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Nota Científica
(Short Communication)

REMARKS ON THE DAILY RHYTHM OF LEPIDOPTERA IN *SIMSIA AMPLEXICAULIS* (CAV.) (ASTERACEAE) IN A CLOUD FOREST OF VERACRUZ STATE, MEXICO

Hernández-Baz, F., González, J. M., Carmona Valdovinos, T. & Castro Bobadilla, G. 2014. Observaciones sobre el ritmo diurno de Lepidoptera en *Simsia amplexicaulis* (Cav.) (Asteraceae) en el bosque nublado del estado de Veracruz, México. *Acta Zoológica Mexicana (n. s.),* 30(2): 414-421.

ABSTRACT. A total of 424 Lepidoptera specimens (256 males, 168 females) visiting flower patches of *Simsia amplexicaulis* were collected. They were found to belong to six families within three superfamilies representing a total of 23 species: Papilionoidea: Pieridae (2 species), Lycaenidae (1 species), Riodinidae (2 species), Nymphalidae (6 species); Hesperioidea: Hesperiidae (11 species); and Noctuoidea: Erebidae (1 species). The temporal distribution of these lepidopterans shows a peak of species visiting a patch of flowers between 12:00 and 13:00. Twenty five of the species (93%) were recorded during such activity hourly peak while only two species were found visiting the flowers during most of the day. Twenty species (74%) visited the flowers only once. As far as we know, this is the first time that *Cuanopepla bella* (Ctenuchidae) is reported visiting flowers of *Simsia amplexicaulis*.

The basic ecological function of adult Lepidoptera is pollination (Scott 1986, Scoble 1995). Unfortunately, not much is known about the entomophylous properties of plant species from México, and even less about their insect pollinators, especially butterflies (psychophily) and moths (phalaenophily). Pollinators are highly diverse and they are present in several ecosystems occupying various spaces and temporal dimensions (Abrol 2013, Faegri & Van der Pijl 1979). Either large or small pollinators could be equally efficient depending on the plant they will frequent to pollinate (Proctor *et al*. 1996, Wilson & Thomson 1996). Most pollinators are generalists and very few are known to be species-specific (Gómez 2002). Without any exception all pollinators perform their pollinating function, however not much is known about how efficient the many pollinator species really are.

The size and shape of the flowers clearly influence the type of pollinator that tackles them, but in the case of the small flowers, even though they might be visited

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by numerous groups of insects, they are mainly visited by bees and butterflies/moths (Abrol 2012, Herrera 1988, Vaughton & Ramsey 1998, Valiente-Banuet 2002).

The daily inflow rhythm of insects towards flowering plants may occur during the course of one day (24 hours), but the flying activity of insects that pollinate plants during light hours has been more frequently recorded (Abrol 2012, Proctor *et al*. 1996). But what happens during the night hours? What is the temporal rhythm of those insects that pollinate at night? This is a question that needs to be addressed and we should expect answers in the future. In this particular work we address such questions on some lepidopterans who visit flowers and inflorescences whose morphological structures are adapted to be pollinated only by this group of insects (Abrol 2012, Aguilar 1965).

Simsia (Asteraceae) is a genus of herbs and shrubs that contains some 20-25 species distributed in arid and semiarid regions from Southwestern United States south through Central and South America to Argentina (MacVaugh 1984). The greatest diversity of the genus occurs from Central Mexico to Panama, and nine different species have been reported from the state of Veracruz in Mexico (Sosa & Gómez-Pompa 1994). *Simsia amplexicaulis* is a widespread species that is frequently found along roads and agricultural lands, but also along ecotones of highland pine-oak to cloud forests (Spooner 1990). This is an herbaceous-shrubby plant that can grow up to 3 m high, and bears flowers all year long, but most especially from August to November. The flower heads have diameters from 20 to 35 mm, with 8 to 14 ray florets, orange-yellow 80 to 150 mm long and 25 to 55 disc florets of the same color and 50 to 70 mm long (Calderón & Rzedowsky 2004; Spooner 1990).

This plant species is frequently visited by numerous insects throughout the day, thus our aim with this work was to study, determine, quantify and analyze the Lepidoptera species that visit *S. amplexicaulis* flowers in the Cloud forests of the Central region of Veracruz State.

Random walks were done along the Coatepec-Zimpizahua región to detect the plants or group of plants with the largest amount of butterflies visiting their flowers. A group of 8 plants of uniform size of about 1.5 m located at a roadside, in an ecotone with the cloud forest, and besides a Coffee-Inga plantation (*Coffea arabica*, Rubiaceae – *Inga jinicuil*, Fabaceae), east of the Coatepec-Xico Road. West and south of the plant patch there is a relict cloud forest *sensu stricto* (Castillo-Campos 1991; Zolá 1987). The site is located at 1100 m, N 19º 27′ 12′′, W 96º 57′ 24′′. The site was selected mainly because it is surrounded by several ecosystems. Its closeness to the cloud forest (West and South) promotes some shade to 25% of the flowers of the plant´s patch.

Lepidopterans species visiting plants in the chosen patch during an 8 h period (8:00 – 16:00) on October 10, 2009 were collected. All visitors were noted, and collected as well as the hour when collected. All data and relevant information was

recorded in a field notebook. Insects were collected using an entomological net as described by Beutelspacher (1991). Once collected the insects were placed in jars containing Ethyl Acetate and the insect material was gathered and processed according to Steyskal *et al*. (1986). Once in the laboratory, they were mounted and spread according to techniques described by Chacón & Montero (2007).

Plants were identified using MacVaugh (1984) keys, and later corroborated with specimens deposited at the XALU herbarium, of INECOL (Instituto de Ecología) in Xalapa, Veracruz. Insects were identified based on Hernández-Baz *et al*. (2010) (Papilionoidea), Glassberg (2007) (Hesperiidae) and Hernández-Baz (2012) (Erebidae: Ctenuchina). All specimens were collected under the Scientific Collector License code: FAUT-0194 and deposited at the Insect Collection SEMARNAT/CITES/CP-0026-VER/05. A chart was elaborated in order to present the list of visitors by hour. All study material was photographed once mounted.

A total of 424 Lepidoptera specimens were collected, of which 256 were males and 168 were females. They were grouped in three Superfamilies and included in 6 families representing 23 species: Papilionoidea: Pieridae (2 species), Lycaenidae (1 species), Riodinidae (2 species), Nymphalidae (6 species); Hesperioidea: Hesperiidae (11 species); and Noctuoidea: Erebidae (1 species). This last species is actually a wasp moth (Ctenuchina) with recognized diurnal habits. All species collected are shown in Plate 1.

The temporal distribution of the species is presented in Table 1. The peak of species visiting the patch of flowers was between hours 12:00 – 13:00 (Table 1). Twenty five of the species (93%) were recorded during that peak hour while only two species (*Pteronymia artena artena*, Nymphalidae and *Achlyodes pallida*, Hesperiidae) visited the flowers during most of the day. Twenty species (74%) visited the flowers only once. As far as we know, this is the first time that *Cyanopepla bella* (Ctenuchidae) is reported visiting flowers of *S. amplexicaulis*.

Even though *S. amplexicaulis* flowers are small, they appear to produce large amounts of nectar (Calderón & Rzedowsky 2004). This seems to be corroborated by the large amount of visits done by butterflies and moths during an eight h period. Curiously enough 74% of the visitors went to the flowers only once, while only two species (7.4%) behaved as constant visitors throughout the day. This pattern has been noticed before with other plant species (Horvitz & Schemske 1990) and appears to indicate that generalist pollinators tend to be more frequent and numerous. This is especially true in the case of skippers (Hesperiidae). Based on the type of visits and visitors, we might assume that the plant is a generalist, which qualifies it as primitive (Ollerton 1999) and far from being a pollinator specialized plant as defined by Janzen (1980) and Gómez (2002).

The patch locations favored the presence of *Pteronymia artena artena* (Nymphalidae) during all day. Most skippers (Hesperiidae) visited the lower flowers (<

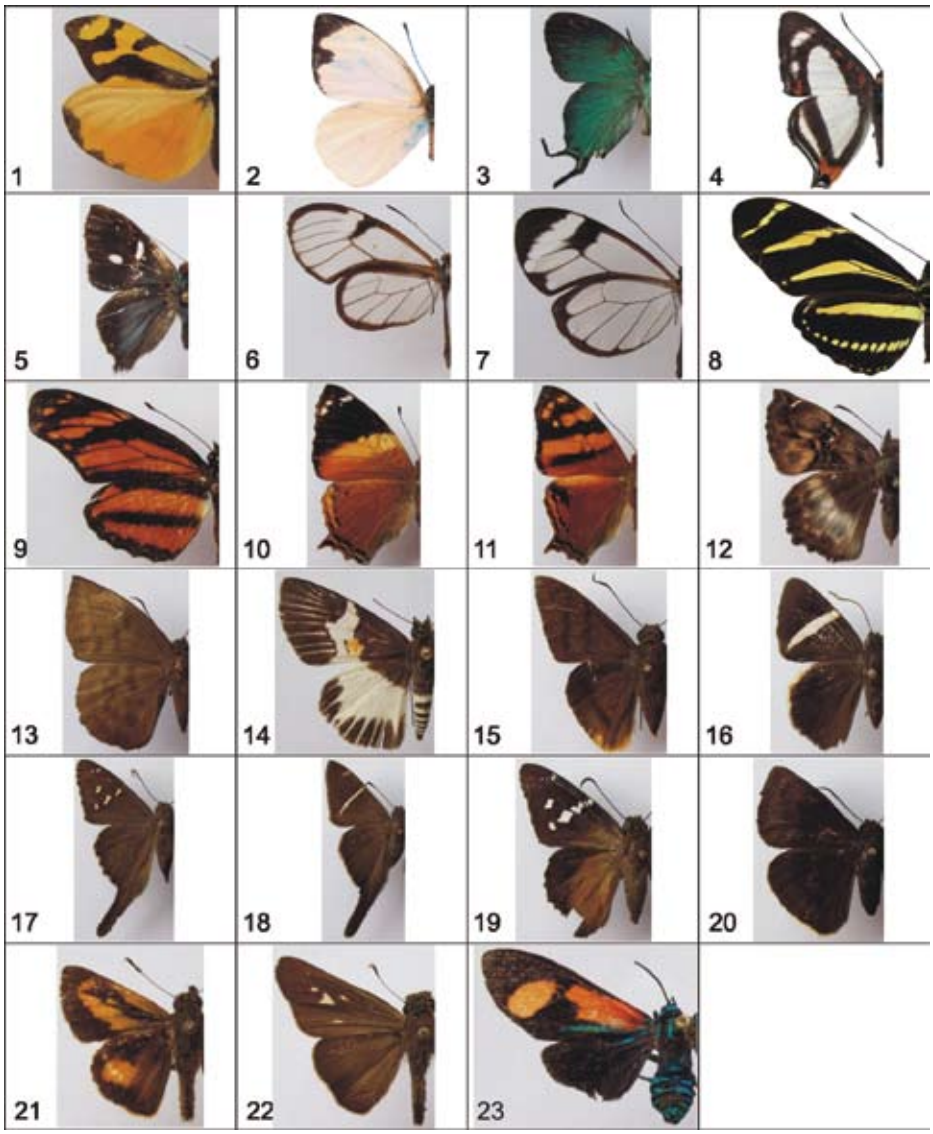

Plate 1. Lepidoptera visiting *Simpsia amplexicaulis* (Cav.) (Asteraceae) in a cloud forest site in the mountain area of Veracruz, México. 1. *Enantia jethys*; 2. *Leptophobia aripa elodia*; 3. *Arcas cypria*; 4 *Thisbe lycorias*; 5. *Anteros carausius carausius*.; 6. *Ptenonymia artena artena*; 7 *Ithomia leila*; 8. *Heliconius charitonius vazquezae*; 9. *Eresia phillyra phillyra*; 10. *Hypanartia godmanii*; 11. *Hypanartia lethe*; 12. *Noctuana lactifera bipuncta*; 13. *Achlyodes pallida*; 14. *Aternes sallei*; 15. *Astraptes anaphus*. 16. *Autochton zares*; 17. *Urbanus dorantes dorantes*; 18. *Urbanus teleus*; 19. *Codatractus bryaxis*; 20. *Aethilla lavochrea*; 21. *Anthoptus epictetus*; 22. *Conga chydaea*; 23. *Cyanopepla bella.*

Table 1. Lepidoptera visiting *Simsia amplexicaulis* (Asteraceae) in a cloud forest – *Coffea-Inga* plantation East of the Coatepec-Xico Road, Veracruz, Mexico.

Taxa		Flight period															
	Papilionoidea	8:00-9:00		9:00-10:00		10:00-11:00		11:00-12:00		12:00-13:00		13:00-14:00		14:00-15:00		15:00-16:00	
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
	Pieridae																
1	*Enantia jethys*									6	8						
2	*Leptophobia aripa elodia*									2	3	5		1			
	Lycaenidae																
3	*Arcas cypria*	1															
	Riodinidae																
4	*Thisbe lycorias*							1		2	1	1					
5	*Sp* 1									1							
	Nymphalidae																
6.	*Pteronymia artena artena*	2	3	2	2	8	5	9	4	8	8	5	7	4	6	3	4
7.	*Ithomia leila*									3							
8.	*Heliconius charitonius vazquezae*							10	3	15	10	12	6	5	7		
9.	*Eresia phillyra phillyra*									3	8						
10.	*Hypanartia godmanii*			10	3	11	4	10	6	9	7	7	5	7	2		
11.	*Hypanartia lethe*			5	6	7	5	10	6	11	5	6	4	3	3		
	Hesperioidea																
	Hesperiidae																
12.	*Noctuana lactifera bipuncta*									1							
13.	*Achlyodes pallida*			2		2		3		1		1		1		1	
14.	*Aternes sallei*	4															

Table 1. (Continúa).

Taxa		Flight period															
	Papilionoidea	8:00-9:00		9:00-10:00		10:00-11:00		11:00-12:00		12:00-13:00		13:00-14:00		14:00-15:00		15:00-16:00	
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
15.	*Astraptes anaphus*									1							
16.	*Autochton zares*									1							
17.	*Urbanus dorantes*									10	8						
18.	*Urbanus teleus*									9	11						
19.	*Codatractus bryaxis*									11	5						
20.	*Aethilla lavochrea*									1	2						
21.	*Anthoptus epictetus*									1							
22.	*Conga chydaea*										1						
	Noctuoidea																
	Erebidae																
23.	*Cyanopepla arrogans*					1											
	Subtotal	7	3	19	11	29	14	43	19	96	77	37	22	21	18	4	4
	Total both sex					♂ 256							♀ 168				
	Subtotal period flight	10		30		43		62		173		59		39		8	
										Total specimens: 424							

1 m high) with the only exception of *Achlyodes pallida* which visited flowers at all altitudes in the patch.

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LITERATURE CITED

Abrol, D. P. 2012. *Pollination Biology: Biodiversity Conservation and Agricultural Production*. Springer, Heidelberg, 821 p.

Aguilar, F. P. 1965. Algunas consideraciones sobre los insectos polinizadores en los alrededores de Lima, *Revista Peruana de Entomología*, 8: 138-145.

Beutelspacher, B. C. R. 1991. *Haga su propia colección de mariposas*. La Prensa Medica Mexicana, México, 104 pp.

Calderón, R. G. & Rzedowski, J. 2004. Manual de malezas de la región de Salvatierra, Guanajuato, *Flora del Bajío y regiones adyacentes*. Fascículo complementario XX, CONABIO, INECOL y CONACYT, 44 pp.

Castillo-Campos, G. 1991. *Vegetación y flora del municipio de Xalapa, Veracruz*. MAB-UNESCO, Instituto de Ecología y Ayuntamiento de Xalapa, 148 pp.

Chacón, I. & Montero, J. 2007. *Mariposas de Costa Rica*. Instituto Nacional de Biodiversidad. Costa Rica, 366 pp.

Faegri, K. & Van der Pijl, L. 1979. *The principles of pollination ecology*. Pergamon Press, Oxford, 242 pp.

Gómez, J. M. 2002. Generalización en las interacciones entre plantas y animales, *Revista Chilena de Historia Natural*, 75: 105-116.

Hernández-Baz, F. 2012. *Biogeografía y conservación de las polillas avispa de México (Lepidoptera: Erebidae: Arctniidae Ctenuchina y Euchromiina)*. Editorial Académica Española, Saarbrücken, Deutschland/Alemania. 328 pp.

Hernández-Baz, F., Llorente-Bousquets, J., Luís-Martínez, A. & Vargas-Hernández, I. 2010. *Las Mariposas de Veracruz*. Editora de Gobierno del estado de Veracruz, México. 221 pp.

Herrera, C. M. 1988. Variation in mutualism: the spatiotemporal mosaic of a pollinator assemblage, *Biological Journal of the Linnean Society,* 35: 95-125.

Horvitz, C. C. & Schemske, D. W. 1990. Spatiotemporal variation in insect mutualism of a Neotropical herb. *Ecology*, 71: 1085-1097.

Janzen, D. H. 1980. When is it coevolution? *Evolution*, 34: 611-612.

McVaugh, R. 1984. Flora Novo-Galiciana: A Descriptive Account of the Vascular Plants of Western Mexico. *Compositae*, 12: 845-853.

Proctor, M., Yeo, P. & Lack, A. 1996. The natural history of pollination. Timber Press, Oregon 487 p.

Ollerton, J. 1999. La evolución de las relaciones polinizador-planta en los artrópodos, *Boletín de la Sociedad Entomológica Aragonesa*, 26: 741-758.

Scoble, M. J. 1995. *The Lepidoptera: Form, function and Diversity*. The Natural History Museum & Oxford University Press, London 404 pp.

Scott. J. A. 1986. *The butterflies of North America*. Stanford University Press, Stanford, California 583 pp.

Spooner, D. M. 1990. Systematics of *Simsia* (Compositae – Heliantheae). *Systematic Botany Monographs*, 30: 1 – 90.

Sosa, V. & Gómez-Pompa, A. 1994. *Lista florística. Flora de Veracruz*. Fascículo 82, 245 pp. INECOL.

Steyskal, G. C., Murphy, W. L. & Hoover, E. M. 1986. Insects and mites: Techniques for collection and preservation. *U.S. Department of Agriculture. Miscellaneus Publication* No. 1443, 103 pp.

Vaughton, G. & Ramsey, M. 1998. Floral display pollinator visitation and reproductive success in the dioecious perennial herb. *Wurmbea dioica (Liliaceae)*. *Oecologia*, 115: 93-101.

Valiente-Banuet, A. 2002. Vulnerabilidad de los sistemas de polinización de cactáceas columnares de México. *Revista Chilena de Historia Natural,* 75: 99-104.

Wilson, P. & Thomson, J. 1996. How do flowers diverge?, pp. 88-111..*In*: D.G. Lloyd and S. Barret (eds.). *Floral Biology*. Chapman and Hall Press.

Zolá, M. G. 1987. *La vegetación de Xalapa, Veracruz*. Instituto Nacional de Investigaciones sobre Recursos Bióticos, México 155 pp.

Fernando HERNÁNDEZ-BAZ[1]*, Jorge M. GONZÁLEZ[2], Tomás CARMONA VALDOVINOS[1] & Gerardo CASTRO BOBADILLA[1]

[1] Facultad de Biología-Xalapa, Universidad Veracruzana. Circuito Gonzalo Aguirre Beltrán s/n. C.P.91000. Zona Universitaria. Xalapa, Veracruz, México. *Correspondence: <fhernandez@uv.mx>

[2] California State University, Fresno, Department of Plant Science, Fresno, California 93740-8033, USA (Research associate, McGuire Center for Lepidoptera & Biodiversity)