Scientific Note: Aggregation of *Epityches eupompe* (Nymphalidae: Ithomiini) in southern Brazil

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**Abstract:** An aggregation of thousands of adults of the ithomiine butterfly *Epityches eupompe* was observed in June-July 2017 at Intervales State Park, São Paulo State, Brazil, with another observation from an amateur naturalist at Corupá, Santa Catarina State, Brazil in September 2006. These aggregations have only been seen during winter, and they may function to provide protection from colder and/or drier climates. The phenomenon has never been previously documented. To publicize these novel observations, a short 1:32 min outreach video was produced and may be viewed via the internet at https://youtu.be/bUO4kpYS2uo, and downloaded from http://doi.org/10.5281/zenodo.1040325.

**Key words:** Paranapanema, Atlantic Forest, ithomiine pocket, citizen science


**Palavras chave:** Paranapanema, Mata Atlântica, bolsão de ithomiine, ciência cidadã

The ithomiine butterfly *Epityches eupompe* (Geyer, 1832) (Nymphalidae: Danainae, Fig. 1) is endemic to the Neotropical Atlantic Forest, occurring in forests with different degrees of disturbance from south Bahia to Argentina (Brown, 1979). It occurs from sea level (e.g., Freitas, 1996) to 2000 m altitude (e.g., Soares *et al.*, 2011), but *E. eupompe* is particularly common from 600 m to 1100 m (d’Almeida, 1938; AVLIF, pers. obs.). From 12th-15th June and on 22nd July 2017, an aggregation of thousands of adult *E. eupompe* was observed at Intervales State Park, in the south of São Paulo State, in southern Brazil (Figs. 1A-C; 24° 15’ 56”S, 48° 24’ 48”W). With 42,000 ha of predominantly dense montane ombrophilous forest, the park contains one of the largest continuous areas of Atlantic Forest (Ribeiro *et al.*, 2009), summing up to more than 120,000 ha in conjunction with the contiguous Carlos Botelho and PETAR State Parks, and the Xitué Ecological Station (Nisi, 2006; Leonel, 2010). The name “Intervales” means “between valleys” (Fig. 1A), in reference to the neighboring mountains that, despite being relatively low (up to 1200 m), may reach temperatures close to 0 °C during winter. The aggregation was observed at a particular site at 791 m altitude, 33 m above a river running from a nearby waterfall in a slope facing west (Figs. 1B, C), in a trail through primary forest opened 12 years ago but unused due to its difficulty. The aggregation was first noticed in 2013 by the personnel involved in trail maintenance and was seen every year since (Ribeiro, F. A. & Conforti, T. B., pers. comm.). *Epityches eupompe* (Fig. 1D) formed the aggregation from May to June as soon as the temperature decreased significantly (usually marked by frost), and dispersed from July to August (Ribeiro, F. A., Floido, J. & Amaral, B., pers. comm.).

Adults were observed hanging and perching at several heights from canopy to understory, on branches and tree trunks of different plant species, none of which were its known solanaceous host plants (Brown, 1987), nor presented any traces of herbivory (Fig. 1E, F). The butterflies stayed motionless for most of the time, with periods of increased activity from 11:00 to 14:00 (see movie at https://youtu.be/bUO4kpYS2uo), but only when the air temperature increased and there was no heavy rain. When sounds of breaking or falling branches and birds in the near vicinity were heard, some individuals flew but soon resumed their resting behavior, returning to the same plant or another plant on which they had previously perched. In addition, there were no flowering plants *in situ* and in surrounding areas, except for bromeliads in the upper levels of the forest, where *E. eupompe* was not observed feeding. Local guides reported that the butterflies prefer the understory when the temperature is “warm” (above 16°C), but otherwise they stay in the canopy.

A small mark-release-recapture sampling was carried out in June 2017. A total of 30 *E. eupompe* adults were marked (all young, judging from the degree of wing wear, and showing no signs of predation) with a blue permanent felt-tipped pen and individual characteristics were recorded (as in Freitas, 1996; Ramos & Freitas, 1999). Each individual received a unique symbol corresponding to each of the seven plant individuals from which they were collected, and an additional unique sequential number. The mean forewing length was 2.81 cm for females (SD = 0.11 cm, n = 25) and 2.68 cm for males (SD = 0.13 cm, n = 5). By exhaustive search with binoculars, a single marked individual was observed *in situ*, on a different plant from where it was collected, and only in July 2017.
Figure 1. A. General view of Intervales State Park showing the large extent of well-preserved forest (photo by Marco A. Pizo, used with his permission); B, C. close view of the area adjacent to the aggregation site (see text for details); D. male *Epityches eupompe* feeding on an Asteraceae flower; E, F. aggregation of *E. eupompe* on a bush in the understory and on a tree trunk near the canopy, respectively. See also the companion video at https://youtu.be/bUO4kpYS2uo.
The aggregation was apparently not related to reproduction since only a single mating pair was observed during five days of observations in June and July 2017. The near absence of mating, together with the lack of males displaying their hindwing androconial hair pencils, indicate that the aggregation does not correspond to a mating lek. Ithomiini butterflies are also known to form aggregations called “ithomiine pockets,” where several species are found in specific sites with high humidity during the dry season (Collenette & Talbot, 1928; Brown, 1972; Young, 1974; Brown & Vasconcellos-Neto, 1976; Pinheiro et al., 2008). However, Intervales does not have marked rainfall seasonality (observations in June had rain every day, as did the weeks leading up to these observations), preventing the establishment of such pockets (see Freitas, 1996). In fact, all other Ithomiini species observed at Intervales did not form aggregations during the study period, nor in other years and seasons (LTS and AVLF pers. obs.), and only three individuals of Mechanitis lysimnia were seen together with the thousands of E. eupompe. The latter species is one of the 20 ithomiine species recorded at the park, which include Aeria olena, Callithomia lenea, Direcenna dero, Episcada carcinia, Episada hymenaea, Episada philoclea, Episadas stepposis, Hypoliera adasa, Hypothyris niniona, Ithomia agnosis, Ithomia drymo, Ithomia lichyi, Mechanitis lysimnia, Melinæa ethra, Melinæa ludovica, Oleria aquata, Placidina euryanassa, Pseudoscada erruca and Pteronymia carlia (data from field collections by LTS and AVLF, and specimens at the “Adão José Cardoso” Zoology Museum, Unicamp). Additionally, E. eupompe was collected at other places within the park and in other months of the year (December to April, when field expeditions were made by LTS and AVLF, deposited in the Zoology Museum, Unicamp under numbers ZUEC-LEP 683, 684, 832, 880, 1267, and 10253-10262), but never with this unusual high abundance. It is likely that populations aggregate in other places of the park, but we cannot point to likely factors that facilitate finding them elsewhere, except for seeking undisturbed forest that lies at a reasonable distance from well-used trails. Similar aggregations were observed by AVLF in 1992 near “Pousada Capivara” at Intervales, and an amateur lepidopterist informed us about a huge aggregation of E. eupompe observed on 7th September 2006, in a forest near to Corupá city, Santa Catarina State (100 – 200 m altitude), about 255 km south of Intervales. It cannot be ascertained whether the population at Intervales migrates south, over such a large distance, but we encourage the participation of both scientists and amateurs, in the context of citizen science (Silvertown, 2009), to report to us any relevant observations that might help us to understand this and similar natural phenomena before they disappear (Young, 1974; Davis, 2015).

Insects frequently surprise us with sudden or cyclic demographic explosions. These population increases may be related to reproduction (e.g., periodical 13- and 17-year cicadas: Alexander & Moore, 1962; Cooley & Marshall, 2001), abundance of host plants (e.g., cricket clouds in monoculture plantations: Drummond & Brown, 1987), and climatic protection associated with migration (e.g., adult hibernation in Mexico during the North American Monarch butterfly migration: Brower & Calvert, 1985; and in Dominican Republic by Anetia briarea: Ivie et al., 1990). Single-species aggregations associated with migratory movement are common in several butterfly groups, such as Danaus plexippus (Brower & Calvert, 1985; Davis, 2015), Nymphalis californica (Whittaker, 1953), and Vanessa cardui (Knowlton, 1954; Talavera & Vila, 2017). An aggregation has been reported for the ithomiine Episada hymenaea, in July 1979 in Paraguay, but the study did not relate it to an ithomiine pocket or migratory movement; it similarly reported a lack of evidence for oviposition and mass emergence (Strickman, 1981). Transparent Ithomiini species are not known to migrate large distances, although opaque, colored ithomines may do so, according to Brown (1977), so we suggest that the observed E. eupompe aggregation is likely related with climatic protection from colder and/or drier weather experienced in nearby areas. If that is the case, the appropriate micro-climate that these thousands of butterflies are able to find year after year is likely dependent on habitat preservation over the large extent that is (still) found at Intervales (Ribeiro et al., 2009; Ribeiro & Freitas, 2014). One approach to understanding this phenomenon could include a phylogeographical analysis using fast-evolving molecular markers (microsatellites or mitochondrial genes) of individuals from this and other populations, especially southwards and at different altitudes, including a visit to Corupá region to assess whether the population observed there still remains, and if it is related to the one at Intervales. If this were to be pursued, recording climatic variables in situ and at nearby sites over months is also desirable. Further mark-recapture studies are not recommended because numerous individuals (certainly more than 30) would need to be sampled and reducing the impact of human presence is perhaps more important than the result of such an experiment. Following this rationale, visits to the site should be maintained as infrequent as they are or become further restricted, but allowing this natural phenomenon to be seen without disturbing it is also important. Thus, a short video aimed at the general public was produced by LTS, and is available at https://youtu.be/bUO4kpYS2uo, http://doi.org/10.5281/zenodo.1040325, or https://vimeo.com/223507916/68acdd08f0.

ACKNOWLEDGMENTS

We would like to thank the Parque Estadual de Intervales staff: Eliseu Cordeiro de Paula for providing meteorological data; local guides Faustino A. Ribeiro, José Fadio, and Benedito Amaral and the director Thiago B. Conforti for informing us about the phenomenon and their outstanding assistance. Marco A. Pizo kindly gave us permission to use his image of Intervales. Marianne Elias, Lucas A. Kaminski, and Keith Willmott improved the final version of the manuscript with critical suggestions. We are also grateful to Grasiela Casas and Alexandra Bächtold who told us about, and photographed, the E. eupompe aggregation in Corupá, Santa Catarina; Daniel Carezzato de Almeida for editing the short video; Tamara M. C. Aguiar, Artur N. Furegatti, and Michela Borges for their assistance at the Zoology Museum, Unicamp; and Julia L. Pablos for helping during the June field trip. This study was done under environmental licenses ICMBio 8585-1 (sol. 10438) and COTEC 260108-004.611/2016. AVLF thanks CNPq (grant 303834/2015-3), RedeLep-SISBIOTA-Brasil/
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