Two new records of clearwing butterfly *Epityches eupompe* (Geyer, 1832) aggregations in Brazilian Atlantic Forest (Nymphalidae, Ithomiini)

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Abstract: A massive aggregation of the clearwing butterfly *Epityches eupompe* (Nymphalidae, Ithomiini) was reported in 2017 at Intervales State Park, São Paulo State, Brazil, with another record at Corupá, Santa Catarina State. In 2023, similar aggregations of this species were observed in two new locations in Brazil: Quilombinho River, Santos, São Paulo State; and Serra da Baitaca State Park, Anhangava, Paraná State. All four observations happened during winter, in Ombrophilous Dense Forest localities of the Serra do Mar mountain range, near streams. The lethargic behavior of the adults and the lack of larval hostplants, signs of herbivory, or other mass emergence evidence, suggest that these aggregations do not reflect areas of growth and reproduction but instead provide climatic protection for adult butterflies. To increase public awareness, we will launch a citizen science campaign to gather knowledge about whether members of the public have seen this phenomenon elsewhere and promote these aggregations as spectacular biological phenomena with ecotourism potential, similar to Monarch butterfly aggregations. We highlight how sustainable tourism can bring people and nature closer together, aiming to benefit both parties.

Key words: ecotourism; ithomiine pocket; microclimatic refugee; Monarch butterfly; Nymphalidae; roosting.

Resumo: Uma agregação em massa da borboleta asa-de-vidro *Epityches eupompe* (Nymphalidae, Ithomiini) foi reportada em 2017 no Parque Estadual Intervales, São Paulo, com outro registro em Corupá, Santa Catarina. Em 2023, agregações semelhantes desta espécie foram observadas em duas novas localidades: Rio Quilombinho, Santos, São Paulo; e Parque Estadual da Serra da Baitaca, Anhangava, Paraná. Todas as quatro observações ocorreram durante o inverno, em localidades de floresta ombrófila densa da Serra do Mar, próximas a riachos. O comportamento letárgico e a falta de plantas hospedeiras, sinais de herbivoria ou outras evidências de emergência em massa sugerem que a agregação não reflete áreas de crescimento e reprodução, mas talvez forneça proteção climática aos adultos. Para aumentar a sensibilização do público, lançaremos uma campanha de ciência cidadã para levantar informações, perguntando se o público viu esse fenômeno em outros locais, promovendo-o como o equivalente ecoturístico à agregação da borboleta monarca. Destacamos como o turismo sustentável pode aproximar pessoas e natureza, para o benefício de ambos.

Palavras chave: bolsão de ithomíneos; borboleta monarca; dormitório; ecoturismo; Nymphalidae; refúgio microclimático.

Adult butterfly aggregations happen in different flavors. For example, multiple species can aggregate for resource exploitation (*e.g*. mud-puddling behavior; Beck *et al*., 1999; Boggs & Dau, 2004), reproduction (*e.g*. hilltopping; Baughman & Murphy, 1988), anti-predator defense (*e.g*. communal roosting; Benson & Emmel, 1973; Brown, 1981; DeVries *et al*., 1987; Sourakov, 2007; Finkbeiner *et al*., 2012), and dry-season protection (*e.g*. ithomiine pockets; Kitching & Zalucki, 1981; Ivie, 1990; Pinheiro *et al*., 2008; Shirai *et al*., 2017). These aggregations can have various levels of fidelity to the location or to the group of individuals/species, and different sizes, from dozens to hundreds of individuals. More remarkably, single-species aggregations occur sometimes in massive numbers, from thousands to millions of individuals. Among single-species butterfly aggregations with a migratory character, perhaps the most iconic are: 1) the Monarch (*Danaus plexippus* (Linnaeus, 1758)) butterfly aggregation, that confers climatic protection associated with migration (Brower & Calvert, 1985); and 2) the longest known butterfly migration (> 4,000 km in a single generation) by the Painted Lady (*Vanessa cardui* (Linnaeus, 1758)), from Africa to Europe, crossing the Sahara Desert (Talavera & Vila, 2017).

We previously reported massive aggregations of tens of thousands of *Epityches eupompe* (Geyer, 1832) in Brazil, at Intervales State Park, São Paulo State, and near Corupá, Santa Catarina State (Shirai *et al*., 2017). Here, we report two new

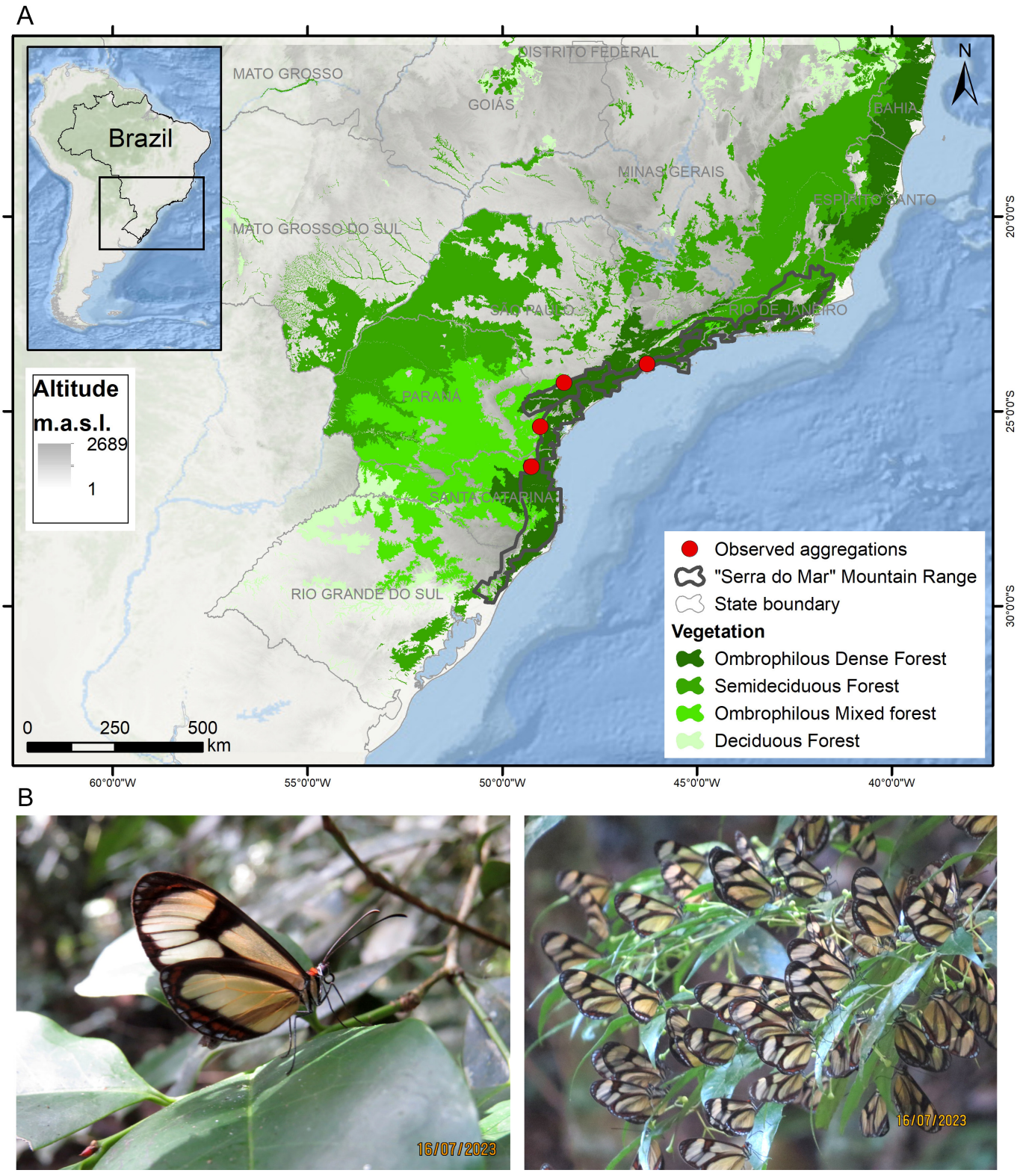

Figure 1. (A) All known *Epityches eupompe* aggregations occur in Ombrophilous Dense Forest at the Serra do Mar mountain range, from upper right to lower left: Quilombinho River, São Paulo; Intervales State Park, São Paulo; Serra da Baitaca State Park, Paraná; and Corupá, Santa Catarina. (B) Butterflies found at Anhangava - images by IS.

localities of *E. eupompe* aggregations, similar in numbers of individuals, both observed in July 2023, at Quilombinho River, Santos, São Paulo State; and Serra da Baitaca State Park, Anhangava, Paraná State (Fig. 1). All four observations happened during winter, near streams, in Ombrophilous Dense Forest (IBGE, 2012) of the largest continuum of Atlantic Forest, at the Serra do Mar mountain range.

The Quilombinho River aggregation was in an isolated trail at around 500 m above sea level, about halfway between the lowlands and the plateau of the Serra do Mar. Trekkers

found this aggregation and communicated through the social media account of the AVLF lab (https://instagram.com/labbor_unicamp). According to Köppen's climate classification, the area has a Cfa climate, Humid Subtropical, influenced by the ocean, without a dry season and with a hot and humid summer, and cool to mild winters (Peel *et al*., 2007; Alvares *et al*., 2013). Mean temperatures of the coldest month are 15.3 ºC and of the hottest month are 22.0 ºC, with annual precipitation of 2,863 mm (Hijmans *et al*., 2005; Worldclim, 2020). This slope area is sheltered between two mountain ranges around 1,000 m high, and has Sub-montane Ombrophilous Dense Forest (IBGE, 2012) with many creeks, close to the Quilombo River.

The Anhangava aggregation was found while IS was trekking at the Serra da Baitaca State Park (Fig. 1B). This park has 3,053.21 hectares, with minimum temperature of -5 °C, an annual average of 13.4 ºC and absolute maximum of 30°C (Roderjan & Grodski, 1999), and includes three vegetation types: Cloud Forest, Alto-montane Ombrophilous Dense Forest, and High-altitude Grassland. Similar to the observations at Intervales, butterflies showed a lethargic behavior, hanging in large clusters and resting at several heights from understory to canopy. If disturbed, immense numbers of butterflies took off and flew, rapidly resuming their resting position once the disturbance passed. Also similar to Intervales, the Anhangava aggregation had no evidence of larval hostplants, herbivory or signs of mass larval emergence.

The coastal region of the Brazilian Southeast is very humid, so moist and sheltered areas are apparently needed for these Atlantic Forest butterflies, and probably more so when winters are windy and drier than usual, acting as a microclimatic refugee. As previously stated, these aggregations of tens of thousands of lethargic *E. eupompe* adults are different from typical ithomiine pockets, since *E. eupompe* aggregations are not composed of multiple species, the individuals are more numerous, and there is little activity involved, such as feeding and reproduction (Shirai *et al*. 2017), despite microclimatic protection being important in both. As far as we know, single-species aggregations in Ithomiini only occur in *E. eupompe* (Shirai *et al*., 2017) and *Episcada hymenaea* (Prittwitz, 1865) (Strickman, 1981; Quinteros & Núñez Bustos, 2018), based on the following literature review. We checked every Google Scholar result using the search term "aggregation" added to every ithomiine genus name listed in the "Butterflies of America" (Warren *et al*., 2023), also searching for the subjective synonyms *Placidina* d'Almeida, 1928 and *Aremfoxia* Real, 1971. We performed individual searches for each genus and, in some cases, we added the term "butterfly" for a more specific filter (*e.g*., for *Aeria* Hübner, 1816, *Athesis* E. Doubleday, 1847, and *Olyras* E. Doubleday, 1847). We found evidence for aggregations only in these two species and, while we cannot confirm that they represent the exact same phenomenon, these single-species aggregations are presumably independently derived in these members of two different subtribes.

To address the lack of information about these kinds of butterfly aggregations, we will launch a citizen science campaign via our social media profiles (Instagram: @labbor_unicamp, @leshirai, @israelschneiberg, @renato.rogner, @andre.roc, @juniayoc, @insecnideos), as well as at the two State Parks involved, based on flyers and videos (publicly available at https://www.youtube.com/watch?v=ZYLeJ2ttY4E, https://www.youtube.com/shorts/ypTzkT2YBQE, https://www.youtube.com/shorts/Y9p--n7cBl8). We had previously suggested that the participation of both scientists an d amateurs could help find other localities for *E. eupompe* aggregations (Shirai *et al*., 2017). This idea has led to the present paper, with non-scientists (see Acknowledgments) and a non-butterfly scientist (IS) communicating their observations, obtained while trekking in the forest. By uniting our interests, we agreed to engage with a wider public, aiming to increase public awareness about biological phenomena like this.

Epityches eupompe aggregations have the potential to become a significant ecotourism attraction in the Atlantic Forest, similar to the Mexican Monarch aggregations. The phenomenon is biologically somewhat different, since we do not yet have any evidence that *E. eupompe* aggregations involve migration and overwintering (Shirai *et al*., 2017), and *E. eupompe* aggregations occur over a much broader area than those of the Monarch. We think it is likely that other *E. eupompe* aggregations exist throughout the species range, from Bahia to Rio Grande do Sul States (d'Almeida, 1938; Brown, 1979), so the citizen science campaign focuses on inspiring the public to report aggregations, along with bringing attention to this fascinating phenomenon. In our experience, observers (including non-scientists) who have witnessed this spectacle have reported it to be one of the most beautiful and magical things that they had ever seen. An impact of such magnitude has strong potential to bring humans closer to nature, which is essential to increase biophilia (Wilson, 1984) and bioliteracy (Janzen, 2010), and decrease biophobia (Vanderstock *et al*., 2022) and environmental apathy (Shirai *et al*., 2022).

While we believe that *Epityches* aggregations could become an ecotourism attraction, clearly it is important to minimize negative impacts on the butterflies. We still argue that this phenomenon might be vulnerable to human disturbance, although it is reassuring to see there are more than we previously knew about. The Intervales aggregation is the only one we know that is recurring: it was first observed in 2013, reassessed in 2017 (Shirai *et al*., 2017), and has been followed yearly ever since (Thiago B. Conforti, pers. comm.). We cannot be sure for how long *E. eupompe* will remain in each of the four places we reported, but we strongly encourage that any action towards these aggregations should be careful, respectful, and sustainable.

Intervales and Anhangava are both protected areas, but hiking is the main attraction of Serra da Baitaca State Park, with trails within a forest that lead to the summit climb (elevation 1,420 m). One of the access trails crosses a small seasonal water body, which is the location where IS found the aggregation. Hundreds of people pass through this trail and may have their attention drawn when butterflies are flying. In such an exposed location, it could be important to restrict access to this portion of the trail, but highlight that the phenomenon occurs there, promoting the observation through binoculars or even through cameras. We will attempt to engage with local land-use managers to discuss appropriate plans for the public to access, view, and experience these aggregations without causing unnecessary

disturbance at Anhangava. At Intervales, where the trail is more protected, the observation could be done closer to the butterflies but still without unnecessary disturbances, such as provoking their flight. When birds vocalize or branches fall in the forest, the butterflies fly by the hundreds or by the thousands, so we suggest instead to quietly observe it, for as long as it takes. We also encourage spreading images and videos, along with information aiming to share and impress others by the sheer natural beauty of this phenomenon.

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LITERATURE CITED

Alvares, C. A., Stape, J. L., Sentelhas, P. C., Gonçalves, J. L. M., Sparovek, G. 2013. Köppen's climate classification map for Brazil. *Meteorologische Zeitschrift* 22: 711-728.

Baughman, J. F., Murphy, D. D. 1988. What constitutes a hill to a hilltopping butterfly? *American Midland Naturalist* 120(2): 441-443.

Beck, J., Mühlenberg, E., Fiedler, K. 1999. Mud-puddling behavior in tropical butterflies: in search of proteins or minerals? *Oecologia* 119: 140-148.

Benson, W. W., Emmel, T. C. 1973. Demography of gregariously roosting populations of the nymphaline butterfly *Marpesia berania* in Costa Rica. *Ecology* 54: 326-335.

Boggs, C. L., Dau, B. 2004. Resource specialization in puddling Lepidoptera. *Environmental Entomology* 33(4): 1020-1024.

Brower, L. P., Calvert, W. H. 1985. Foraging dynamics of bird predators on overwintering monarch butterflies in Mexico. *Evolution* 39(4): 852-868.

Brown, K. S. 1981. The biology of *Heliconius* and related genera. *Annual Review of Entomology* 26: 427-457.

Brown, K. S. 1979. *Ecologia geográfica e evolução nas florestas neotropicais*. Livre docência thesis. Campinas, Universidade Estadual de Campinas. xxxi + 265 pp.; Appendices: 120 pp.

d'Almeida, R. F. 1938. Estudo sobre tres generos da sub-familia Ithomiinae (Lepid.: Rhop.). *Memórias do Instituto Oswaldo Cruz* 33: 381-399.

deVries, P. J., Schull, J., Greig, N. 1987. Synchronous nocturnal activity and gregarious roosting in the neotropical skipper butterfly *Celaenorrhinus fritzgaertneri* (Lepidoptera: Hesperiidae). *Zoological Journal of the Linnean Society* 89: 89-103.

Finkbeiner, S. D., Briscoe, A. D., Reed, R. D. 2012. The benefit of being a social butterfly: communal roosting deters predation. *Proceedings of the Royal Society B: Biological Sciences* 279(1739): 2769-2776.

Hijmans, R. J., Cameron, S. E., Parra, J. L., Jones, P. G., Jarvis, A. 2005. Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology* 25: 1965-1978.

Instituto Brasileiro de Geográfica e Estatística (IBGE). 2012. *Manual Técnico da Vegetação Brasileira*. IBGE, Rio de Janeiro. 275 pp.

Ivie, M. A, Philips, T. K., Johnson, K. A. 1990. High altitude aggregations of *Anetia briarea* Godart on Hispaniola (Nymphalidae: Danainae). *Journal of the Lepidopterists' Society* 44: 209-214.

Kitching, R. L., Zalucki, M. P. 1981. Observations on the ecology of *Euploea core corinna* (Nymphalidae), with special reference to an overwintering population. *Journal of the Lepidopterists Society* 35: 106-119.

Janzen, D. H. 2010. Hope for tropical biodiversity through true bioliteracy. *Biotropica* 42: 540-542.

Peel, M. C., Finlayson, B. L., Mcmahon, T. A. 2007. Updated world map of the Köppen-Geiger climate classification. *Hydrology and Earth Systems Sciences* 11: 1633-1644.

Pinheiro, C. E. G., Medri, I. M., Salcedo, A. K. M. 2008. Why do ithomiines (Lepidoptera, Nymphalidae) aggregate? Notes on a butterfly pocket in central Brazil. *Revista Brasileira de Entomologia* 52(4): 610-614.

Quinteros, R., Núñez Bustos, E. O. 2018. Una enorme congregación de *Episcada hymenaea* (Lepidoptera: Nymphalidae: Danainae) en las yungas del norte de Salta, Argentina. *Acta Zoológica Lilloana* 62(2): 44-50.

Roderjan, C. V., Grodski, L. 1999. Acompanhamento meteorológico em um ambiente de Floresta Ombrófila Densa Altomontana no morro Anhangava, município de Quatro Barras - PR, no ano de 1993. *Cadernos da Biodiversidade* 2(1): 27-34.

Shirai, L. T., Mota, L. L., Freitas, A. V. L. 2017. Aggregation of *Epityches eupompe* (Nymphalidae: Ithomiini) in southern Brazil. *Tropical Lepidoptera Research* 27(2): 111-114.

Shirai, L. T., Stanton, M. A., D'Angelo, G. B., Conforti, T. B., Freitas, A. V. L., Kato, M. J., Yamaguchi, L. F. 2022. Interaction gardens and butterfly catalogues: a joint strategy to promote capacity development in protected areas and reduce the extinction of experience in cities. *Cities and the Environment* 15(1): 3.

Sourakov, A. 2007. Dominican Republic - notes on evolution of butterflies and of our knowledge about them. *News of Lepidopterists' Society* 49: 46-55.

Strickman, D. 1981. Observation of an aggregation of *Episcada hymenaea* Prittev. (Ithomiidae) in Paraguay. *Journal of the Lepidopterists' Society* 35(2): 158.

Talavera, G., Vila, R. 2017. Discovery of mass migration and breeding of the painted lady butterfly *Vanessa cardui* in the Sub-Sahara: the Europe-Africa migration revisited. *Biological Journal of the Linnean Society* 120(2): 274-285.

Vanderstock, A., Grandi-Nagashiro, C., Kudo, G., Latty, T., Nakamura, S., White, T. E., Soga, M. 2022. For the love of insects: gardening grows positive emotions (biophilia) towards invertebrates. *Journal of Insect Conservation* 26:751-762.

Warren, A. D., Davis, K. J., Stangeland, E. M., Pelham, J. P., Willmott, K. R., Grishin, N. V. 2023. *Illustrated Lists of American Butterflies*. [23-VI-2023] http://www.butterfliesofamerica.com.

Wilson, E. O. 1984. *Biophilia: The human bond with other species*. Harvard University Press, Cambridge. 157p.

WorldClim. 2020. *WorldClim - Global Climate Data. Free climate data for ecological modeling and GIS*. www.worldclim.org.