cm

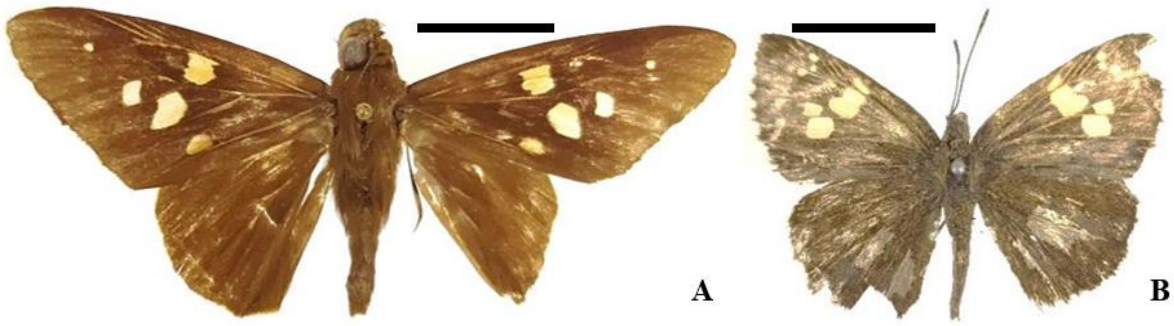

Figure 9. Hesperiidae from Padang Bindu Karst: A, *Hidari irava* (Hesperiinae); B, *Pseudocoladenia dan* (Tagiadinae). Scale bar: 1 cm

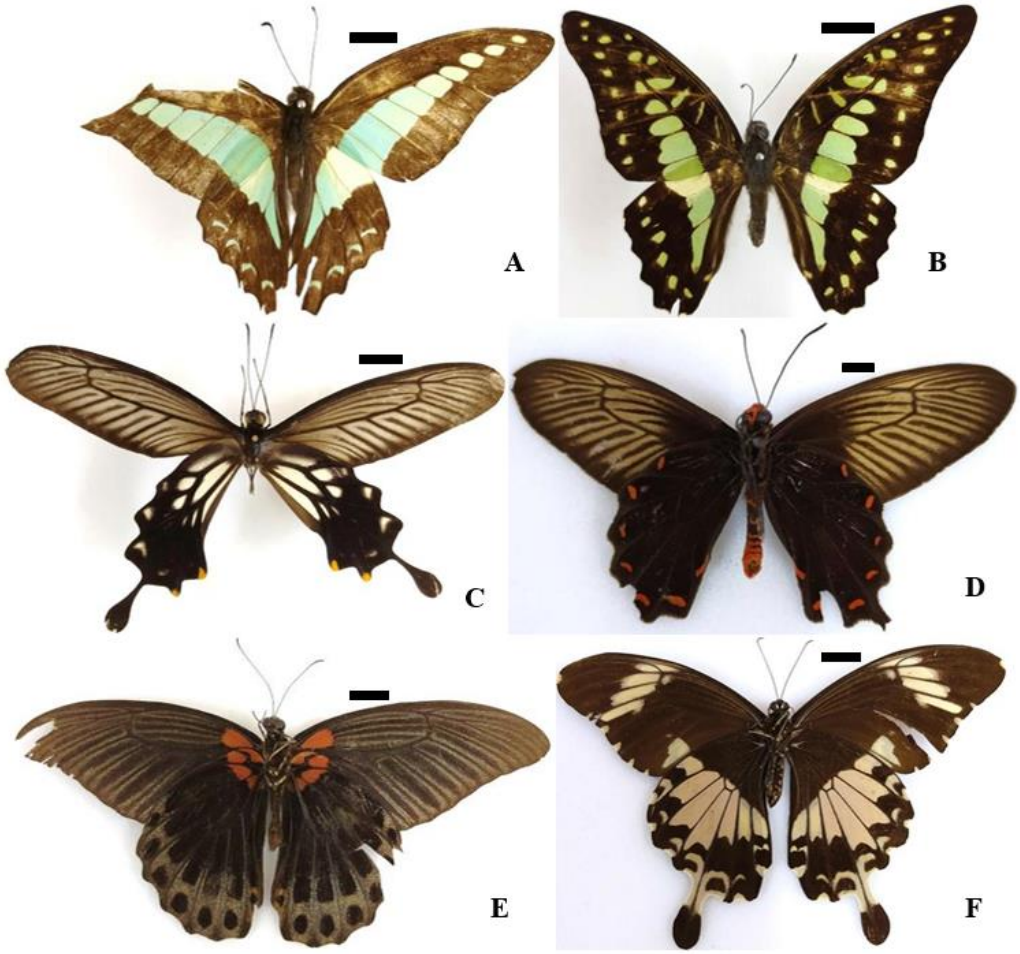

Figure 10. Papilionidae from Padang Bindu Karst: A, *Graphium sarpedon*; B, *Graphium evemon*; C, *Losaria coon*; D, *Pachliopta antiphus*; E, *Papilio memnon* ♂; F, *Papilio nephelus*. Scale bar: 1 cm

Figure 11. Nymphalinae (Nymphalidae) from Padang Bindu Karst: A, *Hypolimnas bolina* ♀; B, *Junonia iphita*; C, *Junonia hedonia*; D, *Junonia atlites*. Scale bar: 1 cm

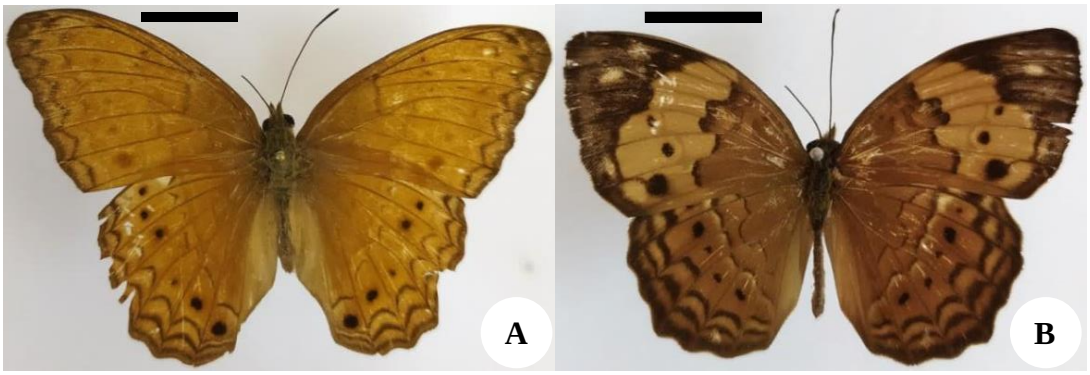

Figure 12. Heliconiinae (Nymphalidae) from Padang Bindu Karst: A, *Cirrochroa tyche*; B, *Cupha erymanthis*. Scale bar: 1 cm

Figure 13. Recto-verso of *Polyura athamas* (Nymphalidae: Charaxinae) from Padang Bindu Karst. Scale bar: 1 cm

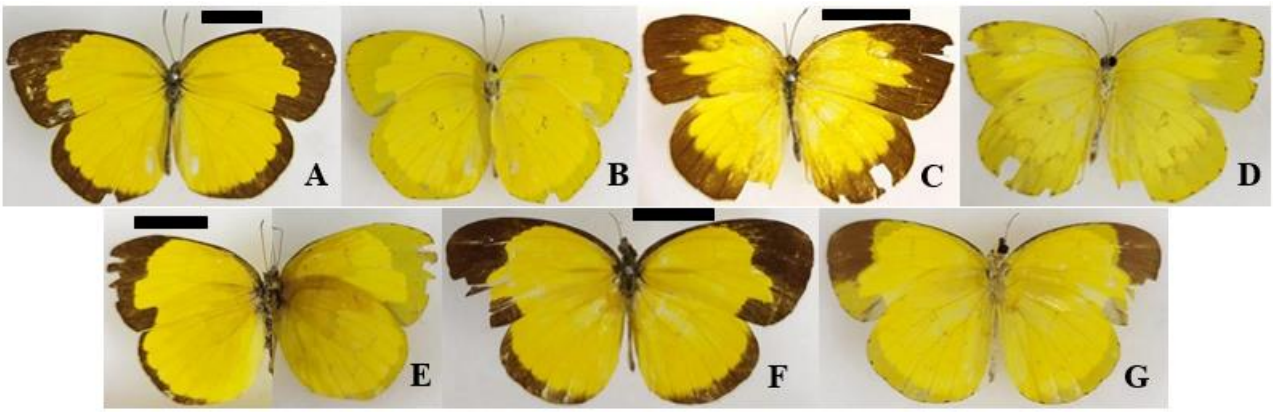

Figure 14. *Eurema* species (Pieridae) from Padang Bindu Karst: A-B, *Eurema alitha* ♂ (recto-verso); C-D, *Eurema alitha* ♀ (recto-verso); E, *Eurema hecabe* ♂ (recto-verso); F-G, *Eurema sari* ♂ (recto-verso). Scale bar: 1 cm.

Figure 15. Recto-verso of *Discophora necho* ♀ (Nymphalidae: Morphinae) from Padang Bindu Karst. Scale bar: 1 cm

Table 5. Prediction of butterfly presence based on vegetation data in the Padang Bindu Karst, South Sumatra, Indonesia

Plant species	Use of plant	Plant site	Butterfly species*	Site of observed butterfly*
Acanthaceae				
Ruellia prostrata	HP	PuC	*Hypolimnas misippus*	-
(= *Dipteracanthus prostratus*)			^***Junonia hedonia***	HC, SC, **PuC**, YC
			Junonia iphita	HC, **PuC**
			Zizula hylax	-
Achariaceae				
Hydnocarpus sp.	HP	PuC	*Cirrochroa orissa*	-
			Cirrochroa tyche	**PuC**
Amaranthaceae				
Cyathula prostrata	HP	PuC	*Pseudocoladenia dan*	CC
Annonaceae				
Annona reticulata	HP	HC	*Graphium agamemnon*	-
			Graphium eurypylus	-
			Graphium sarpedon	PuC
Polyalthia sp.	HP	SC	*Graphium agamemnon*	-
			Graphium doson	HC
			Graphium eurypylus	-
Uvaria rufa	HP	HC, CC	*Graphium eurypylus*	-
Uvaria sp.	HP	CC	*Graphium agamemnon*	-
			Graphium antiphates	-
			Graphium doson	HC
Apocynaceae				
Ichnocarpus frutescens	HP	SC, CC	*Euploea algea*	-
			Euploea core	-
			Euploea mulciber	-
			Euploea sylvester	-
Araliaceae				
Schefflera elliptica	HP	PuC	*Bibasis gomata*	-
Trevesia sundaica	HP	CC	*Bibasis gomata*	-
Arecaceae				
Arenga sp.	HP	SC	*Gangara thyrsis*	-
			Hidari irava	-
Calamus sp.	HP	PuC, YC	*Elymnias hypermnestra*	-
			Elymnias nesaea	-
			Erionota thrax	-
			Gangara thyrsis	-
			Hyarotis adrastus	-
Caryota mitis	HP	HC, CC	*Elymnias panthera*	-
			Faunis canens	-
			Plastingia naga	-
Cocos nucifera	HP	HC, SC	*Amathusia phidippus*	-
			Cephrenes acalle	-
			Elymnias hypermnestra	-
			Elymnias nesaea	-
			Erionota acroleuca	-
			Erionota thrax	-
			Gangara thyrsis	-
			Hidari irava	**SC**
			Lotongus calathus	-
			Suastus gremius	-
Licuala sp.	HP	SC	*Amathusia phidippus*	-
Aristolochiaceae				
Aristolochia acuminata	HP	CC	*Pachliopta antiphus*	PuC
			Pachliopta aristolochiae	-
			Trogonoptera brookiana	-
			Troides amphrysus	-
			Troides helena	-
Asteraceae				
Chromolaena odorata	NP	HC, SC, PuC, CC	*Acraea violae*	-
			Anthene lycaenina	**PuC**
			Appias lyncida	**PuC**
			Badamia exclamationis	-
			Catopsilia pomona	**HC, PuC**

			Cupha erymanthis	**HC, SC, PuC**
			Delias hyparete	-
			Deudorix epijarbas	-
			Euploea core	-
			Euploea mulciber	-
			Eurema blanda	-
			Eurema hecabe	**PuC**
			Graphium agamemnon	-
			Hypolycaena erylus	-
			Jamides bochus	-
			Junonia almana	-
			Junonia atlites	**HC**
			Junonia iphita	**HC, PuC**
			Leptosia nina	**HC, PuC**
			Megisba malaya	-
			Moduza procris	-
			Odontoptilum angulata	-
			Pachliopta aristolochiae	-
			Papilio demoleus	**HC**
			Papilio memnon	**SC**
			Phalanta phalantha	-
			Prosotas nora	-
			Rapala dieneces	-
			Rapala manea	**SC**
			Rapala pheretima	-
Clibadium surinamense	NP	PuC	***Appias lyncida***	**PuC**
			Danaus melanippus	-
			Euploea mulciber	-
			Euploea tulliolus	YC
			Hypolimnas bolina	SC, **PuC**
			Leptosia nina	HC, **PuC**
			Trogonoptera brookiana	-
Capparaceae				
Capparis micracantha	HP	PuC	***Appias lyncida***	**PuC**
			Appias olferna	HC, SC, **PuC**
			Cepora iudith	**PuC**
			Hebomoia glaucippe	-
			Leptosia nina	HC, **PuC**
Combretaceae				
Combretum indicum	HP	SC	*Cupitha purreea*	-
(= *Quisqualis indica*)			***Rapala manea***	**SC**
			Rapala varuna	-
Commelinaceae				
Commelina benghalensis	NP	SC, PuC, CC	***Zizina otis***	**SC**
Convolvulaceae				
Erycibe tomentosa	HP	HC, SC, PuC, CC	*Lasippa tiga*	-
Dilleniaceae				
Dillenia excelsa	HP	SC, PuC, CC	*Vagrans egista*	-
			Vagrans sinha	-
Tetracera scandens	HP	HC, SC, PuC, CC	*Cyrestis nivea*	-
Euphorbiaceae				
Hevea brasiliensis	HP	HC, SC, PuC, CC, YC	***Neptis hylas***	**HC, YC**
Macaranga tanarius	HP	PuC	***Graphium sarpedon***	**PuC**
			Megisba malaya	-
Mallotus philippensis	HP	HC, PuC	*Megisba malaya*	-
			Prosotas dubiosa	-
			Prosotas nora	-
Fabaceae				
Albizia sp.	HP	PuC	***Catochrysops panormus***	**PuC**
			Eurema blanda	-
			Eurema hecabe	**PuC**
			Pantoporia hordonia	HC, CC
			Polyura athamas	**PuC**
Archidendron jiringa	HP	HC	***Eurema sari***	**HC**
			Polyura delphis	-
			Surendra vivarna	PuC
			Zographetus doxus	-

Biancaea decapetala (= *Caesalpinia decapetala*) (= *Caesalpinia sepiaria*)	HP	HC, SC	*Anthene lycaenina*	PuC
			Chilades pandava	-
			Eurema hecabe	PuC
Cassia fistula	HP	PuC, CC	*Anthene emolus*	-
			Catopsilia pomona	HC, **PuC**
			Catopsilia pyranthe	HC, **PuC**
			Catopsilia scylla	-
			Eurema blanda	-
			Eurema hecabe	**PuC**
			Eurema laeta	-
			Eurema simulatrix	-
			Graphium agamemnon	-
			Neptis hylas	HC, YC
Cassia sp.	HP	HC	***Catopsilia pomona***	**HC**, PuC
			Catopsilia pyranthe	**HC**, PuC
			Catopsilia scylla	-
			Eurema blanda	-
			Eurema hecabe	PuC
Dalbergia rostrata	HP	HC, CC	*Pantoporia paraka*	-
			Tapena thwaitesi	-
Derris trifoliata	HP	SC, PuC	*Hasora badra*	-
			Jamides bochus	-
			Jamides celeno	HC
			Nacaduba pavana	-
	NP		***Catopsilia pyranthe***	HC, **PuC**
Desmodium gangeticum	HP	PuC	*Cupido lacturnus*	-
			Neptis hylas	HC, YC
			Papilio demoleus	HC
Desmodium sp.	HP	CC	***Pithecops corvus***	**CC**
Millettia sericea	HP	HC	*Jamides malaccanus*	-
Mimosa sp.	HP	PuC	***Eurema hecabe***	**PuC**
			Surendra vivarna	PuC
Pongamia sp.	HP	SC	*Hasora taminatus*	-
Senna alata	HP	PuC, CC	***Catopsilia pomona***	HC, **PuC**
			Catopsilia pyranthe	HC, **PuC**
			Catopsilia scylla	-
			Eurema alitha	HC, SC, **PuC**, **CC**, YC
			Eurema blanda	-
			Eurema hecabe	**PuC**
			Hypolycaena erylus	-
			Neptis hylas	HC, YC
Senna siamea	HP	HC	***Catopsilia pomona***	**HC**, PuC
			Catopsilia pyranthe	**HC**, PuC
			Catopsilia scylla	-
			Eurema blanda	-
			Eurema brigitta	-
			Eurema hecabe	PuC
			Eurema sari	**HC**
Hypericaceae				
Cratoxylum formosum	HP	PuC, CC	***Eurema hecabe***	**PuC**
			Lexias pardalis	HC
Lamiaceae				
Vitex pinnata	HP	HC, SC, PuC, CC	*Acraea violae*	-
			Zographetus doxus	-
Lauraceae				
Litsea sp.	HP	HC, SC, PuC, CC	***Graphium sarpedon***	**PuC**
Malvaceae				
Grewia sp.	HP	SC	*Neptis hylas*	HC
			Polyura athamas	PuC
Urena lobata	HP	PuC	*Neptis hylas*	HC
			Odontoptilum angulata	-
			Rapala manea	SC
	NP	PuC	*Junonia atlites*	HC
Melastomataceae				
Clidemia hirta	HP	PuC, CC	*Euthalia monina*	-
Melastoma malabathricum	HP	HC, SC, PuC, CC	♦*Allotinus unicolor*	-

			Rapala iarbus	-
			Semanga superba	-
			Spindasis lohita	-
			Tanaecia cocytina	**PuC**
			Tanaecia pelea	-
	NP	HC, SC, PuC, CC	*Elymnias hypermnestra*	-
			Elymnias panthera	-
			Euthalia monina	-
			Junonia atlites	**HC**
			Moduza procris	-
			Pandita sinope	-
			Surendra vivarna	**PuC**
Moraceae				
Ficus benjamina	HP	PuC, CC	*Euploea core*	-
			Euploea eunice	-
			Euploea mulciber	-
Ficus hispida	HP	HC, CC	*Euploea eunice*	-
			Euploea klugii	-
Ficus spp.	HP	HC, PuC, CC	*Badamia exclamationis*	-
			Chersonesia rahria	SC, YC
			Cyrestis themire	**HC, SC, PuC**
			Danaus melanippus	-
			Euploea algea	-
			Euploea core	-
			Euploea mulciber	-
			Euploea tulliolus	YC
			Hypolimnas misippus	-
Streblus asper	HP	HC	*Euploea core*	-
			Euploea eunice	-
			Euploea klugii	-
			Euthalia aconthea	-
Musaceae				
Musa spp.	HP	HC, SC, PuC, YC	*Amathusia phidippus*	-
			Erionota thrax	-
			Faunis canens	-
			Gangara thyrsis	-
			Notocrypta paralysos	-
Myrtaceae				
Syzygium spp.	HP	HC, SC, CC	*Flos apidanus*	-
Oxalidaceae				
Averrhoa carambola	HP	HC	*Hypolycaena erylus*	-
Pentaphylacaceae				
Eurya acuminata	HP	SC, PuC	*Remelana jangala*	-
			Sinthusa nasaka	-
			Tanaecia cocytina	**PuC**
Phyllanthaceae				
Antidesma montanum	HP	HC, SC, PuC, CC	*Dophla evelina*	-
	NP	HC, SC, PuC, CC	***Cupha erymanthis***	**HC, SC, PuC**
Breynia cernua	HP	HC, SC	*Eurema hecabe*	PuC
Bridelia sp.	HP	HC, SC, PuC, CC	*Athyma nefte*	-
Piperaceae				
Piper spp.	HP	SC, PuC	***Ideopsis juventa***	**PuC**
Poaceae				
Gigantochloa nigrociliata	HP	HC	*Matapa cresta*	-
			Matapa druna	-
			Melanitis leda	PuC
			Melanitis zitenius	-
Gigantochloa scortechinii	HP	HC	♦*Allotinus unicolor*	-
Oplismenus compositus	HP	PuC	***Melanitis leda***	**PuC**
			Melanitis phedima	**PuC**
			Mycalesis janardana	**PuC**
			Mycalesis perseus	-
			Orsotriaena medus	**PuC**
Schizostachyum sp.	HP	HC	*Potanthus omaha*	-
Zea mays	HP	SC	*Melanitis leda*	PuC
			Melanitis phedima	PuC
			Parnara bada	-

			Pelopidas conjuncta	-
			Pelopidas mathias	-
Primulaceae				
Ardisia sp.	HP	CC	*Abisara echerius*	-
Rhamnaceae				
Ziziphus sp.	HP	CC	*Caleta roxus*	HC, PuC
			Papilio demoleus	HC
			Rapala manea	SC
Rubiaceae				
Ixora sp.	HP	HC, PuC, CC	*Cheritra freja*	-
			Phalanta phalantha	-
	NP	HC, PuC, CC	***Papilio demoleus***	**HC**
			Papilio polytes	-
			Pelopidas conjuncta	-
			Troides helena	-
Nauclea sp.	HP	HC, PuC	*Moduza procris*	-
Psychotria viridiflora	HP	HC	*Unkana ambasa*	-
Urophyllum sp.	HP	HC	*Bibasis harisa*	-
Rutaceae				
Clausena excavata	HP	HC	***Papilio demoleus***	**HC**
			Papilio palinurus	-
			Papilio peranthus	-
			Papilio polytes	-
Micromelum minutum	HP	HC, CC	***Papilio nephelus***	**CC**
			Papilio palinurus	-
			Papilio polytes	-
Salicaceae				
Flacourtia sp.	HP	HC, CC	***Cupha erymanthis***	**HC**, SC, PuC
			Phalanta phalantha	-
Sapindaceae				
Harpullia arborea	HP	CC	*Deudorix epijarbas*	-
Lepisanthes amoena	HP	HC	*Jamides elpis*	-
Lepisanthes tetraphylla	HP	CC	*Acytolepis puspa*	-
			Arhopala centaurus	-
			Cheritra freja	-
			Megisba malaya	-
			Rapala manea	SC
Nephelium lappaceum	HP	HC, SC, PuC, YC	*Anthene emolus*	-
			Anthene lycaenina	**PuC**
			Delias hyparete	-
			Deudorix epijarbas	-
			Hypolycaena erylus	-
			Nacaduba hermus	-
			Nacaduba kurava	-
			Polyura schreiber	-
			Rapala dieneces	-
			Rapala iarbus	-
			Rapala manea	**SC**
			Rapala pheretima	-
			Rapala varuna	-
Pometia pinnata	HP	HC	*Deudorix epijarbas*	-
Theaceae				
Schima wallichii	NP	SC, CC	*Sinthusa nasaka*	-
Urticaceae				
Poikilospermum suaveolens	HP	CC	*Neptis harita*	PuC
			Rhinopalpa polynice	-
Verbenaceae				
Stachytarpheta jamaicensis	HP	SC, PuC, CC	*Junonia almana*	-
	NP	SC, PuC, CC	*Acraea violae*	-
			Appias lyncida	**PuC**
			Caleta roxus	HC, **PuC**
			Catopsilia pomona	HC, **PuC**
			Catopsilia pyranthe	HC, **PuC**
			Euploea core	-
			Eurema hecabe	**PuC**
			Hypolimnas misippus	-
			Junonia almana	-
			Junonia atlites	HC
			Junonia orithya	HC
			Pachliopta aristolochiae	-
			Papilio demoleus	HC

			Pelopidas conjuncta	-
Vitaceae				
Leea indica	NP	HC, SC, PuC, CC	*Cirrochroa orissa*	-
			Deudorix epijarbas	-
			Eurema hecabe	**PuC**
			Graphium sarpedon	**PuC**
			Zeltus amasa	**SC, PuC**
			Leptosia nina	**HC, PuC**
			Sinthusa nasaka	-
Zingiberaceae				
Curcuma longa (= *Curcuma domestica*)	HP	SC, PuC	*Ancistroides nigrita*	-
			Notocrypta curvifascia	-
			Notocrypta paralysos	-
			Udaspes folus	-
Zingiber sp.	HP	HC	*Jamides alecto*	,-
			Notocrypta paralysos	-
			Udaspes folus	-
Total host plants = 80 species, total nectar plants = 11 species			Number of butterfly species = 154 species	

Note: Site descriptions refer to Table 1. *****All butterfly species in the list are conformed according to abiotic factors (altitude, humidity, temperature, and topography); butterfly species and site of observed butterfly which are written in **bold**, meaning they are in the same area and probably suitable with the host plants and/or nectar plants. ^Expected a new host plant record for the butterfly. ♦Carnivorous larvae possibly present in the plants. HP: Host plant, NP: Nectar plant (Straatman and Nieuwenhuis 1961; D'Abrera 1977; Johnston and Johnston 1980; Smiles 1982; Ackery and Vane-Wright 1984; Fiedler and Maschwitz 1989; Wang and Emmel 1990; Dunn and Dunn 1991; Corbet and Pendlebury 1992; Haribal 1992; Chou 1994; Fiedler 1994; Goh 1994; Mohanraj and Veenakumari 1996; Braby 2000; Igarashi and Fukuda 2000; Robinson et al. 2001; Nair 2003; Page and Treadaway 2003; Vane-Wright and de Jong 2003; Patel et al. 2004; Eliot 2006; Khew 2009; Tan et al. 2009; Hoskins 2010; Suwarno 2010; Tan et al. 2010; Lakshmi and Raju 2011; Peggie and Noerdjito 2011; Tan et al. 2011; Gupta and Majumdar 2012; Gogoi 2013; Tan et al. 2013; Ghorai and Sengupta 2014; Jayasinghe et al. 2014; Khew et al. 2014; Revathy and Mathew 2014; Sengupta et al. 2014; Gogoi 2015; Kalesh and Prakash 2015; Patrick and Kleinpaste 2015; Shihan 2015; Shihan and Kabir 2015; Tan et al. 2015; Fitriana et al. 2016; Koneri and Maabuat 2016; Kumar and Khanduri 2016; Peggie and Amir 2016; Peiris 2016; Raju and Kumar 2016; Rusman et al. 2016; Goode 2017; Hardy and Lawrence 2017; Sanjaya et al. 2017; Shihan 2017; Ismail et al. 2018; Karmakar et al. 2018; Nitin et al. 2018; Suwarno et al. 2018; Afrilianti et al. 2019; National Parks 2019; Savela 2019a, b; Naik and Mustak 2020; Ng et al. 2020; Iqbal et al. 2021b; Panjaitan et al. 2021; Ramana et al. 2021; Samal et al. 2021; Tan et al. 2021; ButterflyCircle 2022; Inayoshi 2022; Kunte et al. 2022; Lovalekar 2022; Sajan and Sapkota 2022; Tan et al. 2022)

Table 6. The occurrence of butterflies based on host plants and/or nectar plants in the Padang Bindu Karst, South Sumatra, Indonesia

(√)HP	**(x)HP**	**(√)NP**	**(x)NP**	**(x)HP(√)HP**	**(x)NP(√)NP**
Appias olferna	*Chersonesia rahria*	*Hypolimnas bolina*	*Junonia orithya*	*Melanitis leda*	*Junonia atlites*
Catochrysops panormus	*Graphium doson*	*Papilio memnon*		*Melanitis phedima*	
Cepora iudith	*Jamides celeno*	*Zeltus amasa*		*Neptis hylas*	
Cirrochroa tyche	*Lexias pardalis*	*Zizina otis*		*Polyura athamas*	
Cyrestis themire	*Neptis harita*				
Eurema alitha	*Pachliopta antiphus*				
Eurema sari	*Pantoporia hordonia*				
Hidari irava	*Pseudocoladenia dan*				
Ideopsis juventa					
Junonia hedonia					
Mycalesis janardana					
Orsotriaena medus					
Papilio nephelus					
Pithecops corvus					
Tanaecia cocytina					
15	**8**	**4**	**1**	**4**	**1**

(√)HPNP	**(x)HPNP**	**(x)HP(√)NP**	**(x)HP(√)HPNP**	**(x)HPNP(√)HPNP**
Anthene lycaenina	*Euploea tulliolus*	*Caleta roxus*	*Eurema hecabe*	*Papilio demoleus*
Appias lyncida			*Graphium sarpedon*	
Catopsilia pomona			*Rapala manea*	
Catopsilia pyranthe			*Surendra vivarna*	
Cupha erymanthis				
Junonia iphita				
Leptosia nina				
7	**1**	**1**	**4**	**1**

Note: Description of the abbreviations see in the text

Table 7. Family of host and nectar plants associated with butterflies in the Padang Bindu Karst, South Sumatra, Indonesia

Host plant		**Nectar plant**	
Acanthaceae	Lauraceae	Asteraceae	Phyllanthaceae
Junonia hedonia	*Graphium sarpedon*	*Anthene lycaenina*	*Cupha erymanthis*
Junonia iphita	Malvaceae	*Appias lyncida*	Rubiaceae
Achariaceae	*Neptis hylas*	*Catopsilia pomona*	*Papilio demoleus*
Cirrochroa tyche	*Polyura athamas*	*Cupha erymanthis*	Verbenaceae
Amaranthaceae	*Rapala manea*	*Eurema hecabe*	*Appias lyncida*
Pseudocoladenia dan	Melastomataceae	*Hypolimnas bolina*	*Caleta roxus*
Annonaceae	*Tanaecia cocytina*	*Junonia atlites*	*Catopsilia pomona*
Graphium doson	Moraceae	*Junonia iphita*	*Catopsilia pyranthe*
Graphium sarpedon	*Chersonesia rahria*	*Leptosia nina*	*Eurema hecabe*
Arecaceae	*Cyrestis themire*	*Papilio demoleus*	*Junonia atlites*
Hidari irava	*Euploea tulliolus*	*Papilio memnon*	*Junonia iphita*
Aristolochiaceae	Pentaphylacaceae	*Rapala manea*	*Junonia orithya*
Pachliopta antiphus	*Tanaecia cocytina*	Commelinaceae	*Papilio demoleus*
Capparaceae	Phyllanthaceae	*Zizina otis*	Vitaceae
Appias lyncida	*Cupha erymanthis*	Fabaceae	*Eurema hecabe*
Appias olferna	*Eurema hecabe*	*Catopsilia pyranthe*	*Graphium sarpedon*
Cepora iudith	Piperaceae	Malvaceae	*Zeltus amasa*
Leptosia nina	*Ideopsis juventa*	*Junonia atlites*	*Leptosia nina*
Combretaceae	Poaceae	Melastomataceae	
Rapala manea	*Melanitis leda*	*Junonia atlites*	
Euphorbiaceae	*Melanitis phedima*	*Surendra vivarna*	
Graphium sarpedon	*Mycalesis janardana*		
Neptis hylas	*Orsotriaena medus*		
Fabaceae	Rhamnaceae		
Catochrysops panormus	*Caleta roxus*		
Catopsilia pomona	*Papilio demoleus*		
Catopsilia pyranthe	*Rapala manea*		
Eurema alitha	Rutaceae		
Eurema hecabe	*Papilio demoleus*		
Eurema sari	*Papilio nephelus*		
Jamides celeno	Salicaceae		
Neptis hylas	*Cupha erymanthis*		
Pantoporia hordonia	Sapindaceae		
Papilio demoleus	*Anthene lycaenina*		
Pithecops corvus	*Rapala manea*		
Polyura athamas	Urticaceae		
Surendra vivarna	*Neptis harita*		
Hypericaceae			
Eurema hecabe			
Lexias pardalis			
40 butterfly species		19 butterfly species	

Based on abiotic factors and vegetation data that can act as host plants and nectar plants, it is estimated that 154 butterfly species were found in the Padang Bindu Karst (Table 5). This number does not include the eleven species collected there, namely *Discophora necho* (Figure 15), *Graphium evemon*, *Losaria coon*, *Mahathala ariadeva*, *Mycalesis horsfieldi*, *Mycalesis orseis* (Figure 5G-H), *Neptis duryodana*, *Papilio iswaroides*, *Parantica aspasia* (Figure 7C), *Petrelaea dana*, and *Ypthima horsfieldii*. This is due to two reasons, namely (1) no records of host plants and nectar plants that support their existence based on our vegetation data (Table 2; Table 5) adjusted for the literature, or (2) from our vegetation data, it is most likely to support their presences, yet has not been reported in the literature.

The butterfly flight range can be quite far and it is possible that they can be found far from their host plants (Peggie and Amir 2006). Of the 58 identified butterfly species collected in the Padang Bindu, 47 species were categorized into 11 groups based on the occurrence of vegetations which can act as host plants and/or nectar plants (Table 6): (i) 15 species were in the same location with their host plants only [(√)HP]; (ii) Eight species in different location with their host plants [(x)HP]; (iii) Four spesies in the same location with their nectar plants only [(√)NP]; (iv) One species *Junonia orithya* in different location with its nectar plant [(x)NP]; (v) Four species in the same location with their host plants, but in other locations where food plants also available, the species are not found [(x)HP(√)HP]; (vi) One species *Junonia atlites* in the same location with its nectar plant, but in other location where nectar plant also available, the species is not found [(x)NP(√)NP]; (vii) Seven species in the same area with

their host plants and nectar plants [(√)HPNP]; (viii) One species *Euploea tulliolus* in different area with its host plant and nectar plant [(x)HPNP]; (ix) One species *Caleta roxus* in the same area with its nectar plant, but in different location with its food plant [(x)HP(√)NP]; (x) Four species in the same area with their host plants and nectar plants, yet in other areas where food plants are available, the species are not found [(x)HP(√)HPNP]; (xi) One species *Papilio demoleus* in the same area with its host plant and nectar plant at once in different area [(x)HPNP(√)HPNP].

Discophora necho (Figure 15) was one of the butterfly representatives whose host plant was not found in Padang Bindu Karst. Meanwhile, Hardy and Lawrence (2017) reported *Bambusa* sp. (bamboo) as its host plant, the same as *Discophora sondaica* which is one of the main pests for commercial bamboo plants (*Bambusa tulda* and *Bambusa pallida*) in Assam, India (Rishi et al. 2014). In the Padang Bindu Karst, *Discophora necho* was found around our basecamp (Putri Cave area) where behind the basecamp is the *Gigantochloa atter* bamboo forest. The currently known host plants for *Discophora sondaica* are *Arundinaria*, *Bambusa*, *Saccharum*, and *Schizostachyum* (Hardy and Lawrence 2017; Iqbal et al. 2021b). Almost of them are bamboo, so we expected that *G. atter* is the host plant for *Discophora necho*.

The relationship between butterflies and host plants is stronger than that of nectar plants (Curtis et al. 2015). Our data confirm this statement and predict the presence of butterflies in the Padang Bindu Karst to be higher in the vicinity of the host plant than in the nectar plants (Table 7). This is very reasonable because the survival of butterflies depends on the availability of food plants (Hellmann 2002; Peggie et al. 2021), yet nectar plants also play a role as food providers for adult butterflies, which may later affect fecundity, namely the ability of butterflies for reproduction (Curtis et al. 2015). The plants *Capparis micracantha* (Capparaceae) and *Oplismenus compositus* (Poaceae) are supposed to be the most widely used by butterflies as food (Table 5) in this preliminary survey. Interestingly, the two host plants are inhabited by different butterfly families, namely Pieridae and Nymphalidae, respectively. Meanwhile, *Chromolaena odorata* (Asteraceae) is supposed to be the nectar plant most frequently visited by butterflies. If viewed from the family level, the host plant which is supposed to be the most inhabited by butterflies is Fabaceae (Table 7). At least 11 species are presumed to use Fabaceae as food plants. The number of butterfly species in the Western Ghats, India, that utilizes the Fabaceae family of host plants is also the highest recorded, followed by Poaceae (Nitin et al. 2018). Meanwhile, Asteraceae is a nectar plant that is supposed to be the most frequently visited by butterflies. At least 12 species are expected to frequent the flower clusters. The research by Santhosh and Basavarajappa (2016) on four butterfly species (*Ariadne merione*, *Graphium agamemnon*, *Junonia hierta*, and *Papilio polytes*) showed that weed-type flowering plants were more frequently visited by them, and Asteraceae was the most visited plant family for its nectar source.

This preliminary survey has not yet featured the overall diversity of butterflies in the Padang Bindu Karst. However, we found a species that we consider rare, i.e., *Mahathala ariadeva*, and several individuals of the *Troides* species, which are protected species. The Padang Bindu Karst, which is a cultural heritage, can be preserved, among others, by observing the diversity of butterflies. The discovery of protected species and rare species is a good value for the karst area. Based on abiotic factors and recorded vegetation data that can act as host plants and/or nectar plants, the number of butterfly species in the Padang Bindu Karst is predicted to reach 2.79 times more than currently observed. An approach based on host plants and nectar plants, as well as abiotic factors to predict the occurrence of butterflies, is one of the butterfly conservation strategies that need to be supported by long-term observations.

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Peggie D. 2022e. *Losaria* Butterfly Specimens at Museum Zoologi Bogor, Indonesia. Research Center for Biology, Indonesian Institute of Sciences (LIPI), Bogor.
Peggie D. 2022f. *Pachliopta* Butterfly Specimens at Museum Zoologi Bogor, Indonesia. Research Center for Biology, Indonesian Institute of Sciences (LIPI), Bogor.
Peggie D. 2022g. *Papilio* Butterfly Specimens at Museum Zoologi Bogor, Indonesia. Research Center for Biology, Indonesian Institute of Sciences (LIPI), Bogor.
Peggie D. 2022h. Pierid Butterfly Specimens (Part 1: *Aoa*, *Belenois*, *Cepora*, *Prioneris*, *Saletara*) at Museum Zoologi Bogor, Indonesia. Research Center for Biology, Indonesian Institute of Sciences (LIPI), Bogor.
Peggie D. 2022i. Pierid Butterfly Specimens (Part 2: *Dercas*, *Gandaca*) at Museum Zoologi Bogor, Indonesia. Research Center for Biology, Indonesian Institute of Sciences (LIPI), Bogor.
Peggie D. 2022j. Pierid Butterfly Specimens (Part 3: *Appias*, *Elodina*, *Leuciacria*, *Udaiana*) at Museum Zoologi Bogor, Indonesia. Research Center for Biology, Indonesian Institute of Sciences (LIPI), Bogor.

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