Journal of the Lepidopterists' Society
60(4), 2006, 227–228

CLUTCH SIZE VARIATION IN *URANIA BOISDUVALII* (GUERIN) (URANIIDAE: URANIINAE).

Additional key words: Moth, gregarious oviposition, Lepidoptera

The moth subfamily Uraniinae is represented by only one genus in the New World, *Urania* Fabricius. This genus contains six species, all with diurnal habits and iridescent colors. Two endemic species of this genus inhabit Cuba: *Urania boisduvalii* (Guérin), distributed throughout the island, and *Urania poeyi* (Gundlach), restricted to eastern Cuba.

In general, the clutches of the Lepidoptera present three patterns based on the number of eggs laid by the female during oviposition: i) eggs laid singly; ii) small clutches of up to 20 eggs; iii) large clutches with more than 20 eggs (García-Barros 2000).

Urania females oviposit at dusk, *ca.* 1700 h (Smith 1992). Guppy (1907) found that *Urania leilus* (L.) laid eggs singly or in pairs on the underside of a leaf. Smith (1992) observed that in *Urania fulgens* Walker the eggs are laid singly or in clutches of up to 90 eggs and *Urania boisduvalii* laid single eggs on the midrib on the underside of large leaves of *Omphalea* spp.

In August 2001, Dr Emanuel Mora brought one of the authors (A. Barro) three leaves of *Omphalea trichotoma* Mueller-Argoviensis that he found with clutches of thousands of eggs of *Urania boisduvalii* in Playa El Holandés, Península de Guanahacabibes, Pinar del Río Province in western Cuba (21˚50.07' N, 84˚46.00' W). For this reason, we decided to study clutch size in *Urania boisduvalii*. We selected two sites for our field studies: the already mentioned Playa El Holandés, and Piedra Alta, Santa Cruz del Norte, La Habana Province (23˚10.04' N, 81˚59.15' W). This work was conducted during June and August 2003 and February and May 2004 in Playa El Holandés, and between October 2002 and December 2004 in Piedra Alta at biweekly intervals.

During the study, we chose 50 plants of *Omphalea trichotoma* in each locality and checked each leaf on its underside. We recorded the number of eggs on each leaf, the way in which they were laid (singly or in clutches) and made notes about the hour of oviposition and behavior of the larvae.

We found 302 leaves with eggs (Figure 1). From this total, 247 leaves (82%) had only one egg, 13 leaves had a pair of eggs on the underside (4%) and 32 leaves (14%) had clutches of 3 to 179 eggs. In addition, we observed two leaves with 432 and 500 eggs and eight leaves with more than 2000 eggs each one. On the leaves with more than 2000 eggs, the eggs were laid in many layers and it was impossible to count their exact number. In both localities we found the same results.

The clutches bigger than 100 eggs could be the result of gregarious oviposition, a phenomenon described in other lepidopterans (Mallet & Jackson 1980, Goodfray *et al.* 1991, Sourakov 1997, Reed 2003, Fordyce & Nice 2004). Although we did not observe different females of *Urania boisduvalii* contributing to a collective egg clutch, we have two reasons that support this idea. Smith (1992) reported a large number of eggs in the ovarioles of migratory *Urania fulgens* (*ca.* 300–400) and only 15–30 eggs in the ovarioles of sedentary females of this species. We consider that *Urania boisduvalii* have similar characteristics to *Urania fulgens* in the number of eggs per ovariole because we counted the number of eggs per ovariole in four females and found that *U. boisduvalii* females have between 15 and 35 eggs per ovariole (22.5± 5.4). Furthermore, during our study at Playa El Holandés on several occasions around 60 females were observed visiting a host plant site and flying around the host plant and ovipositing on *Omphalea* leaves. However, at present we cannot prove that females of *Urania boisduvalii* produce collective egg clutches. In any case, our observations are the first report of great variation in clutch size for the family Uraniidae.

Stamp (1980) summarizes some hypotheses about the adaptive value of gregarious oviposition in butterflies. Some of these hypotheses might explain the large egg clutches laid by *Urania boisduvalii*. Prevention of egg desiccation and protection against predators and parasitoids seem to be two possible hypotheses. In

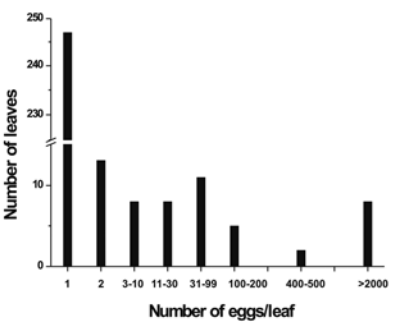

FIGURE 1. Variation in the number of eggs of *Urnia boisduvalii* per leaf of *Omphalea trichotoma*

addition, we found at both study sites that the first and second instars of *Urania boisduvalii* display a gregarious behavior. Perhaps this behavior was facilitated by gregarious oviposition, as suggested by Sillén-Tullberg (1988) for many species of butterflies.

We cannot explain why *Urania boisduvalii* displays such a large range in egg clutch size. Although we have not been able to demonstrate that this species presents gregarious oviposition, finding clutches with more than 2000 eggs in an uraniid moth, supports the idea that in the Lepidoptera this phenomenon is common, as suggested by Reed (2005).

We thank Emanuel Mora for providing us the first leaf of *Omphalea trichotoma* with egg clutches of *Urania boisduvalii*. We also thank to Dr Frank Coro for his comments about the manuscript. We also thank Dr David Arhenholz and one anonymous reviewer for comments.

LITERATURE CITED

FORDYCE, J. A. & C. C. NICE. 2004. Geographic variation in clutch size and a realized benefit of aggregative feeding. Evolution 58: 447–450.

GARCÍA-BARROS, E. 2000. Body size, egg size, and their interspecific relationships with ecological and life history traits in butterflies (Lepidoptera: Papilionoidea, Hesperioidea). Biol. J. Linn. Soc. 70: 251–284.

GOODFRAY, H. C., L. PARTRIDGE & P. H. HARVEY. 1991. Clutch size. Annu. Rev. Ecol. Syst. 22: 409–429.

GUPPY, L. 1907. Life history of *Cydimon* (*Urania*) *leilus* (L). Trans. Entomol. Soc. 3: 405–410.

MALLET, J. L. B. & D. A. JACKSON. 1980. The ecology and social behavior of the Neotropical butterfly *Heliconius xanthocles* Bates in Colombia. Zool. J. Linn. Soc. 70: 1–13.

REED, R. D. 2003. Gregarious oviposition and clutch size adjustment by a *Heliconius* butterfly. Biotropica 35: 555–559.

REED, R. D. 2005. Gregarious oviposition in butterflies. J. Lepid. Soc. 59: 40–43.

SILLÉN-TULLBERG, B. 1988. Evolution of gregariousness in aposematic butterfly larvae: A phylogenetic analysis. Evolution 42: 293–305.

SMITH, N. E. 1992. Reproductive behaviour and ecology of *Urania* (Lepidoptera: Uraniidae) moths and of their larval food plants, *Omphalea* spp. (Euphorbiaceae), pp. 576–593. *In* Quintero, D. & A. Aiello (eds.), Insects of Panama and Mesoamerica. Selected studies. Oxford University Press, Oxford.

SOURAKOV, A. 1997. "Social" oviposition behavior and life history of *Aglais cashmirensis* from Nepal (Lepidoptera: Nymphalidae). Holarct. Lepid. 4: 75–76.

STAMP, N. E. 1980. Egg deposition patterns in butterflies: Why do some species cluster their eggs rather than deposit them singly? Am. Nat. 115: 367–380.

ALEJANDRO BARRO* AND KRYS RODRÍGUEZ
Departamento de Biología Animal y Humana, Facultad de Biología, Universidad de La Habana Calle 25 # 455 e/ J e I, Vedado CP 10400, La Habana, Cuba
* Corresponding author; email: abarro@fbio.uh.cu

Received for publication xxxxxxxxx revised and accepted xxxxxxx.

Journal of the Lepidopterists' Society
60(4), 2006, 228–230

EGG VIABILITY AND LARVAL CONTRIBUTION TO FECUNDITY OF *PARNASSIUS SMINTHEUS* DOUBLEDAY (PAPILLIONIDAE)

Additional key words: life history, reproduction, Rocky Mountain Apollo

Fecundity and egg viability are important components of life history affecting population dynamics and persistence as well as being a central factor in evolution. Despite its basic nature, estimates of fecundity for Lepidoptera are not common (Hunter 1995). Here we briefly present estimates of egg viability and fecundity primarily due to larval resources for the Rocky Mountain Apollo butterfly *Parnassius smintheus* Doubleday, 1847.

We collected 146 female butterflies from two large meadows (sub populations P & Q, see Matter *et al.* 2000) along Jumping Pound Ridge, Kannanskis, Alberta, Canada (51°57'N, 114°54'W, ~2100 m). All *P. smintheus* encountered were removed on six occasions (July 20, 23, 30, 31 and August 11, 19) during the adult flight season of 2005 (~18 July–24 August). We collected ten additional females from nearby Powderface Ridge (Matter and Roland 2002) on August 6th 2005. The removals on Jumping Pound Ridge are part of a larger experiment examining spatial population dynamics. Upon capture, we placed individual butterflies in a glassine envelope and took them to The University of Calgary's Barrier Lake Field Station (~1400 m) where they were kept in the envelopes at ambient conditions. After the female's death, we counted the number of eggs laid by each butterfly. Because butterflies were removed from meadows frequently, each was captured fairly shortly (1–10 d) after its emergence. *Parnassius smintheus* continues to develop eggs in the adult stage (C. Guppy, personal communication). Thus, the number of eggs produced here should largely represent fecundity based on larval resources, rather than total fecundity including additional eggs produced from nectar resources during the adult stage. Additionally, the mating status of females was assessed by the presence or absence of a sphragis which males affix to females during copulation to prevent additional mating by other males (Bird *et al.*